Before using any downloaded PDF version, or printed copy of the PDF version of this Guidance Note, readers should check the Department’s website at the below URL to ensure that the version they are reading is current. Note that the current version of the Department’s Cost Estimation Guidance supersedes and replaces all previous cost estimation guidance published by the Department, other than that already included in current versions of the NOA and NPA.

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1: Introduction

1.1: Context and authority

This guidance note – *Escalation* is one component of the suite of documents that together comprise the Department of Infrastructure and Regional Development and Cities (the Department) cost estimation guidance. It establishes the principles for developing an index series which can be used to either bring past costs to a current basis, or to forecast what prices will be in the future.

1.2: Related guidance

This guidance note should be read in the context of the Overview component of the guidance and the specific requirements of the Notes on Administration (NOA).

Additional useful guidance on cost estimation practices, to the extent that they do not contradict the guidance provided by the Department’s cost estimation guidance, may be found in individual agency cost estimation guidance or manuals, and in the guidance provided by professional associations including AACE International.

1.3: Objective and scope of guidance note 4

Much the same as allocating excess contingency, utilising unrealistically high escalation rates can result in more funding being allocated to a project than is actually required, tying up money that could be used on other projects. This guidance note describes and explains the policy settings relating to escalation for the Australian Government’s Infrastructure Investment Program (IIP). These policy settings endeavour to ensure that the escalation rates used to outturn projects across all Australian jurisdictions are derived using a consistent and robust methodology enabling a fair comparison to be made between projects seeking Commonwealth funding.

The guidance covers the following topics:

- **Overview** – defines escalation in the context of an index series and describes the factors that influence escalation;
- **Development of an appropriate index series** – describes the methodology for developing an index series; and
- **Outturning a project using the Project Cost Breakdown (PCB) template** – explains how to use the Department’s PCB template to outturn a project.

It is expected that the primary users of this document will be jurisdiction public sector organisations (Agencies), including Local Government Authorities, who prepare submissions for funding for transport infrastructure projects 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

An escalation allowance is a provision in costs or prices for changes in technical, economic and market conditions over time\(^1\). In volatile economic conditions it may form a large component of a cost estimate and can have a large impact on the bids and profitability of contractors if allowances are not made for it. Generally escalation would be expected to be positive. Conversely, there may be periods within an economic cycle when it is negative, and therefore in risk terms, escalation may be considered either a threat or an opportunity. In that context, it must be noted that escalation, while being a unique “risk” cost that must be estimated, should not be included within project contingency. Escalation and contingency are determined using different methodologies and used for different purposes.

Escalation is typically used to forecast what costs or prices will be in the future and/or to bring past costs or prices to a current basis (uplifting or rebasing). Being driven by conditions in the economy external to any particular project, it is not suited to the same quantification techniques used to estimate project risks (contingency)\(^2\). 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, not cost estimators.

2.2: Escalation within the context of the IIP

In the context of submissions for Australian Government funding through the IIP, project proponents are required to prepare their cost estimates nominating the base date to which the estimate applies. Note that the base date of the estimate may not be the date the estimate was prepared – it is the date in which the rates used to build the estimate were current.

Adjustments are then made to uplift or rebase those costs to current costs and escalation is subsequently applied to adjust the project cash flow to reflect the costs that will apply when they will actually be incurred. Many projects have at least a three to four year delivery schedule with a substantial proportion of the costs occurring in the delivery phase. Given that approval to proceed with the project may not be received for quite some time after the cost estimate is prepared, escalation may ultimately comprise a significant portion of the overall project estimate.

This point is illustrated by the following simplistic example below for which the following has been assumed:

- the project has a total cost of $1,000 million in year zero dollars extending over four years (year two to year five) with expenditure ramping up to a peak in year four and then declining;

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\(^1\) Adapted from AACE International (2011) Recommended Practice 58R-10: Escalation Estimating Principles and Methods Using Indices

a delay of one year after year zero (the year in which the project was costed) before expenditure commences; and

a constant escalation rate of 4% in each year (noting that the escalation rate normally varies year on year), reflecting the percentage growth in costs from one year to the next.

While the escalation rate in each year is 4%, the escalation factor in each year is cumulative and compounds, with later years experiencing a greater escalation factor, even if the escalation rate remains unchanged, reflecting that, in this example, the costs are increasing each year by the escalation rate of 4%. For example the escalation rate in year two is 1.082 (1.04*1.04) while in year five it is 1.217 (1.04*1.04*1.04*1.04*1.04).

The un-escalated cash flow is profiled across the expected project schedule, reflecting when the expenditure is expected to occur. The expenditure in each year is then multiplied by the cumulative escalation factor to give the escalated expenditure for that year.

<table>
<thead>
<tr>
<th>YEAR</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash Flow (Year Zero $M)</td>
<td>0</td>
<td>100</td>
<td>350</td>
<td>450</td>
<td>100</td>
<td>1,000</td>
</tr>
<tr>
<td>Escalation Rate</td>
<td>4.00%</td>
<td>4.00%</td>
<td>4.00%</td>
<td>4.00%</td>
<td>4.00%</td>
<td></td>
</tr>
<tr>
<td>Escalation Factor</td>
<td>1.04</td>
<td>1.04</td>
<td>1.04</td>
<td>1.04</td>
<td>1.04</td>
<td></td>
</tr>
<tr>
<td>Cumulative Escalation Factor</td>
<td>1.04</td>
<td>1.082</td>
<td>1.125</td>
<td>1.17</td>
<td>1.217</td>
<td></td>
</tr>
<tr>
<td>Annual Escalated Cash Flow ($M)</td>
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<td>108</td>
<td>394</td>
<td>526</td>
<td>122</td>
<td>1,150</td>
</tr>
<tr>
<td>Total Escalation ($M)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>150</td>
</tr>
<tr>
<td>Escalation as a % of Total Escalated (Outturned) Project Cost</td>
<td></td>
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<td></td>
<td></td>
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<td>13%</td>
</tr>
<tr>
<td>Escalation as a % of Total Un-Escalated Project Cost</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15%</td>
</tr>
</tbody>
</table>

Figure 1: Example of escalation calculations

In this simplistic example, escalation is approximately 13% of the total escalated project cost, or 15% of the un-escalated project cost, and is thus quite significant.

Escalation for IIP projects is normally calculated using the Department’s PCB template that draws on:

- actual historical escalation rates to uplift or rebase a previously costed project to current costs (specifically to the costs reflecting the financial year preceding the current financial year so that unadjusted forecast of escalation rates can be applied); and

- forecast escalation rates, applied to current costs (specifically the costs reflecting the financial year preceding the current financial year), to estimate the project costs across the expected project schedule.
2.3: Measuring escalation

A variety of indicators measure price changes in an economy. These include consumer price indices (CPIs), producer price indices (PPIs), construction price indices, price indices relating to specific goods and/or services, and gross domestic product (GDP) deflators.

CPIs are designed to measure changes over time in average retail prices of a fixed basket of goods and services taken as representing the consumption habits of households. Using the CPI or equivalent as the basis of infrastructure project escalation estimates is ineffective because the consumer targeted by the CPI reflects a person whose spending patterns and market have little relevance to infrastructure project spending or markets.

PPIs provide measures of average movements of prices received by the producers of commodities. In principle, PPIs exclude transport costs and consumption taxes. Producer price indices are not a measure of average price levels, or of the costs of production. Moreover, PPIs do not include commercial mark-ups. Though the scope of PPIs varies, they are generally calculated on the basis of the total turnover of a definable industry such as manufacturing, agriculture, or mining.

In broad terms, construction price indices provide measures of changes in the prices of either the inputs to, or outputs of, construction activity.

The demand for price indices for construction activity arose from the need to assess real changes in the output from these activities (i.e. to create a “constant price” series which embodies changes in the quantity of construction activity over time, not the “current price” value of activity which is a function of quantity and price) which cannot be derived solely through reference to regular building and construction statistics. Finding methods to both quantify and manage cost escalation on an individual project is critical for both owners and contractors in order to ensure that there are sufficient funds to deliver the final project within budget and on schedule.

Specifically, the Department requires that index series, as best as possible, reflect movements in costs faced by jurisdictions in delivering land transportation projects. Forecasts of an index can then be used to convert the cost estimate cashflow for projects, developed in real prices, into nominal prices for budgetary purposes.

2.4: Escalation drivers

Some of the drivers of escalation, in addition to general price inflation, include changes in market conditions, technology, regulation, general industry or regional-wide productivity and other

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3 OECD (1997) Sources and Methods: Construction Price Indices, EUROSTAT, Luxembourg,
4 AACE International Transactions 2006 Measuring and Managing Cost escalation
economic factors that generally affect an economic sector or segment\textsuperscript{5}. Major technology or regulatory changes directly impacting a project should be covered within contingency. Escalation may vary across economic sectors or segments, or different geographical regions.

Generally, the selling price of a contract (project) is not simply the result of the sum of its inputs plus a profit; the selling price of a contract is also determined by the bidders based on their opinion of the competition\textsuperscript{6}. The sum of the input costs will provide a floor below which a bidder is normally unwilling to go, so changes in input costs influence bids to a degree. The ceiling however is set by the bidder’s opinion of what their competition will do. The bidder must not only estimate their own costs, but also what other participants will do.

Escalation therefore comes from the interplay of changes in input costs (such as actual changes in the cost of materials like concrete and steel), the bidder’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 bidders are increasing or decreasing their prices.

The movement in an index must be a reflection of the many factors mentioned above. As well as measuring changes in basic costs it indicates the feelings of the industry about its current and future workload. When demand for an industry’s services is high not only do contractors’ margins increase but so do the margins charged by the materials’ suppliers and producers and the money paid to attract labour. When demand is low all these factors fall\textsuperscript{7}.

2.5: Elements of construction industry prices

The price of the output of construction activity is a function of the following factors:

- Direct inputs: These include materials, labour, energy, etc. Direct inputs generally vary in proportion to output.
- Indirect inputs and overheads: These include depreciation, administrative expenses, etc. They are generally fixed and do not vary directly with the volume of output.
- Productivity: Refers to the efficiency with which inputs are converted into outputs (for example, through new technical solutions, increased labour productivity, or more effective organisations of work).
- Profit: Is a residual determined by the sales price, and combinations of the preceding three items. Profit varies widely and may be negative.

The output price for a construction project may change for any one or more of the following reasons:

- Widening or narrowing of profit margins due to changes in market conditions (i.e. irrespective of changes in costs);

\textsuperscript{5} AACE International 2011 Recommended Practice 58R-10 Escalation Estimating Principles and Methods Using Indices
\textsuperscript{6} AACE International Transactions 2006 Measuring and Managing Cost escalation
\textsuperscript{7} It is possible to have a highly competitive market which is still “hot” – i.e. the volume of work increases costs for relatively scarce inputs (such as for concrete, quarry products or labour) but high competition amongst contractors means these costs do not flow through to higher output prices, but rather a reduction in margins.
• Increases or decreases in the prices of direct inputs; and
• Changes in productivity resulting in changes to the quantity of direct inputs per unit of output.

In addition to construction costs, the price actually paid by the final owner includes a number of other cost elements, generally referred to as client costs. See guidance note 2 – base cost estimation for a list and description of typical client costs that may be incurred on land transportation projects.

2.6: Input costs

The input cost factors faced by the land transportation industry may change in their relative proportions to each other over time. The contribution of each input to the overall cost of construction is determined by two factors: the unit price of the input and the input’s per cent share in the total cost of the construction works. Over time, changes in industry practice, input prices and technological advances will inevitably change the input mix, and hence the relativities in the quantities used for both material and non-material inputs. For example, the road construction and maintenance industry has changed in a number of ways since the early 1980’s including: increased use of contractors for both road construction and maintenance; improved technology in road building; and greater use of capital equipment as a substitute for labour, which, for a time, became more expensive in response to greater competition from the mining sector. Input cost drivers for the Australian infrastructure construction sector are explained in further detail at Section 3.1.1.

2.7: The interaction of market conditions with project specific risks

As discussed, drivers of escalation include changes in market conditions, and general industry or regional-wide productivity. This contrasts with contingency, which is concerned with setting aside sufficient funds to manage and mitigate project-specific risks.

In some cases, escalation can interact with project-specific risk considerations. This is because escalation has the potential to result in unexpected adverse outcomes if the flow-on effects symptomatic of rapidly increasing prices are not considered. For example, when the market is reaching capacity constraints, the pool of professions such as highly experienced design engineers or project managers will start to become fully utilised. This leaves a shortage of the best talent for additional projects, which may need to rely on the “B-team”. In turn, implications of not being able to use the best talent could include:

• poor quality designs that omit items, are difficult to construct, or not optimised for the end purpose;
• omission or misunderstanding of project risks; and
• inability to mitigate or properly manage project-specific risks if they occur.

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8 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.
9 Ibid
Each of these will serve to drive up project costs, not because of escalation, but because of secondary effects. They may result in more construction work than initially assumed and, as a result, a greater than expected volume of inputs such as labour or bulk material. In this instance, it seems as though costs are rising faster than escalation forecasts but it is actually due to a greater quantity of inputs rather than faster than expected growth in input prices.

Project-specific risks can and should be accounted for within the contingency allowance. Guidance note 3A provides further detailed guidance, including tools and techniques, to account for risk.

3: Developing an index series

Escalation is driven by economic trends. 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 for a later date (say for argument 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 move be negative.

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.

In 2015 the Department engaged BIS Shrapnel (now BIS Oxford Economics) to develop a suite of state and territory jurisdiction composite road construction indices, with associated forecasts, for representative road projects from which escalation rates can be derived.

BIS Oxford Economics (BISOE), 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. It is expected that each year the Department will engage BISOE (or another supplier) to refresh the previous escalation forecasts, determine the actual indices (and hence escalation rates) for the preceding financial year, and extend the forecasts for a further financial year. BISOE’s forecasts have been informed by extensive macroeconomic modelling which has been documented in comprehensive reports for each jurisdiction.

The following sections outline the methodology used by BISOE to develop a composite index series that reflects movements in costs faced over time by jurisdictional road authorities in delivering road construction projects. It is expected that the same methodology could be applied to
other land transportation sectors such as rail, provided appropriate consideration is given to the differences in those factors (input costs, margins, etc.) that will affect the output price.

3.1: Approach to developing an index

The development of an index generally involves the following steps:

- Identification of the key components which drive direct road (or other applicable sector) construction costs;
- Applying the appropriate component weights for each jurisdiction (if developing a national series);
- Incorporating regional differences into the modelling;
- Inclusion of contractor margins or selling prices;
- Inclusion of client costs; and
- Develop the overarching outturn price index.

The steps above are discussed in turn below.

3.1.1: Key components driving road construction costs

The four main input cost drivers for the Australian infrastructure construction sector are\(^\text{10}\):

- 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 and management resources 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; and
- Oil-based costs: Fuel powers the 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 four main input cost drivers may be further separated on a road project as below:

- 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.

\(^\text{10}\) GHD Meyrick 2011 Final Report for Infrastructure Australia – Evidence Based Comparative Analysis of Major Infrastructure Costs in Australia and internationally
- Cement and Concrete. 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.
- Diesel fuel. Diesel fuel is commonly used to power diesel engine mobile plant and equipment during road construction projects.

3.1.2: Applying appropriate component weights for each jurisdiction

Some input prices will be determined by national or international factors (oil prices, exchange rates), however other inputs may be determined by local demand-side factors such as site-based labour, or the availability of quarry products. Consequently, it is logical to develop an index that accurately reflects input shares at the jurisdiction level.

Through an examination of a number of major road construction projects since 2011, the input shares across Australia as a whole were determined as shown in Table 1:

Table 1: Component weights for road construction projects across Australia

<table>
<thead>
<tr>
<th>State</th>
<th>Construction wages</th>
<th>Engineering Design and Consulting Services</th>
<th>Plant &amp; Equipment Hire</th>
<th>Concrete, Cement &amp; Sand</th>
<th>Bitumen</th>
<th>Diesel</th>
<th>Reinforcing Steel</th>
<th>Project Base Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUST</td>
<td>29%</td>
<td>14%</td>
<td>14%</td>
<td>22%</td>
<td>12%</td>
<td>4%</td>
<td>6%</td>
<td>100%</td>
</tr>
<tr>
<td>NSW</td>
<td>27%</td>
<td>14%</td>
<td>13%</td>
<td>26%</td>
<td>14%</td>
<td>3%</td>
<td>4%</td>
<td>100%</td>
</tr>
<tr>
<td>VIC</td>
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<td>14%</td>
<td>22%</td>
<td>12%</td>
<td>4%</td>
<td>6%</td>
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<td>22%</td>
<td>12%</td>
<td>4%</td>
<td>6%</td>
<td>100%</td>
</tr>
</tbody>
</table>

BIS Shrapnel 2015 Road Construction Cost Escalation Forecasts to 2022
As discussed at section 2.6, input cost factors can, and are likely to change in their relative proportions to each other over time. It must be stressed that the input shares in Table 1 are for road projects as at the date of publication. Regular market research will be undertaken periodically to ensure the accuracy of the weighting structure over time.

3.1.3: Incorporating regional differences into the modelling

Different index series should be able to be developed for urban and rural projects, reflecting the potential for differences in the costs of certain inputs depending upon proximity to major urban centres. Rather than developing separate forecasts, which is likely to be time consuming and costly, utilising validated past data is an effective approach to generate an appropriate rural and urban weighting structure at the jurisdictional level.

3.1.4: Incorporation of contractor margins

While growth in input-based project costs can be estimated as described in the previous section(s), these do not include an allowance for changes in contractor margins (essentially the difference between input-based project costs of construction and the selling prices of construction services by construction contractors). Data suggests that contractor margins are strongly correlated with road construction activity with about a three-year lead where there is a strong positive relationship between margins of tenders and the expected outlook of road construction activity.

3.1.5: Inclusion of client costs

Client costs are the costs borne by jurisdictions in delivering road construction processes 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.

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 given project.

3.1.6: Developing an overarching road construction outturn cost index (RCOCI)

Overall costs borne by jurisdictions in delivering road construction projects will be a combination of construction and client costs.

Following on from the above steps, BISOE developed six separate RCOCIs reflecting choices made as per the geographic region (All of State / Urban / Rural) and project delivery method employed (Design and Construct / Construct Only). All six RCOCIs are based on the same model structure but the weights differ under each specification to better reflect the specific input share relevant to each type.
3.2: Developing forecasts for an index model

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

- Forecasts for the various construction inputs (labour, plant, material as described at section 3.3.1);
- Forecasts of contractor margins; and
- Forecasts of client cost changes, mainly as a result of movements in delivery agency wages.

Growth in input costs for Australian road construction projects tends to be linked to the amount of Australian construction activity going on at any time – in the roads sector as well as more broadly across the building and construction market – insomuch as it affects the prices of locally sourced inputs. There is a positive correlation between construction activity and construction costs because high (and rising) levels of demand (i.e. construction activity) not only places pressure on the existing supply of inputs, boosting input prices, but also allows construction companies to raise their prices (and possibly margins). Where capacity constraints exist, rising construction activity can lead to strong increases in input prices as investment in new capacity is itself costly and takes time to come on stream.

Road construction costs may also vary due to changes in input prices that are determined in global markets (for example, steel and oil products such as bitumen and diesel fuel). These price changes may occur independently from domestic construction activity. This means that in formulating the outlook for input prices, consideration of the outlook for both domestic construction activity (which is a key driver of demand and prices for locally-sourced materials and labour) as well as expected price movements for inputs whose prices are determined in global markets (adjusted for movements in the A$ exchange rate) is required.

In the long run, underlying cost trends such as wages 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 the period leading up to the Global Financial Crisis in 2008 and the subsequent decline in activity, and more recent fluctuations, in some states more than others, in conjunction with the mining/commodity super-cycle.

A further concept to bear in mind 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.

Developing price index forecasts can be approached a number of different ways:

- Studying historical trends to build econometric models that forecast future price index values, generally at an aggregate level. The models of price change for specific goods and
services are usually tied to macroeconomic models that define the underlying economic conditions that drive all prices to an extent;
- Relying less on models and more on expert opinion, market surveys and the like; or
- Using a hybrid approach combining elements of the above as appropriate. This approach is the most typical.

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.

3.3: Uplifting or rebasing

If available, historical price indices can be used to uplift or rebase past project estimates or actual costs to a current year basis. For example if the cost for a project in 2012 (i.e. its base date of estimate) is $10 million, then the cost in 2016 is $10 million x (2016 index/2012 index). This is critical where a project that may have been put on hold for some years is resurrected. Without uplifting or rebasing, the historic estimate is likely to be inaccurate and will not present decision-makers with reliable information.

A worked example explaining the calculations behind the uplift factor within the PCB template is presented at Section 4.3.1.

4: Outturning a project

Outturning a project requires the following input variables:

- Cost estimate, including contingency;
- Schedule (start/finish timing of spending);
- Cash flow pattern (spending pattern within the schedule timing); and
- Indices (cost or price index forecasts).

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.

---

12 AACE International 2012 Recommended Practice 68R-11: Escalation Estimating Using Indices and Monte Carlo Simulation
On behalf of the Department, BISOE has developed composite road construction index series for each Australian jurisdiction. The base (index value 100) was set as at the June quarter 2015, noting that BISOE was originally engaged in late 2015 to develop the composite index series. At that time index values prior to the June quarter 2015 were actual historic rates, while index values beyond that date were forecasts. Each index series has since and will continue to be periodically updated in order to reflect actuals and to update the forecasts, however the base will remain fixed at June 2014/15 quarter.

Owing to the high variability in the proportion of costs relating to property acquisition from one project to the next, property acquisition costs were not considered in the analysis. However, applying the BISOE 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 a jurisdiction expresses a concern regarding escalation of property acquisition costs, they should provide, for the Department to consider, their rationale for any alternative property acquisition escalation rates that they propose to use.

4.1: Outturning projects using the PCB template

Each year the Department will provide each jurisdiction with a PCB template pre-loaded with the jurisdiction-specific index series. The PCB template allows escalation rates to be automatically calculated, taking into account the effective date of costing (financial year quarter) of the base estimate, the procurement type (“Design & Construct” or “Construct Only”), and whether the project is urban or rural.

The steps in the process are further explained and shown with screen shots where appropriate below. 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 submitting PCB templates in conjunction with a project proposal report when seeking Commonwealth funding.

**Step 1**

Select the appropriate escalation index at Cell D34 on tab 2 using the drop-down arrow. The choices are:

- Design and Construct Urban;
- Design and Construct Rural;
- Construct Only Urban; or
- Construct Only Rural.

**Step 2**

Ensure that the base date of estimate is entered into Cell B43 of tab 2. The quarter and year of costing will automatically populate in Cell B44 which will then be drawn upon to automatically calculate and populate the escalation rates in tabs 3A, 3B, 4, and 5.
Failure to enter the base date of estimate into Cell B43 will not permit the escalation calculations to proceed.

**Step 3**

The template will automatically populate the annual escalation rate (%), Escalation (%), and cumulative escalation factor (%) based on the base date of estimate entered at step 2. Users should now enter the cashflow for the base estimate, P50 and P90 at rows 92, 97, and 101 respectively for the applicable phase:

**Table 5: PROJECT CASHFLOW AND ESCALATION CALCULATION TABLE**

<table>
<thead>
<tr>
<th>Total Scoping Phase Expenditure</th>
<th>Scoping Phase Expenditure</th>
<th>Project Cashflow 2016/17 onwards</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Year 1</td>
</tr>
<tr>
<td>Non-estimate</td>
<td>$0</td>
<td>$20.00</td>
</tr>
<tr>
<td>PGH Project Estimate</td>
<td>$0</td>
<td>$20.00</td>
</tr>
<tr>
<td>PM Project Estimate</td>
<td>$0</td>
<td>$20.00</td>
</tr>
</tbody>
</table>

The PCB template will automatically calculate the outturned cashflow and the total outturn cost, with values shown within Table 2 of the PCB template:
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 be performed manually by users.

Table 2 demonstrates how to determine the annual escalation rate from a given set of hypothetical data:

<table>
<thead>
<tr>
<th>Year</th>
<th>Quarter</th>
<th>Index</th>
<th>Financial year average quarterly index</th>
<th>Annual escalation rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sep</td>
<td>103.65</td>
<td>104.75</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Dec</td>
<td>104.38</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mar</td>
<td>105.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jun</td>
<td>105.84</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Sep</td>
<td>106.57</td>
<td>107.67</td>
<td>= (107.67/104.75) - 1</td>
</tr>
<tr>
<td></td>
<td>Dec</td>
<td>107.30</td>
<td></td>
<td>= 2.79%</td>
</tr>
<tr>
<td></td>
<td>Mar</td>
<td>108.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jun</td>
<td>108.76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Sep</td>
<td>109.49</td>
<td>110.59</td>
<td>= (110.59/107.67) - 1</td>
</tr>
<tr>
<td></td>
<td>Dec</td>
<td>110.22</td>
<td></td>
<td>= 2.71%</td>
</tr>
<tr>
<td></td>
<td>Mar</td>
<td>110.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jun</td>
<td>111.68</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

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

Note that the example shown has not applied an escalation rate in year 1. The PCB template will automatically apply a part-year adjustment (uplift) dependent upon the date of costing as entered at Tab 2. The following section explains the uplift factor.

4.3: Uplift factor

To arrive at an actual dollar allowance for escalation, operationally, the Department defines escalation 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. While this approach allows for a determination of escalation rates from one year to the next, a mechanism is required in order to account for any part-year adjustment. Given that the headline escalation rates for each year are derived from the underlying index series, it is not appropriate to simply proportionally divide the escalation rate (for example to divide the escalation rate by two in order to make a half-year adjustment); any adjustment must be tied back to an index value within the index series in order to be theoretically and mathematically correct.

The mechanism to enable all adjustments is to the rebase the entire estimate from the base date of the estimate to financial year zero, where financial year zero is the last year for which actual data is available. This is a simple price conversion. Once rebased to this point (and its associated index value), the headline forecast escalation rates can be applied to the project cashflow. In other words, the uplift factor is used to shift the un-escalated cost estimate (and associated cashflow) from the quarter of costing, to financial year zero.
4.3.1: Uplift Example

In certain circumstances, the outturn costs in year one may be less than the project estimate even though the escalation rate in that year is positive. While this may seem impossible, it is perfectly correct under some conditions and also explains why the uplift factor is usually less than one. The following example demonstrates.

A project has a base date of estimate of January 2018. The current financial year is 2017/18, therefore financial year zero (the last year for which actual data is available) is 2016/17. This means that the estimate must be rebased (uplifted) to the index that relates to 2016/17 in order to apply the headline escalation rates, but must also take into account the fact that the base date of estimate is halfway through the financial year.

Table 2A.5 from the PCB template shows the annual escalation rates, which were in turn derived from the index series as per Table 2A.1 (extract shown)

<table>
<thead>
<tr>
<th>Quarter</th>
<th>2016/17</th>
<th>2017/18</th>
<th>2018/19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sep</td>
<td>94.23</td>
<td>100.86</td>
<td>104.14</td>
</tr>
<tr>
<td>Dec</td>
<td>95.09</td>
<td>101.66</td>
<td>104.84</td>
</tr>
<tr>
<td>Mar</td>
<td>99.60</td>
<td>102.51</td>
<td>105.48</td>
</tr>
<tr>
<td>Jun</td>
<td>100.85</td>
<td>103.83</td>
<td>106.28</td>
</tr>
<tr>
<td>Average of quarters</td>
<td><strong>97.44</strong></td>
<td><strong>102.22</strong></td>
<td><strong>105.19</strong></td>
</tr>
<tr>
<td>Escalation rate</td>
<td>-</td>
<td>102.22/97.44 = 4.9%</td>
<td>105.19/102.22 = 2.9%</td>
</tr>
</tbody>
</table>
Given that the project has a base date of estimate of January 2018, this relates to the March quarter for which the index is 102.51.

The uplift factor equals the average of the index in FY0, divided by the index of the quarter in which the estimate was costed, or,

\[
\frac{97.44}{102.51} = 0.951
\]

The cashflow in each financial year is subsequently multiplied by 0.951 in order to rebase the entire estimate to 2016/17 prices. Escalation (as per the headline rates) is then applied to the rebased cashflow. The following figure shows the calculations undertaken within the template:

\[\text{Uplift} = \frac{97.44}{102.51} = 0.950519502\]

\[\text{P50} = $110 \times 0.950519502 = $104.557145\]

\[\text{Rate} = 4.9011931137\% \text{ as per BISOE forecast}\]

\[\text{Escalation factor} = 4.90\% + 1 = 1.049011931137\]

\[\text{P50 Outturn} = $104.557145 \times 1.049011931137 = $109.68\]

Figure 6: How the uplift value is determined and incorporated within PCB template outturn calculations

It can also be seen that in this particular instance, counterintuitively, the year 1 P50 outturn cost as calculated by the template of $109.68 is less than the P50 project estimate of $110.

Note that the index for the March quarter (relating to a January base date of estimate) is 102.51. This index value is greater than the index value for the financial year as a whole, which is the average of the four quarters. 102.51 effectively represents an escalation rate between 16/17 and 17/18 of 102.51/97.44 = 5.20%, which is greater than the headline rate of 4.90%

In other words, an index of 102.51 is already picking up all of the increase in prices between 16/17 and 17/18, and is in fact, picking up some of the increases into 18/19.
This example demonstrates one key point regarding the base date of estimate – the base date of estimate is not necessarily the date the estimate was prepared; it is the date (or time period) for which the rates in the estimate relate.

To clarify, if, in the example, while the estimate may have been prepared in January 2018, if historical rates were used, which were current at some previous period of time, perhaps September 2016, then September 2016 is the base date of estimate. That would result in an uplift factor of 1.03 (97.44/94.23) and a re-based P50 of $113.75. Escalation of 4.9% would then be applied on the re-based (uplifted) P50 of $113.75, resulting in a P50 outturn of $119.33.

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. Expert advice should be sought in the development of an index series for other modes, such as rail, as well as the composite indexes used to build the overarching series.

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 BISOE-derived escalation rates. 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: Definitions and Abbreviations

**Table 5: Definitions and Abbreviations**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agency</td>
<td>A state or territory body that generally will deliver an infrastructure project.</td>
</tr>
<tr>
<td>Base Date</td>
<td>A ‘base date’ is a reference date from which changes in conditions can be assessed. In the context of a base estimate it is the period when the estimate has been prepared to reflect the current market conditions.</td>
</tr>
<tr>
<td>Base Estimate</td>
<td>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 that 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.</td>
</tr>
<tr>
<td>Contingency</td>
<td>A specific allocation of resources required in addition to the base estimate to cover inherent and/or contingent risks for a desired confidence level.</td>
</tr>
<tr>
<td>Contractor Direct Costs</td>
<td>Costs that are directly attributable to a project cost object such as materials or labour.</td>
</tr>
<tr>
<td>Contractor Indirect Costs</td>
<td>Costs incurred by the contractor to perform work that are not directly attributable to a project cost object. These generally include costs such as preliminaries, supervision, and general and administrative costs.</td>
</tr>
<tr>
<td>Escalation</td>
<td>Escalation is inflation in prices, and in this context, changes in prices for construction output. Changes in construction output prices are driven, in turn, by changes in prices for construction inputs, ranging from materials, labour and contractor services and ‘know how’. Prices for these inputs are determined through the interaction of supply and demand. Escalation is usually measured by examining changes in a suitable composite price index over a period of time. Specifically, the Department defines escalation 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. The exception is for the first year in which escalation is applied; here the escalation rate is defined as the composite quarterly indexes for that financial year divided by the composite index for the quarter in the previous financial year to which the project costs relate.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Index Series</strong></td>
<td>A statistical measure of changes in a representative group of data points.</td>
</tr>
<tr>
<td><strong>Infrastructure Investment Program (IIP)</strong></td>
<td>The Government's Infrastructure Investment Program supports land transport projects that will deliver the highest benefits to the nation. When completed, these projects will significantly improve the efficiency and safety of land transport infrastructure in Australia.</td>
</tr>
<tr>
<td><strong>Jurisdiction</strong></td>
<td>An Australian state or territory.</td>
</tr>
<tr>
<td><strong>Margin</strong></td>
<td>An allowance that includes the construction contractor’s corporate overheads and profit.</td>
</tr>
<tr>
<td><strong>NOA</strong></td>
<td>Notes on Administration.</td>
</tr>
<tr>
<td><strong>Outturn Cost</strong></td>
<td>The sum of the price-escalated costs for each year of a project’s duration. Outturn cost calculation requires the non-escalated or real project cost to be presented as a cash flow and the application of an escalation index for each project year to derive the price escalated cost for each year. The Department’s PCB Template can be used to calculate outturn costs.</td>
</tr>
<tr>
<td><strong>PCB</strong></td>
<td>Project Cost Breakdown.</td>
</tr>
<tr>
<td><strong>Project proposal Report (PPR)</strong></td>
<td>A statement detailing the scope and benefits of the project submitted by proponents as part of the project approval process.</td>
</tr>
<tr>
<td><strong>Rebasing</strong></td>
<td>The process of applying a single adjustment factor to each year of a project’s cashflow to reflect the changes in cost from when the project was initially costed to the cost applicable to the financial year preceding the current financial year. Also known as uplifting.</td>
</tr>
</tbody>
</table>