AACE INTERNATIONAL RECOMMENDED PRACTICE

47R-11

COST ESTIMATE CLASSIFICATION SYSTEM - AS APPLIED IN THE MINING AND MINERAL PROCESSING INDUSTRIES

AACE INTERNATIONAL

AACE International Recommended Practice No. 47R-11

COST ESTIMATE CLASSIFICATION SYSTEM – AS APPLIED IN THE MINING AND MINERAL PROCESSING INDUSTRIES

TCM Framework: 7.3 – Cost Estimating and Budgeting

Rev. July 6, 2012

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Any terms found in AACE Recommended Practice 10S-90, *Cost Engineering Terminology*, supersede terms defined in other AACE work products, including but not limited to, other recommended practices, the *Total Cost Management Framework*, and *Skills & Knowledge of Cost Engineering*.

Contributors:

Disclaimer: The opinions expressed by the authors and contributors to this recommended practice are their own and do not necessarily reflect those of their employers, unless otherwise stated.

Allison Bull (Primary Contributor)
John K. Hollmann, PE CCE CEP (Primary Contributor)
Gord Zwaigenbaum, P.Eng. CCE (Primary Contributor)
Nelson Augusto Alvares da Silva
Jonathon Brown
Simon P. Hoadley
Roy K. Howes
Gordon Robert Lawrence
Bruce A. Martin
Luis Miralles
Martin R. Oros Bergeret
Geoffrey A. Wilkie, P.Eng.
John A. Wilson
Allen Wong

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PURPOSE

As a recommended practice (RP) of AACE International, the *Cost Estimate Classification System* provides guidelines for applying the general principles of estimate classification to project cost estimates (i.e., cost estimates that are used to evaluate, approve, and/or fund projects). The *Cost Estimate Classification System* maps the phases and stages of project cost estimating together with a generic project scope definition maturity and quality matrix, which can be applied across a wide variety of process industries.

This addendum to the generic recommended practice provides guidelines for applying the principles of estimate classification specifically to project estimates in the mining and mineral processing industries, excluding upstream oil and gas projects. This addendum supplements the generic recommended practice (17R-97)[1] by providing:

- a section that further defines classification concepts as they apply to the mining industries
- a section on the geopolitical nature and investment regulation of mining projects that impact on the estimating process and its basis definition deliverables
- a chart that maps the extent and maturity of estimate input information (project definition deliverables) against the class of estimate.

As with the generic RP, the intent of this addendum is to improve communications among all of the stakeholders involved with preparing, evaluating, and using project cost estimates, specifically for the mining and mineral processing industries.

The overall purpose of this recommended practice is to provide the mining and mineral processing industry definition deliverable maturity matrix which is not provided in 17R-97. It also provides an approximate representation of the relationship of specific design input data and design deliverable maturity to the estimate accuracy and methodology used to produce the cost estimate. The estimate accuracy range is driven by many other variables and risks, so the maturity and quality of the scope definition available at the time of the estimate is not the sole determinate of accuracy; risk analysis is required for that purpose.

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It is understood that each enterprise may have its own project and estimating processes and terminology, and may classify estimates in particular ways. This guideline provides a generic and generally acceptable classification system for the mining industries that can be used as a basis to compare against. This addendum should allow each user to better assess, define, and communicate their own processes and standards in the light of generally-accepted cost engineering practice.

As a final note regarding purpose, users must be aware of the industry's well documented history of challenges with overruns of feasibility estimates [6 to 9]. An intent of this RP is to help improve upon this past performance.

INTRODUCTION

For the purposes of this addendum, the term "mining industries" is assumed to include any firm that is involved in a mining (mineral) project, which is defined in NI 43-101 as "any exploration, development or production activity, including a royalty interest or similar interest in these activities, in respect of diamonds, natural solid inorganic material, or natural solid fossilized organic material including base and precious metals, coal and industrial minerals" [4].

Mining estimates depend on data from/for project permitting; drilling and exploration; underground and surface mining; ore handling, milling and metallurgical processing; tailings and water management; and other onsite and offsite infrastructure facilities that may be familiar to any process plant or uniquely mining. This recommended practice is intended to cover entire mining projects; this extends from the mine (surface or underground) through the initial processing phase of producing a marketable product, including all associated process and infrastructure facilities within the scope of the project. However, if the project is for a processing plant with no other mining aspect, it is assumed covered by 18R-97. Standalone exploration programs based on drilling or remote means are not included in this RP; however, exploration such as sinking shafts, driving drifts from an operation or drilling funded as part of mine development may be covered. In addition, projects for mine reclamation and closure may be included. Other than these exclusions, this addendum is specifically intended to cover the full mining project scope and should not be combined with other addendums.

An unusual characteristic of mining projects is that some portion of the mining scope needed for initial production may be capitalized and included in the project estimate. Therefore, the initial capitalized elements of the mining plan (e.g., tunnels, pre-stripping, initial water management, pit crushers, initial mining equipment, etc.) must have more advanced definition than later elements that will be charged to operations or later sustaining capital costs.

This guideline reflects generally-accepted cost engineering practices. This RP was based upon the practices of international companies who are engaged in mining projects around the world, as well as published references and standards.

GEOPOLITICAL NATURE AND INVESTMENT REGULATION OF MINING INDUSTRIES

The geopolitical nature and significant investment risk of the mining project industries increases the public profile and influences the capital cost estimating process, including the interpretation of estimate classifications. The following are regulations and situations that are applicable to the mining industries.

Security exchanges in the various jurisdictions have established regulatory codes for reporting of mining project feasibility that cover reports to potential investors and other stakeholders in the projects. This includes well recognized national and international codes and standards such as the following:

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- Canada: *Canadian Securities Administrators (CSA) National Instrument (NI) 43-101, Standards Of Disclosure For Mineral Projects*, which is widely used and representative proxy of international reporting standards and is a primary reference for this RP addendum[5] Note that NI 43-101 defers to the Canadian Institute of Mining and Metallurgy (CIM) to provide definition standards for mineral resources and reserves[5].
- United Kingdom: *Institution of Metals, Minerals and Mining (IMMM)* or *Pan-European Reserves and Resources Reporting Committee (PERC)*
- Australia (and New Zealand): *Joint Ore Reserves Committee (JORC)*
- South Africa: *South African Code for Reporting of Exploration Results, Mineral Resources and Mineral Reserves* (SAMREC)
- USA: *United States Securities And Exchange Commission (SEC) Industry Guide 7: Description of Property by lssuers Engaged or to be Engaged in Significant Mining Operations*
- International standards (for general reference):
    - *United Nations Framework Classification (UNFC) for Fossil Energy and Mineral Resources*
    - *Committee for Mineral Reserves International Reporting Standards (CRIRSCO)*

The regulatory codes recognize the evolutionary nature of feasibility studies (FS). NI 43-101 focuses on two aspects of estimates: 1) geological knowledge and confidence including volume and purity of the mineral ores based on exploration results, and 2) modifying factors influencing the profitability of extraction including mining, processing, metallurgical, economic, marketing, legal, environmental, socio-economic and governmental factors. Capital costs are one of the drivers of profitability and hence one of the modifying factors. The geologic factors such as drilling and assay results are the basis for establishing if the asset is a resource which may or may not be profitable. Resource categories are inferred, indicated or measured (listed in the order of increasing confidence). The modifying factors are the basis for establishing if the resource is profitable and hence a reserve. Reserve categories are potential or probable.

To demonstrate that a geologic resource is profitable and hence an economic reserve, NI 43-101 requires that the economics be demonstrated through a study. The study must be at least a preliminary feasibility study (PFS). Based on this type of study an indicated resource can be established as a potential reserve, and a measured resource can be established as a proven reserve. The code prohibits disclosure of results of an economic analysis that includes inferred resources unless it includes certain declamatory statements (i.e., they are never a reserve). The regulatory codes require that feasibility study reports be signed by competent party (i.e., a Qualified Person or QP) responsible for the content. Interestingly, the code leaves the appropriate level of detail for the preliminary feasibility study to the discretion of the QP making the study. In respect to NI 43-101, this RP may be a useful guide for the QP's study in regards to capital cost estimates.

It is important to highlight the NI 43-101 terminology (defined by CIM[4]) relative to economic studies because these are often used as *de-facto* capital cost estimate categories in lieu of more defined estimate classifications such as this RP. NI 43-101 includes the following definitions for study types:

- **feasibility study** - means a comprehensive study of a mineral deposit in which all geological, engineering, legal, operating, economic, social, environmental and other relevant factors are considered in sufficient detail that it could reasonably serve as the basis for a final decision by a financial institution to finance the development of the deposit for mineral production.
- **preliminary feasibility study** and **pre-feasibility study** - each mean a comprehensive study of the viability of a mineral project that has advanced to a stage where the mining method, in the case of underground mining, or the pit configuration, in the case of an open pit, has been established and an effective method of mineral processing has been determined, and includes a financial analysis based on reasonable assumptions of technical, engineering, legal, operating, economic, social, and environmental factors and

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the evaluation of other relevant factors which are sufficient for a qualified person, acting reasonably, to determine if all or part of the mineral resource may be classified as a mineral reserve.

The primary distinction between the above is that the feasibility study is a suitable basis for a final decision. This RP recommends that a best industry practice to manage investment risk is to equate mining feasibility study capital cost estimates as AACE Class 3 (basis for full funding) and preliminary and pre-feasibility study estimates as AACE Class 4.

There is no economic study defined by CIM pursuant to NI 43-101 that is strictly equivalent to Class 5; however, NI 43-101 itself defines the following term that is usually applied to studies done prior to the PFS and FS but does not imply reserve status;

- **preliminary economic assessment (PEA)** - means a study, other than a pre-feasibility or feasibility study, that includes an economic analysis of the potential viability of mineral resources.[4]

In common mining practice, the term PEA usually is equivalent to Class 5, but not always; it may also be used for a more advanced study that simply does not meet the qualifications for a PFS or FS. Another term in common use is scoping study which is more or less equivalent to Class 5.
Mining industry estimators must be aware that other industries do not use the term feasibility (or the other terms above) for their estimates of an equivalent AACE Class. One of the reasons for this RP is to encourage the use of the common, numbered Class terminology.

Other geopolitical circumstances (or modifying factors per NI 43-101) for mining projects may directly or indirectly impact on the interpretation of the status and quality of project definition deliverables and hence estimate classifications. Examples of status considerations include:

- Mining projects are often in remote sites and have unique logistical and environmental issues.
- Resources are often seen as national legacies with attendant political, legal and socio-economic considerations.
- Improved metal prices and/or extraction technologies may lead to reacquisition of abandoned mining properties that have unforeseen environmental legacies and regulatory implications.
- Volatility in metal prices have led to abrupt study deferrals and resumptions causing problems such as ambiguous mining rates, skipped study steps and an unrealistic study schedule.
- Feasibility studies may tend to focus on technical issues at the expense of business and project delivery issues (e.g., execution strategy and planning deliverables).

COST ESTIMATE CLASSIFICATION MATRIX FOR THE MINING AND MINERAL PROCESSING INDUSTRIES

Table 1 provides a summary of the characteristics of the five estimate classes. The maturity level of definition is the sole determining (i.e., primary) characteristic of Class. In Table 1, the maturity is roughly indicated by a % of complete definition; however, it is the maturity of the defining deliverables that is the determinant, not the percent. The specific deliverables, and their maturity or status are provided in Table 3. The other characteristics are secondary and are generally correlated with the maturity level of project definition deliverables, as discussed in the generic RP[1]. The post feasibility classes (Class 1 and 2) are only indirectly covered by the regulatory codes where new funding is indicated. Again, the characteristics are typical and may vary depending on the circumstances.

	Primary Characteristic	*Secondary Characteristic*		
ESTIMATE CLASS	**MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES** Expressed as % of complete definition	**END USAGE** Typical purpose of estimate	**METHODOLOGY** Typical estimating method	**EXPECTED ACCURACY RANGE** Typical variation in low(L), and high(H) ranges[a]
Class 5	0% to 2%	Conceptual planning	Capacity factored, parametric models, judgment, or analogy	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	Screening options	Equipment factored or parametric models	L: -15% to -30% H: +20% to +50%
Class 3	10% to 40%	Funding authorization	Semi-detailed unit costs with assembly level line items	L: -10% to -20% H: +10% to +30%
Class 2	30% to 75%	Project control	Detailed unit cost with forced detailed take-off	L: -5% to -15% H: +5% to +20%
Class 1	65% to 100%	Fixed price bid check estimate	Detailed unit cost with detailed take-off	L: -3% to -10% H: +3% to +15%

Notes: [a] The state of technology, availability of applicable reference cost data and many other risks affect the range markedly. The +/- values represent typical percentage variation of actual costs from the cost estimate after application of contingency (typically at a 50% level of confidence) for given scope.

Table 1 – Cost Estimate Classification Matrix for Mining and Mineral Processing Industries

This matrix and guideline outline an estimate classification system that is specific to mining industries. Refer to the generic estimate classification RP[1] for a general matrix that is non-industry specific, or to other addendums for guidelines that will provide more detailed information for application in other specific industries. These will provide additional information, particularly the project definition deliverable maturity matrix which determines the class in those particular industries.

Table 1 illustrates typical ranges of accuracy ranges that are associated with the mining industries. Depending on the technical and project deliverables (and other variables) and risks associated with each estimate, the accuracy range for any particular estimate is expected to fall into the ranges identified although extreme risks can lead to wider ranges. However, it should be noted that the average quality and accessibility of mineral bodies is declining, and processing complexity increasing over the years so the high end of the accuracy range may be increasing (this RP will be reviewed over time).

In addition to the degree of project definition, estimate accuracy is also driven by other systemic risks such as:

- Level of non-familiar or first of a kind technology in the project.
- Complexity of the project.
- Quality of reference cost estimating data.
- Quality of assumptions used in preparing the estimate.
- Experience and skill level of the estimator in the mining and mineral processing industries
- Estimating techniques employed.
- Time and level of effort budgeted to prepare the estimate.
- The accuracy of the geotechnical data.
- Remote nature of project locations and the lack of benchmark data for these remote locations.
- Political, environmental, and other regulatory circumstances.
- Socio-economic conditions

Systemic risks such as these are often the primary driver of accuracy; however, project-specific risks (e.g. risk events) also drive the accuracy range.

Mining projects are very sensitive to volatility in metal pricing and geopolitical issues. Early geological studies may be highly speculative and entail a lot of uncertainty as to the commercial viability of a new mining project. Conversely, a project may have a history of feasibility studies for current and previous owners that can readily be revived to meet securities disclosure rules when the technology and metal prices improve sufficiently to spark interest among investors. Accordingly, estimate classifications represent benchmarks for minimum definition recognizing the evolution of a mining project. Therefore, Table 1 provides a range in accuracy values. This allows application of the specific circumstances inherent in a project, and an industry sector, to the indication of realistic estimate class accuracy range percentages.

Figure 1 also illustrates that the estimating accuracy ranges overlap the estimate classes. There are cases where a Class 5 estimate for a particular project may be as accurate as a Class 3 estimate for a different project. For example, similar accuracy ranges this may occur if the Class 5 estimate of one project that is based on a repeat project with good cost history and data and, whereas the Class 3 estimate for another is for a project involving new technology. There are also cases where a Class 3 estimate has no better accuracy than a Class 5 estimate. It is for this reason that Table 1 provides ranges of accuracy range values. This allows application of the specific circumstances inherent in a project, and an industry sector, to the indication of realistic estimate class accuracy range percentages. While a target range may be expected of a particular estimate, the accuracy range is determined through risk analysis of the specific project and is never pre-determined.

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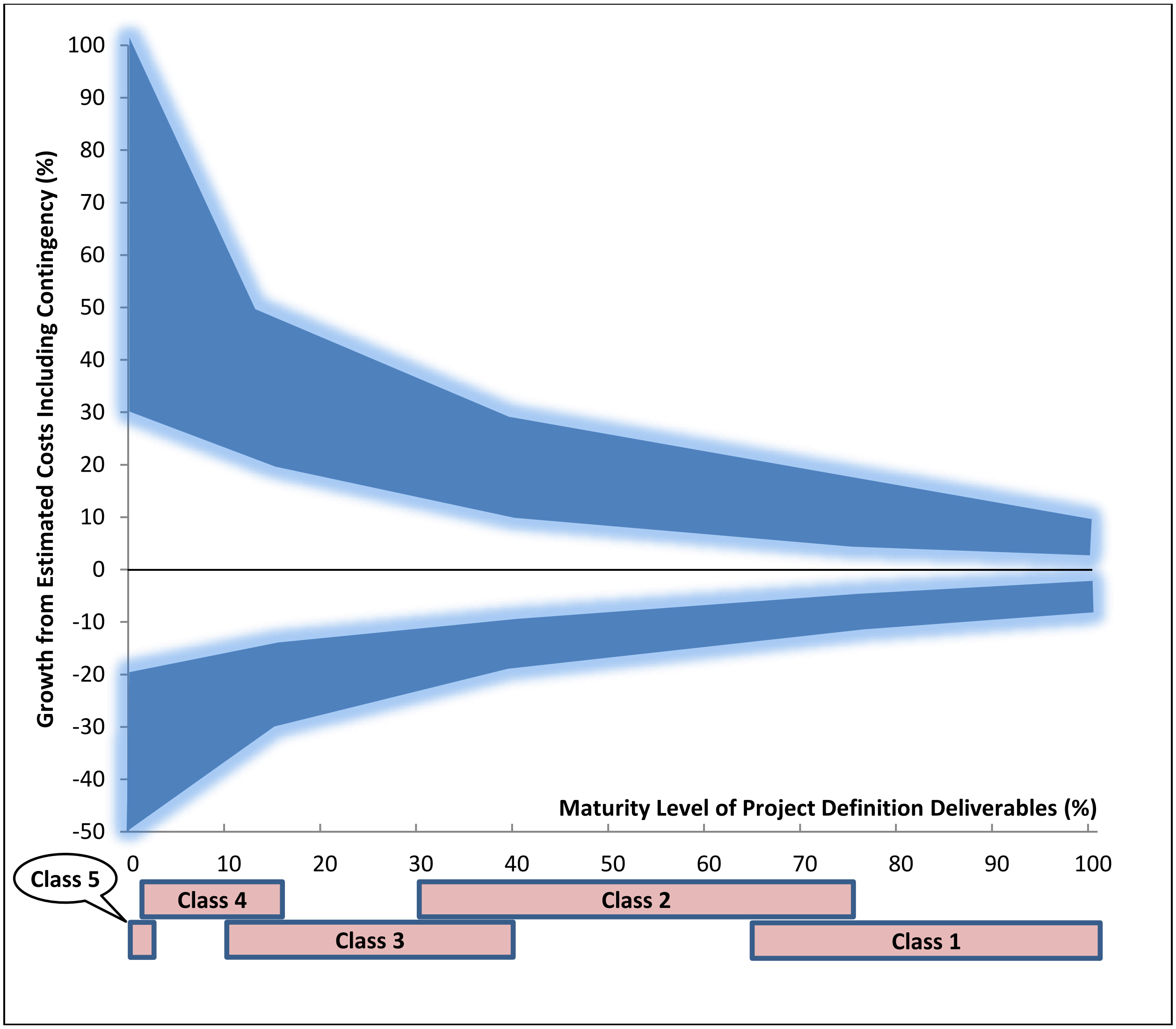

Figure 1 – Example of the Variability in Accuracy Ranges for a Mining Industry Estimate

DETERMINATION OF THE COST ESTIMATE CLASS

The cost estimator makes the determination of the estimate class based upon the maturity level of project definition based on the status of specific key planning and design deliverables. The percent design completion may be correlated with the status, but the percentage should not be used as the Class determinate. While the determination of the status (and hence the Class) is somewhat subjective, having standards for the design input data, completeness and quality of the design deliverables will serve to make the determination more objective. Alternatively, the estimator should make note of estimates that are released but do not fully meet the client-specified estimate class based on the available project definition deliverables.

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CHARACTERISTICS OF THE ESTIMATE CLASS

The following tables (2a through 2e) provide detailed descriptions of the five estimate classifications as applied in the mining and ore processing industries. They are presented in the order of least-defined estimates to the most-defined estimates. These descriptions include brief discussions of each of the estimate characteristics that define an estimate class.

For each table, the following information is provided:

- **Description:** A short description of the class of estimate, including a brief listing of the expected estimate inputs based on the maturity level of project definition deliverables. The minimum inputs reflect the range of industry experience, but would not generally be recommended.

- **Maturity Level of Project Definition Deliverables Required:** Describes a particularly key deliverable and a typical target status in stage-gate decision processes, plus an indication of approximate percent of full definition of project and technical deliverables. For the mining industries, this correlates with the percent of engineering and design complete.

- **End Usage:** A short discussion of the possible end usage of this class of estimate.

- **Estimating Methods Used:** A listing of the possible estimating methods that may be employed to develop an estimate of this class.

- **Expected Accuracy Range:** Typical variation in low and high ranges after the application of contingency (determined at a 50% level of confidence). Typically, this represents about an 80% confidence that the actual cost will fall within the bounds of the low and high ranges. The estimate confidence interval or accuracy range is limited by the reliability of the scope information available at the time of the estimate in addition to the other variables and risks identified above.

- **Alternate Estimate Names, Terms, Expressions, Synonyms:** This section provides other commonly used names that an estimate of this class might be known by. These alternate names are not endorsed by this recommended practice. The user is cautioned that an alternative name may not always be correlated with the class of estimate as identified in Tables 2a-2e.

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CLASS 5 ESTIMATE	
Description: Class 5 estimates are generally based on inferred resources defined by preliminary drilling exploration and metallurgical analysis and general experience with related projects to comply with disclosure standards such as NI 43-101. This would include a simple geological model and estimated grade of mineralization. A simple mine plan is then prepared that covers mining method (open pit, underground); gross production schedules; nominal plant capacity; assumed block flow diagrams and process rates; and conceptual definition of infrastructure needs. There may be a minimum of metallurgical test work and geotechnical, hydrological or other back up studies available. No design drawings or equipment specifications may be prepared beyond some rough notes and sketches by the project engineer, perhaps little more than proposed plant type, capacity and location. **Maturity Level of Project Definition Deliverables Required:** Key Deliverable and Target Status: Block flow diagram and assumed mine plan agreed by key stakeholders. 0% to 2% of full project definition. **End Usage:** Class 5 estimates are prepared for any number of strategic business planning purposes, such as but not limited to market studies, assessment of initial viability, evaluation of alternate schemes, rough project screening, project location studies, and long-range capital planning.	**Estimating Methods Used:** Class 5 estimates generally rely on available internal and industry data for similar previous projects. Gross unit costs may be applied to mining and excavation volumes. Equipment factoring techniques may be used to extend major plant equipment costs to include all commodities, and gross unit costs applied to building volumes, pipeline and other elements. Cost/capacity methods may be used for some plant elements. Indirect costs are factored from directs based on internal and industry experience with typical cost ratios and other parametric and modeling techniques utilized. **Expected Accuracy Range:** Typical accuracy ranges for Class 5 estimates are -20% to -50% on the low side, and +30% to +100% on the high side, depending on the technological, geographical and geological complexity of the project, appropriate reference information and other risks (after inclusion of an appropriate contingency determination). Ranges could exceed those shown if there are unusual risks. Declining quality and accessibility of ore bodies may be driving higher risks. The uncertainty varies by work type so that moderate ranges apply to structures, wider ranges apply to earthworks and infrastructure and narrower ranges apply to machinery (assuming applicable procurement data is available from similar past projects). **Alternate Estimate Names, Terms, Expressions, Synonyms:** Preliminary economic assessment or PEA (per NI 43-101), Geological study estimate, order of magnitude estimate, capacity factor estimate, conceptual study, venture analysis, scoping study, preliminary evaluation,

Table 2a – Class 5 Estimate

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CLASS 4 ESTIMATE	
Description: Class 4 estimate is usually carried out using indicated or measured resources defined by drilling confirmation of the mineralized zone(s). A preliminary geological model and detailed mine plan are required, including supporting pit optimization, geotechnical and hydro-geological studies, etc. The metallurgical test work should determine the probable process flow sheet and approximate material balance, and identify the major equipment. Engineering would comprise at a minimum: general arrangement (GA) drawings, equipment lists for major equipment, nominal plant capacity, block schematics, and process flow diagrams (PFDs) for the main process systems. **Degree of Project Definition Deliverables Required:** Key Deliverable and Target Status: Process flow diagram (PFD) issued for design for plant and detailed mine plan for the mine. 1% to 15% of full project definition. **End Usage:** Class 4 estimates are vitally important to mining investors internationally. A mineral resource cannot be identified as an economic reserve without an estimate of at least this class. They are held to disclosure requirements by the involved securities jurisdictions and are subject to analysis by third party reviewers. The estimates are used for refining and screening of options, analyzing technical and economic feasibility and then identifying the preferred option(s) for the final feasibility study (Class 3 estimate) prior to commitment.	**Estimating Methods Used:** Major equipment costs are based on recent budget prices from vendors based on preliminary requirements. Facility costs are estimated by approximate quantity take-offs from the GA drawings and applying unit cost factors. Earthworks and infrastructure are not well defined in detail but allowances can be set based on preliminary contours for overland piping lengths and overhead electrical power lines, etc. Equipment installation is estimated by a combination of quantity take-offs and unit cost factors based on the available scope definition. The same method also applies to indirect costs (as a % of directs). **Expected Accuracy Range:** Typical accuracy ranges for Class 4 estimates are -15% to -30% on the low side, and +20% to +50% on the high side, depending on the technological, geographical and geological complexity of the project, appropriate reference information, and other risks (after the inclusion of an appropriate contingency determination). The uncertainty varies by work type with moderate ranges applying to structures and plant commodities, wider ranges applying to earthworks and infrastructure and narrower ranges applying to equipment installation. **Alternate Estimate Names, Terms, Expressions, Synonyms:** Pre-feasibility or preliminary feasibility (per NI 43-101), intermediate economic study estimate, equipment factor estimate

Table 2b – Class 4 Estimate

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<table>
<tr><th colspan="2">CLASS 3 ESTIMATE</th></tr>
<tr><td>

Description:
A Class 3 estimate is prepared using probable or proven ore reserves as defined within acceptable confidence limits as per the securities codes. A detailed mine plan is required (pre-stripping may begin upon project approval). Metallurgical test work is sufficient to expand the detail in equipment lists and specifications. Engineering is expected to provide general arrangement drawings (GAs), preliminary piping and instrument diagrams (P&ID's) and single line electrical drawings. Also, plot plans and layout drawings are better defined.

Degree of Project Definition Deliverables Required:
Key Deliverable and Target Status: Piping and instrumentation diagrams (P&IDs) issued for design for plant and detailed mine plan for the mine.
10% to 40% of full project definition.

End Usage:
Class 3 estimates are typically prepared to support full project funding requests for internal and/or external investment. By default, the Class 3 estimate is the initial baseline for project and change control until superseded by the updated project control estimate (Class 2).

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Estimating Methods Used:
Class 3 estimates are generally based on detail take-offs and estimates for significant cost items for direct and indirect costs where detailing can be done (e.g., pipe fittings not detailed). Major equipment and contracts are priced based on supplier quotations. Construction (bulks, labor and equipment) are estimated based on local pricing and trade agreements covering the available quantity take-offs. Mass earthwork and infrastructure such as transport pipelines and power transmission lines are based on take-off from preliminary contours and routing. Less significant costs may be factored such as small bore pipe as a % of large bore.

Expected Accuracy Range:
Typical accuracy ranges for Class 3 estimates are
-10% to -20% on the low side, and +10% to +30% on the high side, depending on the technological, geographical and geological complexity of the project, appropriate reference information, and other risks (after inclusion of an appropriate contingency determination). The uncertainty varies by work type with moderate ranges applying to structures and plant commodities, wider ranges applying to earthworks and infrastructure and narrower ranges applying to equipment installation.

Alternate Estimate Names, Terms, Expressions, Synonyms:
Feasibility estimate (per NI 43-101), bankable feasibility estimate, final feasibility estimate, initial budget (or baseline) estimate, forced detail estimate, design basis memorandum (DBM).

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</table>

Table 2c – Class 3 Estimate

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CLASS 2 ESTIMATE	
Description: A Class 2 estimate is based upon a detailed mine design and production schedule using proven ore reserves and contains all of the input of a Class 3 estimate with regard to process information. Class 2 scope definitions will include all the information contained in Class 4 and Class 3 estimates as well as additional engineering information as the project proceeds into the execution phase such as detail project execution plan and schedules, accurate topographic maps, actual surveys of the plant site and foundation data, etc. **Degree of Project Definition Deliverables Required:** Key Deliverable and Target Status: All specifications and datasheets complete including for instrumentation. Mine design with production schedule (pre-stripping or ore body access likely underway). 30% to 75% of full project definition. **End Usage:** Class 2 estimates are typically prepared as the detailed contractor control baseline (and update to owner's control baseline) against which all actual costs and resources will now be monitored for variations to the budget, and form a part of the change management program.	**Estimating Methods Used:** Class 2 estimates generally involve a high degree of deterministic estimating methods. Class 2 estimates are prepared in great detail as needed to support bidding, project administration and change control. Most of the equipment will have been ordered or have firm quotes Mass earthwork and infrastructure such as transport pipelines and power transmission lines are based on take-off from definitive contours and routing. Some subcontracts for early works may be underway. For those areas of the project still undefined, an assumed level of detail takeoff (forced detail) may be developed to use as line items in the estimate rather than factored allowances. **Expected Accuracy Range:** Typical accuracy ranges for Class 2 estimates are -5% to -15% on the low side, and +5% to +20% on the high side, depending on the technological, geographical and geological complexity of the project, appropriate reference information, and other risks (after the inclusion of an appropriate contingency determination). Ranges could exceed those shown if there are unusual risks. **Alternate Estimate Names, Terms, Expressions, Synonyms:** Definitive cost estimate, project control estimate (PCE), revised baseline estimate, detailed control estimate, execution phase estimate, fall-out detail estimate.

Table 2d – Class 2 Estimate

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CLASS 1 ESTIMATE	
Description: Class 1 estimates are generally prepared for discrete parts or sections of the total project rather than for the entire project based on extensive design definition. Reserves will be proven with civil and pre-stripping work usually being underway. The detail estimate may be used by subcontractors for bidding or by owners for check estimates for various purposes. **Degree of Project Definition Deliverables Required:** Key Deliverable and Target Status: All deliverables in the maturity matrix complete. 65% to 100% of full project definition. **End Usage:** Class 1 estimates are used by contractors to support their bids or by owners as a check on bids received. The estimates may be used by both parties to support their contract negotiations, change control process, and/or to analyze and resolve claims and disputes.	**Estimating Methods Used:** Class 1 estimates generally involve the highest degree of deterministic estimating methods, and require a great amount of effort. Class 1 estimates are prepared in great detail, usually on a selected portion of the project scope. All items in the estimate are usually unit cost line items based on actual design quantities. **Expected Accuracy Range:** Typical accuracy ranges for Class 1 estimates are -3% to -10% on the low side, and +3% to +15% on the high side, depending on the technological, geographical and geological complexity of the project, appropriate reference information, and other risks (after inclusion of an appropriate contingency determination). Ranges could exceed those shown if there are unusual risks. **Alternate Estimate Names, Terms, Expressions, Synonyms:** Full detail estimate, tender check estimate, firm price, bottoms-up estimate, detailed engineering estimate, detailed control estimate, forced detail estimate, change order estimate.

Table 2e – Class 1 Estimate

ESTIMATE INPUT CHECKLIST AND MATURITY MATRIX

Table 3 maps the extent and maturity of estimate input information (deliverables) against the five estimate classification levels. This is a checklist of basic deliverables found in common practice in the mining industries. The maturity level is an approximation of the completion status of the deliverable. The completion status is indicated by the following letters.

- **None (Blank):** Development of the deliverable has not begun.
- **Started (S):** Work on the deliverable has begun. Development is typically limited to sketches, rough outlines, or similar levels of early completion.
- **Preliminary (P):** Work on the deliverable is advanced. Interim, cross-functional reviews have usually been conducted. Development may be near completion except for final reviews and approvals.
- **Complete (C):** The deliverable has been reviewed and approved as appropriate.

The terms for resource and reserve determination are from NI 43-101.

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	ESTIMATE CLASSIFICATION				
	CLASS 5	**CLASS 4**	**CLASS 3**	**CLASS 2**	**CLASS 1**
MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES	**0% to 2%**	**1% to 15%**	**10% to 40%**	**30% to 75%**	**65% to 100%**
General Project Data:					
Project Scope Description	General	Preliminary	Defined	Defined	Defined
Mine and Plant Production/Facility Capacity	Assumed	Preliminary	Defined	Defined	Defined
Plant Location	General	Approximate	Specific	Specific	Specific
Soils & Hydrology	None	Preliminary	Defined	Defined	Defined
Resource Determination	Inferred	Indicated	Measured	Measured	Measured
Reserve Determination	Assumed	Probable	Proven	Proven	Proven
Geology	General	Preliminary	Defined	Defined	Defined
Geotechnical and Rock Mechanics	General	Preliminary	Defined	Defined	Defined
Metallurgical Test Work	General	Preliminary	Defined	Defined	Defined
Integrated Project Plan	None	Preliminary	Defined	Defined	Defined
Project Master Schedule	Assumed	Preliminary	Defined	Defined	Defined
Mine Life Plan/Schedule	General	Preliminary	Preliminary	Defined	Defined
Initial Mine/Ore Access (Roads, Prestripping, Tunnels, Shafts, Water Management, Waste Management, etc.)	General	Preliminary	Defined	Defined	Defined
Mine Operations Layout (Pit Design, Dumps, Roads, Water Management, Waste Management, etc.)	General	Preliminary	Preliminary	Defined	Defined
Escalation Strategy	None	Preliminary	Defined	Defined	Defined
Work Breakdown Structure	None	Preliminary	Defined	Defined	Defined
Project Code of Accounts	None	Preliminary	Defined	Defined	Defined
Contracting Strategy	Assumed	Assumed	Preliminary	Defined	Defined
Mine (Production Equipment, Prestripping, etc.)	Assumed	Preliminary	Defined	Defined	Defined
Non-Process Facilities (Infrastructure, Ports, Pipeline, Power Transmission, etc.)	Assumed	Preliminary	Defined	Defined	Defined
Engineering Deliverables:					
Block Flow Diagrams	S/P	P/C	C	C	C
Plot Plans		S/P	P	C	C
Process Flow Diagrams (PFDs)		P	C	C	C
Utility Flow Diagrams (UFDs)		S/P	C	C	C

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Piping & Instrument Diagrams (P&IDs)		S/P	C	C	C
Heat & Material Balances		S/P	C	C	C
Process Equipment List		S/P	C	C	C
Utility Equipment List		S/P	C	C	C
Electrical One-Line Drawings		S/P	C	C	C
Specifications & Datasheets		S	P/C	C	C
General Equipment Arrangement Drawings		S	C	C	C
Spare Parts Listings			P	C	C
Mechanical Discipline Drawings			S/P	P/C	C
Electrical Discipline Drawings			S/P	P/C	C
Instrumentation/Control System Discipline Drawings			S/P	P/C	C
Civil/Structural/Architectural Discipline Drawings			S/P	P/C	C

Table 3 – Estimate Input Checklist and Maturity Matrix (Primary Classification Determinate)

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CONTRIBUTORS

Disclaimer: The opinions expressed by the contributors to this recommended practice are their own and do not necessarily reflect those of their employers, unless otherwise stated.

Allison Bull (Primary Contributor)
John K. Hollmann, PE CCE CEP (Primary Contributor)
Gord Zwaigenbaum, P.Eng. CCE (Primary Contributor)
Nelson Augusto Alvares da Silva
Jonathon Brown
Simon P. Hoadley
Roy K. Howes
Gordon Robert Lawrence
Bruce A. Martin
Luis Miralles
Martin R. Oros Bergeret
Geoffrey A. Wilkie, P.Eng.
John A. Wilson
Allen Wong

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