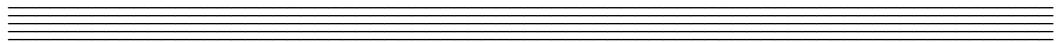


Special Report

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**A Manager's Checklist
for Validating
Software Cost and Schedule Estimates**



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Review and Approval

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FOR THE COMMANDER

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A Manager's Checklist for Validating Software Cost and Schedule Estimates

Abstract. This report provides a checklist of questions to ask and evidence to look for when assessing the credibility of a software cost and schedule estimate. The checklist can be used either to review individual estimates or to motivate and guide organizations toward improving their software estimating processes and practices.

1 Introduction

When you—or your boss or customer—receive a cost or schedule estimate for a software project, what do you look for to determine your willingness to rely on that estimate?

This report provides a checklist to help you address and evaluate a number of issues that are key to estimates we can trust. The checklist guides you through the seven questions in this table:

Seven Questions to Ask When Assessing Your Willingness to Rely On a Cost and Schedule Estimate

- | |
|---|
| <ol style="list-style-type: none">1. Are the objectives of the estimate clear and correct?2. Has the task been appropriately sized?3. Are the estimated cost and schedule consistent with demonstrated accomplishments on other projects?4. Have the factors that affect the estimate been identified and explained?5. Have steps been taken to ensure the integrity of the estimating process?6. Is the organization's historical evidence capable of supporting a reliable estimate?7. Has the situation changed since the estimate was prepared? |
|---|

Each question is illustrated with elements of evidence that, if present, support the credibility of the estimate. The answers you receive should help you judge the extent to which you can safely use the estimate for planning, tracking, or decision making. The checklist can be used also to motivate and guide organizations toward improving their software estimating processes and practices.

2 The Validation Checklist

We present the checklist for validating software cost and schedule estimates on the pages that follow. You may make, use, or distribute as many copies as you wish, so long as you reproduce the entire checklist, including the copyright notice.

The purpose of the checklist is not to impose criteria, but to arm you with questions to ask when deciding whether or not to rely on a particular estimate. Only you can determine which questions to ask and whether or not the answers you get provide sufficient evidence to satisfy your requirements for using the estimate.

Although we prepared this checklist to help you evaluate estimates for *software* costs and schedules, almost everything in it applies equally to hardware and systems engineering projects. If you have responsibilities for developing hardware or integrated systems, you may find that altering the word 'software' wherever it appears will make the checklist applicable to estimates for these systems as well.

The checklist in this report was produced as part of the SEI's Software Cost Estimating Improvement Initiative [Park 94]. Please let us know if you find it helpful, or if you have suggestions for improving its usefulness for your organization. For related checklists that can help you evaluate the processes used for making software estimates, please see the SEI report *Checklists and Criteria for Evaluating the Cost and Schedule Estimating Capabilities of Software Organizations* [Park 95].

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- [Park 92] Park, Robert E., et al. *Software Size Measurement: A Framework for Counting Source Statements* (CMU/SEI-92-TR-20, ADA258304). Pittsburgh, Pa: Software Engineering Institute, Carnegie Mellon University, September 1992.
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- [Park 95] Park, Robert E. *Checklists and Criteria for Evaluating the Cost and Schedule Estimating Capabilities of Software Organizations* (CMU/SEI-95-SR-05). Pittsburgh, Pa: Software Engineering Institute, Carnegie Mellon University, January 1995.

Checklist for Validating Software Cost and Schedule Estimates

This checklist is designed to help managers assess the credibility of software cost and schedule estimates. It identifies seven issues to address and questions to ask when determining your willingness to accept and use a software estimate. Each question is associated with elements of evidence that, if present, support the credibility of the estimate.

Issue 1. Are the objectives of the estimate clear and correct?

Evidence of Credibility

- The objectives of the estimate are stated in writing.
- The life cycle to which the estimate applies is clearly defined.
- The tasks and activities included in (and excluded from) the estimate are clearly identified.
- The tasks and activities included in the estimate are consistent with the objectives of the estimate.

Issue 2. Has the task been appropriately sized?

Evidence of Credibility

- A structured process has been used to estimate and describe the size of the software product.
- A structured process has been used to estimate and describe the extent of reuse.
- The processes for estimating size and reuse are documented.
- The descriptions of size and reuse identify what is included in (and excluded from) the size and reuse measures used.
- The measures of reuse distinguish between code that will be modified and code that will be integrated as-is into the system.
- The definitions, measures, and rules used to describe size and reuse are consistent with the requirements (and calibrations) of the models used to estimate cost and schedule.

The size estimate was checked by relating it to measured sizes of other software products or components.

The size estimating *process* was checked by testing its predictive capabilities against measured sizes of completed products.

Issue 3. Are the estimated cost and schedule consistent with demonstrated accomplishments on other projects?

Evidence of Credibility

The organization has a structured process for relating estimates to actual costs and schedules of completed work.

- The process is documented.
- The process was followed.

The cost and schedule models that were used have been calibrated to relevant historical data.

(Models of some sort are needed to provide consistent rules for extrapolating from previous experience.)

The cost and schedule models quantify demonstrated organizational performance in ways that normalize for differences among software products and projects.

(So that a simple, unnormalized, lines-of-code per staff-month extrapolation is *not* the basis for the estimate.)

The consistency achieved when fitting the cost and schedule models to historical data has been measured and reported.

The values used for cost and schedule model parameters appear valid when compared to values that fit the models well to past projects.

The calibration of cost and schedule models was done with the same versions of the models that were used to prepare the estimate.

The methods used to account for reuse recognize that reuse is not free.
(The estimate accounts for activities such as interface design, modification, integration, testing, and documentation that are associated with effective reuse.)

Extrapolations from past projects account for differences in application technology.

(For example, data from projects that implemented traditional mainframe applications require adjustments if used as a basis for estimating client-server implementation. Some cost models provide capabilities for this, others do not.)

Extrapolations from past projects account for observed, long-term trends in software technology improvement.

(Although some cost models attempt this internally, the best methods are usually based on extrapolating measured trends in calibrated organizational performance.)

Extrapolations from past projects account for the effects of introducing new software technology or processes.

(Introducing a new technology or process can initially reduce an organization's productivity.)

Work-flow schematics have been used to evaluate how this project is similar to (and how it differs from) projects used to characterize the organization's past performance.

Issue 4. Have the factors that affect the estimate been identified and explained?

Evidence of Credibility

A written summary of parameter values and their rationales accompanies the estimate.

Assumptions have been identified and explained.

A structured process such as a template or format has been used to ensure that key factors have not been overlooked.

Uncertainties in parameter values have been identified and quantified.

A risk analysis has been performed, and risks that affect cost or schedule have been identified and documented.

(Elements addressed include issues such as probability of occurrence, effects on parameter values, cost impacts, schedule impacts, and interactions with other organizations.)

Issue 5. Have steps been taken to ensure the integrity of the estimating process?

Evidence of Credibility

Management reviewed and agreed to the values for all descriptive parameters *before* costs were estimated.

Adjustments to parameter values to meet a desired cost or schedule have been documented.

If a dictated schedule has been imposed, the estimate is accompanied by an estimate of

- The normal schedule.

- The additional expenditures required to meet the dictated schedule.

Adjustments to parameter values to meet a desired cost or schedule are accompanied by management action that makes the values realistic.

More than one cost model or estimating approach has been used, and the differences in results have been analyzed and explained.

People from related but different projects or disciplines were involved in preparing the estimate.

At least one member of the estimating team is an experienced estimator, trained in the cost models that were used.

Estimators independent of the performing organization concur with the reasonableness of the parameter values and estimating methodology.

The groups that will be doing the work accept the estimate as an achievable target.

Memorandums of agreement have been completed and signed with the other organizations whose contributions affect cost or schedule.

Issue 6. Is the organization's historical evidence capable of supporting a reliable estimate?

Evidence of Credibility

The estimating organization has a method for organizing and retaining information on completed projects (a historical database).

The database contains a useful set of completed projects.

Elements included in (and excluded from) the effort, cost, schedule, size, and reuse measures in the database are clearly identified.

(See, for example, the SEI checklists for defining effort, schedule, and size measures.)

Schedule milestones (start and finish dates) are described in terms of criteria for initiation or completion, so that work accomplished between milestones is clearly bounded.

Records for completed projects indicate whether or not unpaid overtime was used.

Unpaid overtime, if used, has been quantified, so that recorded data provide a valid basis for estimating future effort.

Cost models that were used for estimating have been used also to provide consistent frameworks for recording historical data.

(This helps ensure that comparable terms and parameters are used across all projects, and that recorded data are suitable for use in the estimating models.)

The data in the historical database have been examined to identify inconsistencies, and anomalies have been corrected or explained.

(This is best done with the same cost models that are used for estimating.)

The organization has a structured process for capturing effort and cost data from ongoing projects.

The producing organization holds postmortems at the completion of its projects.

- To ensure that recorded data are valid.
- To ensure that events that affected costs or schedules get recorded and described while they are still fresh in people's minds.

Information on completed projects includes

- The life-cycle model used, together with the portion covered by the recorded cost and schedule.

Actual (measured) size, cost, and schedule.

The actual staffing profile.

An estimate at completion, together with the values for cost model parameters that map the estimate to the actual cost and schedule.

- A work breakdown structure or alternative description of the tasks included in the recorded cost.

A work-flow schematic that illustrates the software process used.

- Nonlabor costs.

Management costs.

- A summary or list of significant deliverables (software and documentation) produced by the project.
- A summary of any unusual issues that affected cost or schedule.

Evolution in the organization's work-flow schematics shows steady improvement in the understanding and measurement of its software processes.

Issue 7. Has the situation changed since the estimate was prepared?

Evidence of Credibility

The estimate has not been invalidated by recent events, changing requirements, or management action (or inaction).

The estimate is being used as the basis for assigning resources, deploying schedules, and making commitments.

The estimate is the current baseline for project tracking and oversight.

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