PROJECT COST ESTIMATING GUIDELINES

BRITISH COLUMBIA

Ministry of Transportation and Infrastructure

DECEMBER 2020

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1.0 POLICY

All rehabilitation and capital projects require a project cost estimate, regardless of project size, complexity, schedule, or stage of project development.

Every project cost estimate must:

- be prepared early in the project life cycle so it can be used in business cases and value analysis
- be completed by an expert in transportation project cost estimating
- rely on knowledgeable resources for specialized fields
- reflect the entire scope of work needed to successfully complete the project
- include contingency that is based on detailed risk analysis
- follow a standardized format that can be updated and refined as required
- have the assumptions documented
- be updated as design progresses or new information is received about the project
- include inflationary impacts over a realistic schedule
- be approved by the appropriate authority (see Sec. 4.0).

2.0 BACKGROUND

These guidelines establish the policy and framework for developing project cost estimates for capital and rehabilitation projects used by the Ministry of Transportation and Infrastructure (Ministry).

These guidelines are developed to support the Capital Program Board in ensuring the effective management of the Ministry's capital plans, and the application of the capital management practices as set out by Treasury Board and the Capital Asset Management Framework. They are intended for use by project managers, estimators, planners, programmers, project sponsors, and others involved in determining project cost estimates in support of developing and implementing the Ministry's capital expansion and rehabilitation programs.

These guidelines are not a comprehensive document on the discipline of cost estimating, nor do they provide detailed instructions for an individual inexperienced in cost estimating. This document is not a user manual on any specific cost estimating system.

3.0 DEFINITION AND PURPOSE

A "project cost estimate" is a prediction of the most likely total cost to complete the identified scope of work for a specific project.

Project cost estimates are based on identifying, quantifying, and estimating the cost of consuming all the resources (e.g. labour, material, equipment, real property) required to complete all project activities, including appropriate allowances for associated risks and uncertainty (contingency), using market or relevant prices at the time the estimate is prepared.

A cost estimate is a key component of a project business cases as it justifies the funding request. Cost estimates are also used in value analysis/value engineering and program planning in the Ministry's capital plan.

Cost estimates must be prepared using consistent formatting and standardized processes to enhance their efficiency, accuracy, reliability, and credibility.

Cost estimates must be continually revised and updated as the project proceeds through its life cycle. They originate during the early planning stages of project development and are updated and refined at strategic points throughout the project's life cycle as more current information becomes known. Each updated estimate should reflect prevailing pricing for the entire scope of work to be performed, based on the knowledge and risk analysis at the time the estimate is prepared. The result is a series of successive estimates, each indicating a greater level of confidence than the preceding estimate.

3.1 COST ESTIMATE VERSUS PROJECT BUDGET

The project **cost estimate** is the total anticipated cost to complete the project, inclusive of inflationary impacts over a realistic implementation schedule with adequate contingency to deal with identified risks.

The project **budget** is the approved funding amount to deliver the project on the approved schedule.

The entire budget development process is not detailed within these guidelines. See Chapter 5 of the *Project Management Policy Manual* for information on budget development.

The Ministry annually issues the Highway Construction Cost Inflation (HCI) Index that applies to projects in the Ministry's capital plan. Refer to the current rate at:

https://intranet.gov.bc.ca/trannet/doing-business/pm-planning/references-and-tools#pmss

4.0 COST ESTIMATE CLASSES

Cost estimate classification systems are used throughout the estimating industry to categorize cost estimates based on the maturity level of the project. The Association for the Advancement of Cost Engineers provides generally accepted industry guidelines for cost estimating classification systems.

It is important that estimators clearly identify the **"Estimate Class"** on each cost estimate so that budget/funding decisions are made with a clear understanding of the amount of project development upon which the cost estimate was prepared.

Table 1 depicts the Ministry's estimate classification system. This table provides the project phase and expected accuracy range for each estimate level.

The estimate classes are named such that they are consistent with the stages of project development.

The expected accuracy ranges provided in Table 1 are intended as a guide only; they are not a standard or a target. They represent the typical expected variation of actual final project costs from the cost estimate for projects of ***medium risk and complexity under normal circumstances***. Projects with higher or lower levels of risk or complexity will have correspondingly higher or lower accuracy ranges.

A project budget should be based on no less than a Class 3 cost estimate. Class 4 and 5 cost estimates involve significantly greater risk assumptions and uncertainty.

TABLE 1 – Ministry Project Cost Estimate Classification

Estimate Class	Purpose of Estimate	Project Phase/ Milestone	Accuracy Range Percentage
5	Option Screening	Planning Study	-50 to +100
4	**Treasury Board Stage 1 Submittal** Preliminary budget approval	Preliminary or Concept[1] Design	-30 to +50
3	**Treasury Board Stage 2 Submittal** Baseline budget approval	Detailed Design[2]	-20 to +30
2	Pre-tender Estimate – affordability check	Tender or RFP[3]	-15 to +20
1	Control Budget	Construction or Award[4]	-10 to +15

[1] Concept design applies to design-build procurement
[2] Includes completed functional design
[3] RFP applies to design-build procurement
[4] Control budget adjusted to reflect awarded contract value

5.0 COST ESTIMATES FOR TREASURY BOARD TWO-STAGE SUBMITTALS

In a two-stage Treasury Board process, Stage 1 occurs in the early stages of project development and requires a Class 4 cost estimate. Stage 2 occurs in the later stages of project development when detailed design is near completion and a Class 3 cost estimate can be produced.

Chapter 2: Governance of the *Project Management Policy Manual* discusses the two-stage approval process in more detail.

6.0 PRINCIPLES OF COST ESTIMATING

All project cost estimates for the Ministry must be developed using the following guiding principles:

- cost estimates must be prepared by individuals with knowledge, skill and experience in estimating transportation infrastructure projects using industry recognized, repeatable, and defendable practices
- cost estimates must be prepared using a high standard of professional and ethical integrity
- they should not be prepared under circumstances that may be perceived to be in conflict of interest
- pre-tender costs estimates must not be publicly released or disclosed outside the Ministry
- cost estimates must be developed employing expertise from appropriate disciplines for the relevant project components.
- cost estimates must be approved by the designated representative of the Capital Program Board, or in the case of a major project, the Project Director and Executive Director, Major Project Procurement and Alternative Procurement.

Project cost estimates must be based on the best, most complete information available on the project at the time the estimate is being prepared. A clear and concise scope statement identifying in-scope and out of scope parameters for the project is a critical component for preparing a cost estimate. Cost estimates must:

- reflect the **entire approved scope of work**, including all the elements and activities necessary to successfully complete the project
- be "**all inclusive**" in that they include all material, labour, equipment, overhead, and administration costs
- include **contingency** based on detailed risk analysis (see Section 7.0)
- have **assumptions** clearly documented
- be **updated** as new information becomes available.

7.0 CONTINGENCY

Project cost estimates are expected to include an adequate contingency to offset uncertainties and risks.

Contingency is the funding added to a cost estimate to cover potential cost items which are not known at the time the estimate is developed. Contingency is intended only for the project components identified within the approved scope, **not for scope changes**.

Contingency must be:

- based on a quantitative risk analysis
- presented on the estimate as a separate line item
- expressed in terms that can be easily understood
- reviewed and recalculated at defined milestones through the project life cycle
- reflective of direction in government policy that can influence project costs.

Quantitative risk analysis is a process in which:

- project risks are identified
- upper and lower mitigation costs are recorded
- the probability of the risk assessed
- the risk scenario is modelled.

This is referred to a probabilistic risk modelling and may be accomplished using a "three-point estimate" for simple low-cost projects as discussed in the Project Management Policy Manual, Chapter 4, or using Monte Carlo simulation, which is discussed further in the Risk Management section of TRANnet.

When Monte Carlo analysis is used, the confidence level for establishing contingency should be greater than 65%, but should not exceed 85%, and unless otherwise directed by the Capital Program Board. Table 2 below shows an example of how contingency varies depending on the cumulative probability.

Contingency must be managed throughout the project life cycle. As the risk register is updated and risk is mitigated or retired, contingency assigned to the risk item must be reduced in the project financial forecast. At certain milestones, material changes in the contingency level must be released.

Contingency is not used for costs induced by external influences such as:

- changes in project scope as approved by the Capital Program Board, Treasury Board, or other authority
- changes in government policies or regulations
- force majeure, such as natural disasters, extreme weather events, or major catastrophes

TABLE 2

Cumulative Probability	Estimated Contingency ($)	Total Project Cost ($)	Contingency as % of Base
60%	26,259,500	101,648,934	35
75%	28,258,800	103,648,234	38
85%	**29,887,000**	**105,276,343**	**40**
91.5%	31,336,100	106,725,534	42
95%	32,422,400	107,811,834	43
99%	41,437,900	116,827,334	55

8.0 COST ESTIMATES REVIEWS

Project cost estimates should undergo periodic reviews by an independent third party to validate the cost estimates. This is particularly important for high value projects where the cost estimates are very complex and often subject to varying assumptions. The guidelines for value thresholds for independent reviews are detailed in Table 4.6 in the *Project Management Policy Manual*.

Each cost estimate is based on the experience and interpretation of the estimator. An independent review of the estimate will provide project managers and decision makers with a second opinion which will provide assurances as to the accuracy of the original estimate or reveal errors or omissions.

These reviews are also important to ensure that any changes to the conditions and underlying assumptions for the original estimate are appropriately reflected in subsequent estimates.

The Planning and Programming Branch has retained several qualified cost estimators on "as and when required" consulting services contracts who may be utilized for cost estimate reviews.

9.0 COST ESTIMATING METHODS AND TOOLS

The commonly used cost estimating methods are parametric, elemental, and detailed cost. They are discussed below.

9.1 PARAMETRIC ESTIMATING METHOD

The parametric method produces a high-level estimate using various factors (*parameters*) developed from past projects, historical databases, engineering practices, and technologies, such as:

- cost per lane-kilometre of roadway
- cost per interchange
- cost per square metre of a bridge structure
- cost per intersection.

This approach is beneficial when little or no design information is available.

Costs from recent, similar projects provide valuable information, but the historical data must always be reviewed to ensure it aligns with current market conditions.

The parametric method is primarily intended to be used at the very early stages of project development, prior to any detailed project planning. It can also be used as part of a quality assurance check on a more detailed cost estimate prepared during project planning or preliminary design. It **should not** be used as the basis for approving a project budget.

This method may be used for **Treasury Board Stage 1** submissions where required.

9.2 ELEMENTAL PARAMETRIC ESTIMATING METHOD

In the elemental parametric approach, the *elements* are the building blocks (such as the design, the land acquisition, the project management, and the construction sub-elements, such as grading, structural, paving, utilities, etc.) and the *parameters* are the variables that need to be defined (such as number of lanes, lane widths, depth of materials, number of culverts for drainage, tunnel width and height, etc.).

This method involves more project-specific parameters than the parametric method. It does not provide a breakdown of traditional labour, equipment, or materials; however, it does provide a consistent and increasingly detailed breakdown for decision-making over the project life cycle. The elemental parametric method also uses historical costs and relevant historical percentages; however, the costing is at a much more detailed level, often consisting of composite unit prices from previous tender records and/or market rates.

Elemental parametric estimating can be used to produce estimates throughout the project lifecycle (from planning to detailed design). It can be used for the early planning estimates by simply entering the relatively few known parameters and using assumptions for the remaining inputs. As the project information increases and assumptions are gradually replaced with known quantities, the elemental parametric estimate becomes more defined and can be compared to the original estimate.

This method can be used for any size project and is particularly recommended for very large, complex projects. This method is also effective for developing project option analysis for comparison purposes. Elemental parametric estimates are often used as a basis for developing a project budget.

This method may used for **Treasury Board Stage 2** submissions where required.

9.3 DETAILED COST ESTIMATING METHOD

Detailed cost estimating is the most accurate estimating method, as each cost item is quantified and priced. This method can only be used when detailed design is complete and a Schedule 7 – *Approximate Quantities and Unit Prices* (or equivalent level of detail) is completed.

Two approaches are generally used in detailed cost estimating: the cost-based approach, and the historical bid-based approach.

Cost-based approach:

This method is also known as "bottom up" estimating and contractors generally use it to prepare bids. Cost based estimates require significant time and effort but they could be used to prepare a "**mock bid**." This approach may also be valuable on projects where geography, unique elements or technologies, or other factors may render historical unit prices to be unreliable and the project team or estimator wishes to confirm market prices or costs.

Historical bid-based approach:

This approach applies historical unit cost data (e.g. recent average unit prices) to quantities or measures of individual work items to determine a total cost for each item.

The unit cost data is often gathered from prior construction contracts and then adjusted to reflect current prices, or to accommodate specific conditions as set out in the Special Provisions (Schedule 3) of the construction contract, or address unique geographic, market, or other project parameters. The historical bid-based approach is commonly used by the Ministry in preparing the pre-tender cost estimate in anticipation of tendering a construction contract. The unit rates are applied against item quantities set out in the *Schedule of Approximate Quantities and Unit Prices* (Schedule 7) of the construction contract being tendered.

9.4 INDIGENOUS ACCOMMODATION COSTS

NOTE: This policy is currently under development. Please contact:

- ***Vickie Willow**, Executive Director of Procurement Contracts & Risk Management, for details on Indigenous procurement*
- ***Sarah Dugan**, Director, Indigenous Relations, for details on consultation and accommodation*

10.0 COST ESTIMATE DOCUMENTATION

The complete project cost estimate consists of project information (scope etc.), the assumptions, and the estimate of costs for each cost element. An estimate submitted with just a total dollar amount is of limited value without a record of the context, basis, and assumptions used to develop it. **A copy of the entire project cost estimate must be retained in the project records, and all cost estimates should also be retained electronically**.

Cost estimates must be prepared throughout the project life cycle. Early conceptual and planning level estimates are prepared in support of a business case for approving project funding. These estimates should be retained by the program area staff responsible for developing and submitting the business case, such as regional planning staff or project sponsors.

Once the project is assigned to a project manager, the project manager becomes responsible for retaining the project cost estimate and historical estimates.

Project cost estimates should be prepared at strategic points throughout the project lifecycle, ideally at each project phase, consistent with the estimate levels as outlined Table 4.1.

Scope changes should be clearly and completely documented on the estimate. The changes to the project risk profile that may results from any scope changes must also be documented and considered in the cost estimate.

Each cost estimate should be presented in a consistent, repeatable format to ensure that it clearly demonstrates how the newer estimate evolved from the previous, less-detailed estimate. The desired result is a seamless progression of estimates, each comparable to the previous.

11.0 COST ESTIMATING RESOURCES

The TRANnet website has link to the following resources:

- this document (Project Cost Estimating Guidelines)
- construction cost data
- information on procuring cost estimating resources
- cost estimating tools (spreadsheets).

https://intranet.gov.bc.ca/trannet/doing-business/pm-planning/project-cost-estimating

12.0 COST ESTIMATING PERFORMANCE MEASURES

Project cost estimates should be evaluated at project completion to determine the accuracy of the cost estimating process. The project sponsor is responsible for conducting a sample of project cost estimating audits to accomplish this evaluation. Selecting projects for cost estimates audits should be based on:

- high value projects as they will offer more scope for cost analysis
- complex projects will likely have more sophisticated cost estimates
- projects where there is a significant variance of the final cost from the original cost or baseline budget
- other issues that may warrant a review of the estimate.

In addition to individual project cost audits, an annual review of a large sample of smaller projects should be done to analyze the cost estimates at various stages of the project life cycle. For example, comparing the conceptual cost estimate against the baseline budget, the pre-tender budget , and final project actual cost.

Cost estimating performance reviews are intended to:

- improve the Ministry's cost estimating processes and subsequently these guidelines
- measure the accuracy of cost estimates against the accuracy ranges in Table 1
- measure the success of estimating the final cost of the project.

PROJECT COST ESTIMATING GUIDELINES