COST ESTIMATE CLASSIFICATION SYSTEM - AS APPLIED FOR THE PETROLEUM EXPLORATION AND PRODUCTION INDUSTRY
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COST ESTIMATE CLASSIFICATION SYSTEM – AS APPLIED FOR THE PETROLEUM EXPLORATION AND PRODUCTION INDUSTRY
TCM Framework: TCM Cost Estimating and Budgeting

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Purposes

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 (17R-97) [2] provides guidelines for applying the principles of estimate classification specifically to project estimates in the petroleum exploration and production industry. This addendum supplements the generic recommended practice by providing:

- A section that further defines classification concepts as they apply to the petroleum exploration and production industry.
- A section on the geopolitical nature and investment regulation of petroleum exploration and production projects that impact 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 petroleum exploration and production industry.

The overall purpose of this recommended practice is to provide the petroleum exploration and production industry a project 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 determinant; a risk analysis is required for that purpose.

This document is intended to provide a guideline, not a standard. 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 petroleum exploration and production industry 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 budget authorization, appropriation, or funding estimates. An intent of this RP is to help improve upon past performance.

Introduction

For the purposes of this addendum, the term “petroleum exploration and production industry” is assumed to include any firm encompassing “all the steps involved in finding, producing, processing, transporting, and marketing of oil and natural gas.” [1]
The projects are generally bigger, cost more and are in remote and challenging environments where risks and the cost variability are greater than in the manufacturing and processing industries.

This recommended practice is intended to cover petroleum exploration and production (E&P) projects covering drilling, completion, gathering systems, and processing to a marketable product, including all associated process and infrastructure facilities within the scope of the project. Infrastructure facilities may be especially significant. Offshore facilities, such as subsea systems, fixed platforms, and floating facilities, are covered by this RP. Early seismic and exploration studies may be expensed and excluded from this RP. All facilities downstream of the production facilities are also excluded.

This guideline reflects generally-accepted cost engineering practices. This RP was based upon the practices of national oil and gas companies (NOCs) and international oil and gas companies (IOCs) who are engaged in petroleum exploration and production (upstream) projects around the world, as well as published references and standards.

**GEOPOLITICAL NATURE AND REGULATION OF PETROLEUM E&P INDUSTRIES**

The geopolitical nature and significant risks in the petroleum E&P project industries increase the public profile and influence the capital cost estimating process, including the interpretation of estimate classifications. Examples of regulatory bodies which are applicable to the petroleum E&P industries include:

- National departments of energy.
- Society of Professional Engineers.
- Society of Petroleum Evaluation Engineers.
- World Petroleum Council.
- United States Securities and Exchange Commission (SEC).
- American Petroleum Institute.
- American Society of Mechanical Engineers.
- Environmental protection agencies.
- Maritime and coast guard agencies.

In estimating the capital costs for petroleum E&P projects consideration must be given to the political and regulatory environment. The political and regulatory environment includes relations with developing nations, which may impose additional regulations and taxes on the investment; or in the worst case, may expropriate the investment.

Geopolitical circumstances for petroleum E&P projects may directly or indirectly impact the interpretation of the status and quality of project definition deliverables and hence estimate classifications. Examples of status considerations include:

- Petroleum E&P projects are often in remote locations and have unique logistical and environmental issues.
- Resources are often seen as national legacies with attendant political, legal and socio-economic considerations.
- Improved petroleum prices and/or extraction technologies may lead to reacquisition of leases that have unforeseen environmental legacies and regulatory implications.
- Feasibility studies may tend to focus on technical issues and less on business and project delivery issues associated with the political and/or regulatory environment (e.g., execution strategy and planning deliverables).
Drilling and completion risks can change as the drilling program progresses, especially involving multi-year
drilling programs.
- Site specific factors, such as lease boundaries and expirations, can affect development plans.
- The industry historically has been characterized by the interplay of significant swings in supply and
demand.

**COST ESTIMATE CLASSIFICATION MATRIX FOR THE PETROLEUM EXPLORATION AND PRODUCTION INDUSTRIES**

A purpose of cost estimate classification is to align the estimating process with project stage-gate scope
development and decision making processes. Upstream scope development and decision making must be aligned
with petroleum resources definitions, classification, and categorization. Industry guidelines for that purpose are
defined in the *Guidelines for Application of the Petroleum Resources Management System (PRMS)* by the Society of
Petroleum Engineers (SPE). These guidelines are complex and must be read directly to get a full understanding,
but the following discussion summarizes the ties between petroleum resources and estimate classification.

Per the SPE, the PRMS is a project-based system, where a project: “Represents the link between the petroleum
accumulation and the decision-making process, including budget allocation...In general, an individual project will
represent a specific maturity level at which a decision is made on whether or not to proceed”. The PRMS guidelines
explain in detail the unique portfolio nature of resource development (upstream) projects and the need to
evaluate the complex integration and phasing of resources and development alternatives.

The PRMS has two distinct dimensions: “(1) the development project...and, in particular, the chance of
commerciality of that project; and (2) the range of uncertainty in the petroleum quantities that are forecast to be
produced and sold in the future from that development project.” The PRMS addresses commerciality with
discounted cash flow/net present value methods incorporating the capital expenditure, the operating expenditure,
and forecasted sales of petroleum quantities.

Table 1 provides a summary of the characteristics of the five estimate classes. The maturity level of project
definition is the sole determining (i.e., primary) characteristic of Class. In Table 1, the maturity is roughly indicated
by a percentage 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 general RP. The post sanction classes (Class 1 and 2) are only indirectly covered
where new funding is indicated. Again, the characteristics are typical and may vary depending on the
circumstances.
## Table 1 – Cost Estimate Classification Matrix for Petroleum Exploration and Production Industries

<table>
<thead>
<tr>
<th>ESTIMATE CLASS</th>
<th>MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES</th>
<th>END USAGE</th>
<th>METHODOLOGY</th>
<th>EXPECTED ACCURACY RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 5</td>
<td>0% to 2% Conceptual planning</td>
<td>Capacity factored, parametric models, judgment, or analogy</td>
<td>L: -20% to -50%</td>
<td>H: +30% to +100%</td>
</tr>
<tr>
<td>Class 4</td>
<td>1% to 15% Screening options</td>
<td>Equipment factored or parametric models</td>
<td>L: -15% to -30%</td>
<td>H: +20% to +50%</td>
</tr>
<tr>
<td>Class 3</td>
<td>10% to 40% Funding authorization</td>
<td>Semi-detailed unit costs with assembly level line item</td>
<td>L: -10% to -20%</td>
<td>H: +10% to +30%</td>
</tr>
<tr>
<td>Class 2</td>
<td>30% to 75% Project control</td>
<td>Detailed unit cost with forced detailed take-off</td>
<td>L: -5% to -15%</td>
<td>H: +5% to +20%</td>
</tr>
<tr>
<td>Class 1</td>
<td>65% to 100% Fixed price bid check estimate</td>
<td>Detailed unit cost with detailed take-off</td>
<td>L: -3% to -10%</td>
<td>H: +3% to +15%</td>
</tr>
</tbody>
</table>

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 [(3) typically at a 50% level of confidence] for given scope.

This matrix and guideline outline an estimate classification system that is specific to petroleum E&P industries. Refer to the generic estimate classification RP [2], 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 petroleum E&P 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. It should be noted that the average quality and accessibility of reservoirs in production are declining, and processing complexity is increasing; therefore, the high end of the expected accuracy range may be higher than is currently stated in this RP.

In addition to the degree of project definition covered in Table 1, 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.
- Estimating techniques employed.
- Time and level of effort budgeted to prepare the estimate.
- The accuracy of the geotechnical data.
Unique/remote nature of project locations and the lack of reference data for these locations.
- Geo-political, environmental, and other regulatory circumstances.
- Socio-economic conditions.

Systemic risks are often the primary driver of accuracy; however, project-specific risks (e.g., risk events) also drive the accuracy range. Systemic risks may have a significant impact on estimate accuracy.

Petroleum E&P projects are very sensitive to volatility in oil and gas pricing as well as geopolitical issues. Early geological studies may be highly speculative and entail a lot of uncertainty as to the commercial viability of a new E&P project. Conversely, a project may have a history of feasibility studies from current and previous owners that can be readily revived to meet securities disclosure rules when the technology and oil and gas prices improve sufficiently to spark interest among investors. Accordingly, estimate classifications provide targets for minimum level of project definition. 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 indicate the 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 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. 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.