Purpose

The purpose of this document is to provide guidance on the practice of **Project Estimating** and to describe the practice overview, requirements, best practices, activities, and key terms related to this requirement. In addition, templates relevant to this practice are provided at the end of this guide.

Practice Overview

Establishing realistic estimates for project schedules, budgets, resources, etc. is one of the most challenging aspects of planning a project. Project managers are constantly challenged to provide timely, accurate, and updated project estimates. Often these estimates are for work that project manager's may have little experience or familiarity with or to achieve a project goal that has never been accomplished before. The practice of project estimating answers key questions, such as those below, that may impact how estimating will be performed for the project:

- What is the work to be estimated?
- How will the estimate be determined?
- When will the work be accomplished?
- Who will do the work?
- Do interdependencies exist between tasks and/or other projects that may impact estimates?

Project estimating is an activity that occurs throughout the life of a project. In the early stages of a project's life cycle, such as the concept stage, less information is known about the required work to complete the project. These early estimates often have little time invested in determining the estimate and are often "ball-park" estimates. Early estimates are often rough and may eventually have a variance greater than +/- 100%, or more, from the actual effort required to complete the work.

As the project progresses more information regarding details of the project and type of work becomes available. More detailed information often changes any initial perceptions of expected work effort. As a result, initial project estimates should be reevaluated repeatedly throughout the project's life. Revised estimates become more accurate as greater detail becomes know about the work to be accomplished. If necessary, updates to the project schedule and other project documentation should be made to reflect major changes in estimates. These changes should then be communicated to project stakeholders and, if dramatic enough, may require a change request against the project.

Delivering results within estimated time, cost, and quality parameters is critical to project success. In the effort to obtain reasonably accurate estimates the importance of clearly specified, detailed, requirements cannot be overstated. This is one of the most important factors in obtaining an accurate estimate. Another important factor to achieving estimating success is to understand the project team's capability to deliver quality work within the environment that they will be working in. These are just some of the factors that influence how estimates will be determined.

As more detail is learned about the expected project work, it becomes easier to more accurately estimate the effort required to complete the work. One of the more ideal ways of estimating is to estimate how long a task will take based on experience implementing similar tasks in the past. Using this method, estimates are based on actual results from similar tasks of previous projects. However, projects are often unique and work performed to successfully complete one project may not necessarily apply to other projects. Thus, in the absence of experience a project manager may utilize any number of different estimating techniques, some of which include:

- **Top-Down Estimating** – This technique often estimates large, high-level, chunks of work, often at the feature or function level. Often performed in the early stages of a project before detailed information about the project work is known. This estimate technique provides more of a "ball-park" estimate and is used only to provide an early perspective into the amount of potential

project work. Later, as work is decomposed into smaller, more manageable, pieces different estimating techniques are used and estimates often vary drastically from the initial top-down estimate.

- **Bottom-Up Estimating** – This technique often estimates detailed pieces of work and those estimates are then aggregated into a total estimate for the entire project.
- **Analogous Estimating** – This technique uses expert judgment and historical information of similar activities as the basis for estimating future schedule activity.
- **Parametric Estimating** – This technique uses independent variables to help estimate expected project work. These independent variables may be feature definitions, design or specification documents, or any other variables that describes the scope or type of project work.

  Three-Point Estimating – This technique uses a mathematical formula to determine a weighted average of three types of estimates and uses the formula (*Estimate=[Optimistic+[4*Most Likely]+Pessimistic]/6*) to calculate a weighted average estimate. This method is also referred to as the Program Evaluation and Review Technique (PERT)
  1. *Optimistic* – An estimate that is based on the best-case scenario for work completion
  2. *Most likely* – An estimate that, given the resources available to do the work, is the most realistically expected
  3. *Pessimistic* – An estimate that is based on the worst-case scenario for work completion
- **What-If Analysis** – This technique is used to evaluate the effects of changing selected factors within the project schedule, resources, scope, quality, etc. to determine what effects those changes may have on the outcome of the project.

Input into estimates often comes from the persons(s) most familiar with the type of work needing to be estimated. The practice of estimating uses information inputs from scheduled activities, project scope, resource requirements, calendars, etc. to compile as accurate an estimate as possible with the information available at the time of the estimate.

Estimating techniques always involve assumptions and guesses. Thus, it is important not to rely on solely one source for any particular estimate. It is good practice to obtain estimates from multiple sources and if possible utilizing different estimating techniques.

For example, at the beginning of a project less detail is known about the work to be done and estimates are usually for larger chunks of work. Thus, the top-down estimating technique is often the most appropriate at this stage of the project's life. This technique in combination with analogous and/or parametric estimating may be used to define high-level estimates and schedules for inclusion into the business case and/or project charter. What-if analysis my also be incorporated in this early estimating process to provide a high-level idea of how alternates may affect budgets, schedules, resources, etc.

As the project progresses more information becomes available also allowing for more detailed estimates. As the project progresses a bottom-up estimate combination with the three point estimating technique based on analogous and/or parametric inputs may be more appropriate. A more detailed what-if analysis may also be incorporated to provide an idea of how alternatives affect project variables.

Using the three-point estimating technique a project manager might obtain three different estimates from three different individuals who might work on a particular scheduled activity and then average the three to determine the estimate to be used in the schedule. This might look like this:

Estimator	Best Case	Most Likely	Worst Case	PERT Estimate
Individual 1	100hrs	150hrs	300hrs	167hrs
Individual 2	95hrs	135hrs	250hrs	148hrs
Individual 3	115hrs	160hrs	325hrs	180hrs
			Average Estimate =	165hrs

Another method of obtaining estimates is to conduct an estimation workshop. An estimation workshop allows the project manager to gather those individuals involved in the estimation process in one location where estimates can be agreed upon quickly with input from all project/functional areas. This also allows cross-communication regarding activities that may span multiple business units, departments, and/or teams. The goal of an estimation workshop should be to:

- Estimate work effort for each schedule activity
- Assign each activity estimate a level of risk (high, medium or low)
- Document any estimate constraints or assumptions
- Document any dependencies on external project activities
- Document any newly identified risks

Ideally, the estimation workshop would involve the individuals who will be performing the project work. However, if these individuals are not available, the functional team leaders and/or knowledge experts often participate in their place. For larger projects it may be necessary to conduct multiple workshops to estimate all of the project's work.

Regardless of which estimating techniques are used, one major hurdle to overcome is often the fear of being incorrect. It might be necessary to emphasize to the estimating team that this fear is natural and to be conscious of not paralyzing project progress resulting from over-analyzing estimates. Any estimate is better than no estimate at all. It is however important to be as accurate as possible by utilizing the information available in conjunction with expert judgment and agreed upon estimating techniques. It's also just as important to continue moving the project forward towards completion.

Best Practices

The following best practices are recommended for the practice of **Project Estimating**:

- **Expectations** – Set expectations regarding estimates based on the information available to make those estimates. At the beginning of a project when information is less available estimates are often less accurate. Later as more information becomes available estimates become more accurate.
- **Multiple Estimates** – For the best possible estimate, use multiple estimating techniques and different sources for each estimate.
- **History** – Maintaining and analyzing the historical accuracy of estimates may help make future estimates more accurate.
- **Review** – Do a sanity check on the estimates. Have others review them as well.
- **Document** – Document all assumptions and estimating techniques.

Practice Activities

For projects the following practice activities are appropriate:

- Define the planned work by decomposing WBS work packages into schedule activities
- Sequence schedule activities in the order which they will be performed
- Identify resources to completed the work
- Agree upon a common unit of measure for estimating (hours, days, dollars, etc.)
- Estimate the level of effort required to complete the work utilizing the available resources
- Develop a project schedule. Ensure that adjustments are made to the sequence of activities that accounts for resource availability
- Control the schedule by identifying and monitoring and influencing factors that cause schedule change

Practice Attributes

This section provides a list of practice attributes to help project teams determine when and how applying **Estimating** impacts a project.

PROJECT ESTIMATING

Practice Owner	CDC UP Project Office – NCPHI
Criteria	All projects regardless of type or size should have some mechanism in place for estimating project work, duration, schedule, resources, etc.
Estimated Level of Effort	Moderate
Prerequisites	Completed WBS
Practice Dependencies	WBS
Practice Timing in Project Life Cycle	High-level estimates are often done early in the project life cycle with updates, refinements, and detailed estimated made throughout the project's life, as necessary.
Templates/Tools	Estimating Practices Guide, Project Estimating Template, Estimating Checklist
Additional Information	N/A

Key Terms

Follow the link below to for definitions of project management terms and acronyms used in this document.
http://www2.cdc.gov/cdcup/library/other/help.htm

Related Templates/Tools

Below is a list of template(s) related to this practice. Follow the link below to download the document(s).
http://www2.cdc.gov/cdcup/library/matrix/default.htm

- Project Estimating Practices Guide
- Project Estimating Template
- Project Estimating Checklist