

Contingency in Capital Cost Estimation

How much of a contingency factor should be included in a capital cost estimate?

Contingency is a key component of all cost estimates, from the conceptualization of a technology or project to its final implementation. Among project managers, financial managers and project owners, the connotations of contingencies may differ, depending on the potential impacts to a capital project and the resources needed to address them. Proper contingency assessment is required for capital projects to achieve their technical and business objectives.

Contingency is defined as an amount added to a cost estimate for an established project scope to account for items, conditions and/or requirements that experience has shown will likely result in additional project costs.


What does contingency usually include? Conceptual or early-stage capital cost estimates are initiated prior to the expenditure of resources on process development and detailed engineering. As a project moves through successive stages of development, its scope is defined with more and more detail, and project elements that are not depicted on the conceptual-stage process flow diagrams are identified. The requirements for the project's implementation are identified and then detailed in an evolutionary way.

What should not be covered by contingency? Contingencies are not intended to account for major changes that do not add detail to the project scope, such as changes in overall process flows and unit operations, capacities, end product specifications, facility sizes, major demolition work, start-up expenses, accelerated construction schedules, cost escalation, currency effects, and extraordinary events such as major strikes, terrorism and natural disasters.

What's the difference between scope definition and major scope changes? Scope definition refines the process flow-sheets by adding detail to the already-identified unit operations with attractive economic returns, such as material recycle, energy and utilities conservation, process instrumentation and controls, and buildings and infrastructure requirements. In contrast, previously unidentified unit operations are considered major scope changes, and are not included in the contingency for the defined project scope and corresponding cost estimate.

How should extraordinary events be anticipated? Such events are uncertain and the probability that one will affect a single project is low. But across a portfolio of projects, there is a real probability that one or more might occur. Such "unique" events can be addressed through risk analysis, and are best managed separately from capital project cost estimates by a corporate finance function. Often specified as an owner management reserve or an event risk contingency, these reserves or insurances are not expected to be spent unless these events actually occur.

What aspects of cost estimating are accounted for in a project contingency? Implicit in the preparation of progres-



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sive cost estimates is that the cost-estimating detail corresponds to the stage of technology or project development. Technology and project development is typically managed through two to five stages, depending on the business market, implementation timeframe and organizational structure of the owner. In the process industries, project development may include up to five stages: conceptual, feasibility, front-end engineering, definitive and contractor's estimates.

In brief, a conceptual or order-of-magnitude estimate ($\pm 50\%$ accuracy) requires a process flowsheet and cursory definition of major items of equipment, whereas a definitive estimate ($\pm 10\%$ accuracy) requires the final detailed-engineering packages, including construction schedule, material take-offs, labor sourcing, and site-specific tie-in requirements. (The optimal resource utilization for the technology development, information requirements, and cost estimating technique for each stage is beyond the scope of this article.) If a project has a substantial contingency remaining upon its completion, either the level of engineering exceeded that required for the stage of development or an excessive contingency was assigned.

How should contingencies be assigned? Techniques ranging from straightforward to very sophisticated are used to assign contingency in different sectors of the construction industry. All of these methods have limitations.

Experience in the development and execution of relevant technology and construction projects enables the most realistic contingency assessments. The technology or project type is another consideration — for example, a fast-track biotechnology product requires a higher estimating contingency than an expansion of a well-established hydrocarbon steam reformer.

Contingencies are assigned as a percentage of the base estimate; the summation of the base estimate and contingency comprise the total fixed capital cost estimate. The table summarizes estimation accuracies and contingency assignments for the process industries.

Assignment of a project contingency for capital cost estimates should be approached in a rational and informed manner, from the conceptualization of a technology to its final implementation. Clarification and communication of the characteristics of cost estimating contingency is useful for project engineering, management and corporate finance.

Cost estimates for the process industries.

Classification	Accuracy*	Contingency†
Conceptual Estimate	$\pm 50\%$	30%–50%
Feasibility Estimate	$\pm 30\%$	20%–30%
Front-End Engineering	$\pm 20\%$	15%–25%
Definitive Estimate	$\pm 10\%$	8%–15%
Contractor's Estimate	$\pm 5\%$	5%–10%

* Estimate confidence level of two standard deviations.

† Percentage of base cost estimate for project.