Principles of Schedule Contingency Management

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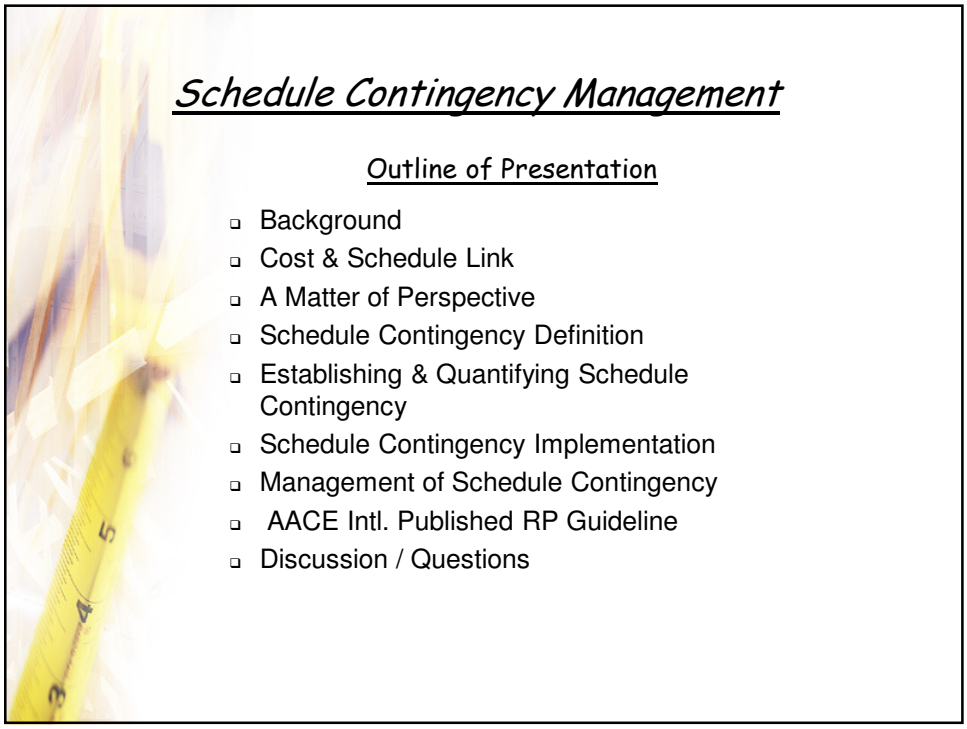


Schedule Contingency Management

Outline of Presentation

- Background
- Cost & Schedule Link
- A Matter of Perspective
- Schedule Contingency Definition
- Establishing & Quantifying Schedule Contingency
- Schedule Contingency Implementation
- Management of Schedule Contingency
- AACE Intl. Published RP Guideline
- Discussion / Questions

Schedule Contingency (New) Definition

Schedule contingency is defined as an amount of time included in (added to) the project or program schedule to mitigate (dampen/ buffer) the effects of risks or uncertainties identified or associated with specific elements of the project schedule.

Related Definitions

Terms often used interchangeably for schedule contingency.

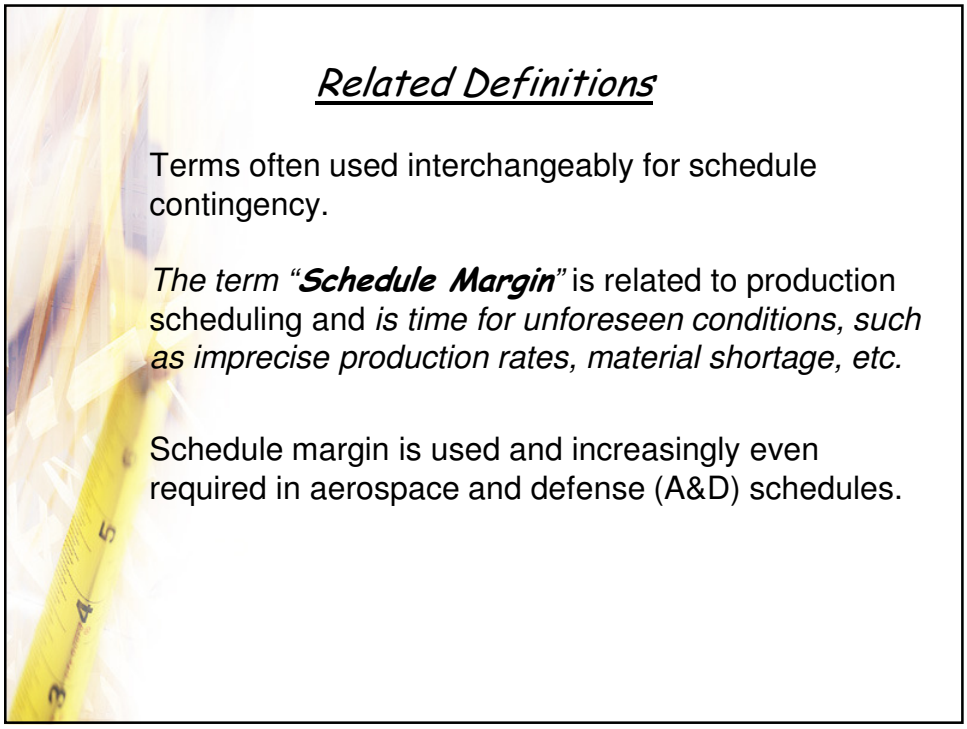
*The term "**Schedule Buffer**" originated in Critical Chain Theory (CCPM) and has been* used interchangeably *by practitioners* to mean schedule contingency.

Related Definitions

Terms often used interchangeably for schedule contingency.

*The term "**Schedule Margin**"* is related to production scheduling and *is time for unforeseen conditions, such as imprecise production rates, material shortage, etc.*

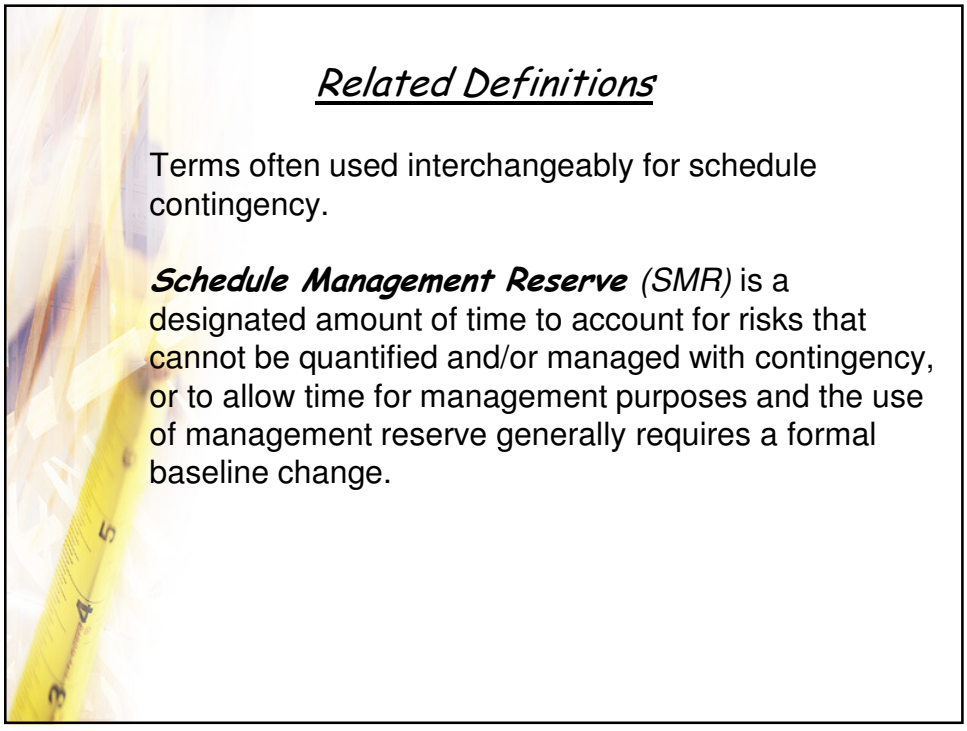
Schedule margin is used and increasingly even required in aerospace and defense (A&D) schedules.



Related Definitions

Terms often used interchangeably for schedule contingency.

Schedule Management Reserve *(SMR)* is a designated amount of time to account for risks that cannot be quantified and/or managed with contingency, or to allow time for management purposes and the use of management reserve generally requires a formal baseline change.



Cost & Schedule Contingency Link

Cost Contingency is “an amount added to an estimate to allow for items, conditions or events for which the occurrence is uncertain and that experience shows will likely result in additional costs.”

Reference: AACEI RP 10S-90

Cost & Schedule Contingency Link

Cost contingency is intended to cover:

- Incomplete designs
- Construction disturbances (accidents or breakdowns)
- Changes in market conditions
- Regulatory risk
- Estimating inaccuracies
- Technological changes
- Omissions
- Abnormal construction and start-up problems
- Unforeseen safety requirements
- Unanticipated price changes

Cost & Schedule Contingency Link

Schedule contingency should cover:

- Incomplete designs
- Construction disturbances (accidents or breakdowns)
- Changes in market conditions
- Regulatory risk
- Technological complexities
- Unidentified testing and start-up problems
- Unforeseen regulatory and safety requirements
- Unusual Schedule Risks including:
  - Unavailable Labor, Materials, Equipment
  - Uncertainties in Contractor Stability
  - Unavailable Facilities

Cost & Schedule Contingency Link

Schedule contingency shares many attributes with cost contingency.

Both are typically established using statistical analysis or judgment based on past asset or project experience.

Both cost and schedule estimates are by definition uncertain and there is general agreement that the uncertainty should be explicitly addressed in project planning.

Cost contingency by definition is “expected to be expended” while schedule contingency may also serve a risk mitigation role (i.e., time buffering).

~ Reference: AACEI RP 70R-12

Cost & Schedule Contingency Link

Contingency usually excludes major scope changes such as changes in end product specification, capacities, facility sizes and/ or the location of the asset or project.

Contingency time for construction rework is not normally included in construction schedules.

Contingency also excludes extraordinary events such as major strikes and natural disasters.

~ Reference: AACEI RP 70R-12

Cost & Schedule Contingency Link

As a rule of thumb, when there are contingency "costs" added to the project estimate, there most likely is an element of "time" contingency.

Conversely, most project risks that affect schedule durations also affect costs.

Contingency estimating methods that "link risk drivers and cost/schedule outcomes" are described in AACEI Recommended Practice No. 40R-08, *Contingency Estimating – General Principles*.

Refer to AACE's RPs on risk analysis and contingency estimating for additional guidance.

~ Reference: AACEI RP 40R-08

Schedule Contingency Risk Analysis

The following should be considered by the project planners during the schedule risk analysis:

- Overall duration of project (assumed or developed)
- Durations of major work packages (assumed or developed)
- Physical size, density (congestion) of features to be installed;
- Project staffing allowed (i.e. space limitations)
- Types of labor and equipment resources
- Project funding or Cash flow requirements
- Long lead time & specialty items
- Unique (R&D) or first time technology applications
- Subcontracts and purchase orders (types and quantities)
- Known (or anticipated) Areas of Risk

A Matter of Perspective

Errors and Omissions:

An engineering or design error may be considered a "scope change" to the construction contractor which would not be addressed with contingency.

But to the owner, unless the basic premise of the project changes (i.e., capacity, size, location, etc.) very little is a scope change because the owner's contingency must address all risks, including errors and omissions.

The owner and the contractor have different project perspectives

A Matter of Perspective

Because contingency is viewed differently by the various stakeholders (e.g. owner/ architects & engineers/ contractor & subcontractors) it is often difficult to adopt one perspective regarding the establishment, use, management, and reporting of schedule contingency.

Schedule contingency usually cannot be managed successfully from only one project participant's perspective.

Schedule contingency should be developed from a total project perspective and needs to be managed from the top (project owner) down.

A Matter of Perspective

Project contract (terms and conditions) will determine whether or not schedule contingency can be jointly established and managed in the project schedule. Schedule contingency should be managed consistent with the project specifications.

Scheduling specifications require modification to include the definitions and guidelines for the management and use of schedule contingency.

Successful use of contingency/buffers requires a significant investment of time at the beginning of the project to educate the project participants to understand the contingency management process.

Contingency – Why Not in the Activities

Schedule Contingency will not be included in the individual project work activities as "duration padding" but rather should be established as a separate "buffer" activity for the associated tasks.

- If not visible then it cannot be managed
- Activities are likely to experience lower production rates
- Critical path may change during project execution

Schedule Contingency Characteristics

Schedule Contingency Characteristics:

- IS NOT FLOAT
- IS NOT LAG/LEAD
- IS NOT a Non-work period in the calendar
- IS a Schedule ACTIVITY

When treated as project float or Lag/ Lead, Schedule Contingency is not visible and can not be managed.

Schedule Contingency Attributes

Generally accepted attributes of schedule contingency:

- Schedule contingency must be visible in the schedule.
- Schedule contingency is time only and does not contain scope, resources or costs.
- Schedule contingency is only established based upon an analysis of schedule risk.
- Schedule contingency is not float (i.e. neither project float nor total float).

Schedule Contingency Attributes

Additional accepted attributes of schedule contingency:

- Schedule contingency is not lag/lead (relationship durations).
- Schedule contingency is not hidden artificial lengthening of schedule activities.
- Schedule contingency is not the improper use of what some term as “preferential logic”.
- Schedule contingency is not a non-work period in the software calendar.
- Schedule contingency is not management reserve.

Establishing Schedule Contingency

- Schedule contingency may be established by either the owner or the contractor (or both) and is only established based upon a schedule risk analysis.
- The actual placement and duration of the schedule contingency (or buffer) will be determined by, and based upon, the completion of a project schedule risk analysis.
- The project may include more than one schedule contingency (or buffer) element linked to key performance milestones or to the completion of a specific group of related tasks where unforeseen events could put the project schedule performance at risk.

Schedule Contingency Implementation

- More than one schedule contingency buffer element may be included in the project schedule.
- The buffer may be related to a key schedule performance target (goal, objective or milestone) or to the completion of a specific group of similar tasks that could otherwise put subsequent elements of the project schedule performance at risk.
- The actual placement and duration of the schedule contingency (or buffer) will be determined by and based upon the completion of a schedule risk analysis for the project.

Schedule Contingency Logic Techniques

Incomplete Design:

If the project design is incomplete for key areas of the project, but does not want to wait for that final detailed design resolution which could be on going during the early stages of construction, the owner may be willing to add a schedule contingency to the project that is shared by both the owner and the contractor.

The schedule could include time contingencies for these incomplete design items. The contractor would advise the owner of the required design completion dates to support the construction schedule.

However if the design is changed after the contractor's work has started or completed, this becomes a potential change order situation.

Schedule Contingency Logic Techniques

Key Equipment Delay:

Schedule contingency might be included when the owner is responsible to supply major components or key equipment (not included in the contractor's scope) and contingency time might be added to account for possible delivery delay.

Schedule Contingency Logic Techniques

Key Milestones:

The project schedule may include more than one schedule contingency activity (or buffer element) linked to key performance milestones.

An accepted technique is to link buffer activities as predecessors to project intermediate milestones earlier than the final completion milestone; this provides opportunities to mitigate the impact of risks to key milestone activities along the project critical path.

For example, the failure to accomplish "building enclosure" in a timely manner could delay the performance of interior work required to complete the project on time. An earlier target milestone could be added as a contingency ahead of the later "required" performance date.

Completion of these early target milestone releases unused time for future planned activities.

Schedule Contingency Logic Techniques

Features of Work:

The project schedule may include more than one schedule contingency activity (or buffer element) linked to the completion of a specific group of related work tasks where events could put subsequent project schedule performance at risk. This technique is to add an activity at the end of a group of similar classes or categories of tasks.

For example, in a multi-story building project, an activity named "paint - buffer" is added after the last trade group activity i.e. "paint - top floor", so that any overall duration deviation in this feature (group) can be absorbed in the schedule network.

- The use of the schedule contingency for a group of similar activities should be evaluated at the completion of that feature of work and all unused time would be zeroed out.
- Another acceptable technique is to place all of that contingency time in a single activity at the end of the project schedule where it would expect to be expended or used.

Quantifying Schedule Contingency

Some of the factors that need to be considered when quantifying time contingency:

- Project physical size, (congestion) density of features to be installed.
- Labor productivity for the various features of work such as: civil & site earthwork, concrete, structural steel, buildings, installed machinery & equipment, piping, electrical, instrumentation, painting, insulation and scaffolding.
- Design percent complete and level of detail developed.

Quantifying Schedule Contingency

Several methods that have been used to quantify schedule contingency including; prior project history; expert judgment; guidelines or statistical methods.

- What if there is no prior experience or project history?
- Used some statistical method or expert judgment
- Subjective based on a “gut feel” for the risk
- While reviewing the baseline schedule the user took out the "safety" margins from the individual tasks and then added a "safety" task on the critical or longest path.
  - caution this can artificially force a sequence of tasks onto the critical path.
- Assumed a “rule of thumb” guideline
  - For example, “adding a 10 day cushion for every year of project duration.”

A “rule of thumb” method requires agreement by the project stake holders.

Quantifying Schedule Contingency

Schedule contingency can be quantified by using various software methods of risk modeling and analysis.

Monte Carlo type simulations and analysis of CPM schedule models can be performed with a variety of software products.

AACE Recommended Practices provide guidelines and special considerations for performing Monte Carlo type analysis on CPM schedule models:

- RP 57R-09, *Integrated Cost and Schedule Risk Analysis Using Monte Carlo Simulation of a CPM Model*
- RP 64R-11, *CPM Schedule Risk Modeling and Analysis: Special Considerations*

Additional AACE RPs have been published that provide guidance related to Schedule Risk Analysis.

Management of Schedule Contingency

A basic principle of risk management is that schedule contingency should be managed using the risk and change management processes.

Schedule contingency management must be integrated with other schedule management procedures and processes.

Schedule contingency management is a project management function and should not be left to the scheduler to “tinker” with activity durations or logic.

Schedule contingency is "drawn down" during the execution phase using a defined procedure. To that end, contingency must be an identifiable element of the schedule (i.e. an activity or activities) that can be reassessed periodically and explicitly managed.

Management of Schedule Contingency

The practice for assessing and managing the contingency activities is sometimes called the contingency drawdown method.

The *TCM Framework* specifies that if a risk event or circumstance (or the response to it) requires more time than allocated for an affected activity(s), then some duration can be "drawn down" from the appropriate buffer, as approved and documented.

Contingency change management requires a disciplined, well documented and controlled process.

References: AACE *TCM Framework* (Chapter 10.3)
"*Developing the Project Controls Plan*" ~ RP 60R-10
"*Documenting the Schedule Basis*" ~ RP 38R-06

Management of Schedule Contingency

Schedule contingency should be reassessed periodically.

The schedule reassessment should evaluate the adequacy of contingency for the remaining project work by using the risk management process in conjunction with the overall project forecasting.

The risk management process evaluates and quantifies the impact of any risk factors inherent to the scope and plans (as affected by changes) as well as any risk events that may potentially occur.

Schedule Contingency Generally Accepted

Generally accepted attributes of schedule contingency:

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Schedule Contingency Management

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The Project Team should plan to use Schedule Contingency!