Five Questions a Project Manager Should Ask About Every Estimate

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Introduction

Every day, project managers make decisions based on estimates. Since each decision can determine whether a project succeeds or fails, accurate estimates are critical. Projects launched without a rigorous initial estimate are five times more probable of experiencing delays and cancellations. Even projects with sound initial estimates are doomed to overrun cost and schedule budgets if they are not guided by rules of thumb and rigorous estimates-to-complete. Therefore, project managers must be armed with simple metrics and rigorous estimating models to be successful. Simple or complex, there are five questions project managers should ask about every estimate as they define and manage their projects.

This paper stresses the value of accurate estimating, the project management discipline developing estimating rules-of-thumb and the application of those metrics to aid successful decision-making.

Project Managers must be Accurate Estimators

The key to successful project completion is an accurate estimate and a realistic risk assessment. Capers Jones, in a study of two hundred and fifty complex, software-intensive projects identified only twenty-five as successful in achieving their initial cost, schedule and performance objectives. Jones defines a failed project as one that is six months over schedule and fifteen percent over its cost estimate (p.5). Cost estimating was revealed as one of the six best practices utilized by the successful projects.

How to be an Accurate Estimator

Successful project managers make daily use of three powerful tools to become accurate estimators: simple rules-of-thumb, rigorous predictive mathematical models, and the project management triangle. They create an accurate estimating discipline in their organizations by asking five consistent questions to support their personal estimating competence and to set a baseline for every estimate.

Rules of Thumb

A rule of thumb is a principle with broad application that is not intended to be strictly accurate or reliable for every situation. It is an easily learned and easily applied procedure for approximately calculating or recalling some value, or for making some determination (“Rule of Thumb”). It is a simple model.

An example is the “Tailor Rule of Thumb”, a simple approximation that was used by tailors to determine the wrist, neck, and waist circumferences of a person through one single measurement

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of the circumference of that person's thumb. The rule states that twice the circumference of a person's thumb is the circumference of their wrist, twice the circumference of the wrist is the circumference of the neck, and twice around the neck is the person's waist. For example, if the circumference of the thumb is four inches, then the wrist circumference is eight inches, the neck is sixteen and the waist is thirty-two. An interesting consequence of this is that this simple method can be used to determine if trousers will fit: the trousers are wrapped around the neck, and if the two ends barely touch, then they will fit. Any overlap or lack thereof corresponds to the trousers being too loose or tight, respectively ("Rule of Thumb").

Some project management rules of thumb are cost per source line of code (SLOC) for software projects and cost per pound for development and manufacturing projects.

Mathematical Models

A mathematical model is an abstract model that uses mathematical language to describe a system. Mathematical models are used particularly in the natural sciences and engineering disciplines (such as physics, biology, and electrical engineering) but also in the social sciences (such as economics, sociology and political science); physicists, engineers, computer scientists, and economists use mathematical models most extensively. Mathematical models can take many forms, including but not limited to dynamical systems, statistical models, or differential equations ("Mathematical Models").

Cost and schedule models to aid project management were first developed in the early 1950's after World War II efforts demonstrated the value of operations research to assist military affairs (Hillier and Lieberman, p. 5-6). Today, many project organizations develop models that reflect their practices and productivity. This can be time consuming and the resulting models do not benefit from external industry benchmarks – the practices and productivity of other organizations. Commercially available project management models have estimating relationships derived from the performance of thousands of projects and their application is guided by databases of industry benchmarks. One such model is TruePlanning by PRICE Systems, L.L.C.

The Project Management Triangle

The Project Management Triangle establishes a general framework from which to develop estimating rules of thumb and rigorous models.

Projects are planned and managed within scope, time, and cost constraints. These constraints are referred to as the Project Management Triangle. Each side represents a constraint (Exhibit 1). One side of the triangle cannot be changed without impacting the others. The time constraint refers to the amount of time available to complete a project. The cost constraint refers to the budgeted amount available for the project. The scope constraint refers to what must be done to produce the project's end result. These three constraints are often competing constraints: increased scope typically means increased time and increased cost, a tight time constraint could mean increased costs and reduced scope, and a tight budget could mean increased time and reduced scope ("Project Management").

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The discipline of project management is about providing the tools and techniques that enable the project team to organize their work to meet these constraints.

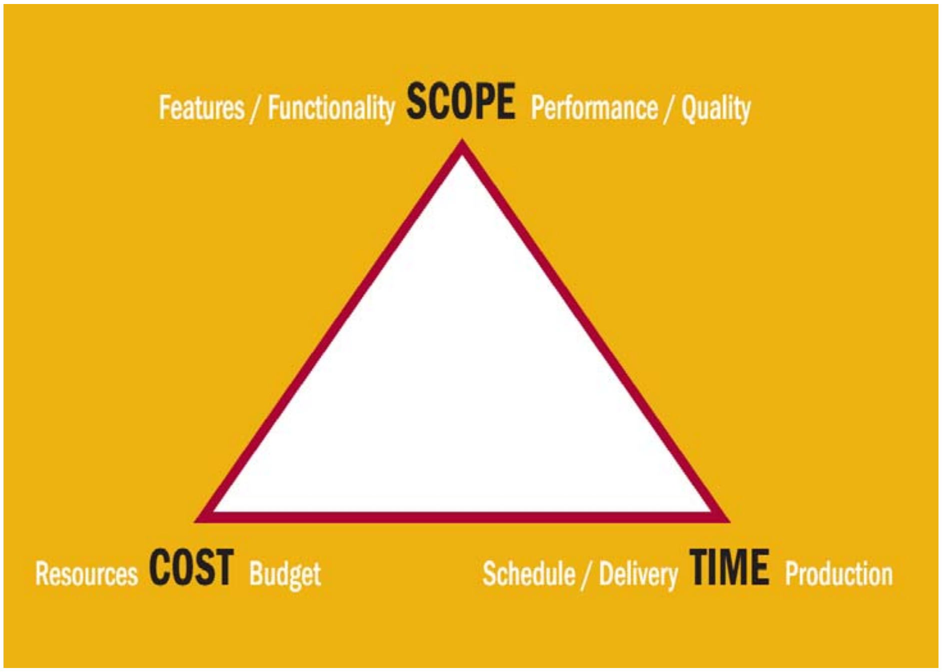

Exhibit 1: The Project Management Triangle

Decision Support Models

Every day, project managers make decisions based on estimates of the dynamics of the project management triangle. Since each decision can determine whether a project succeeds or fails, accurate estimates are critical. Projects launched without a rigorous initial estimate are five times more probable of experiencing delays and cancellations. Even projects with sound initial estimates are doomed to cost overrun if they are not guided by informed decisions within the constraints of the triangle. Rigorous mathematical models are extremely effective decision support tools, but project managers often do not have the time to apply these models to make critical decisions. Therefore, project managers must be armed with both simple and rigorous estimating models to be successful.

A simple model of the Project Management Triangle is below:

Cost = Scope × Productivity (Cost/Scope)

Time = Cost ÷ Availability (Cost/Time Unit)

Scope = Cost ÷ Productivity

where Productivity is a Cost/Scope metric, and
Availability is a Cost/Time-Unit metric.

An example of using this simple model for a software development effort is below:

TtlHours = TtlSLOC ×(Hours/SLOC)
TtlMonths = TtlHours ÷(Hours/Month)
SLOC = TtlHour ÷ (Hours/SLOC)
so, if
SLOC = 10,000; and
Productivity = .09 Hours per SLOC; and
Availability = 468 Hours per Month;
then
Cost = TtlHours = 900; and
Time = TtlMonths = 1.92

This simple model combined with a measured productivity benchmark and known availability is a decision support rule of thumb for software development projects. Rules of thumb are simple models based on averages, while rigorous models take into account several other reality factors. Reality factors help you normalize data to determine better rules of thumb. Some common reality factors are resource and schedule constraints, and operating environment.

Uncertainty and Risk

Models typically determine point estimates, or the most likely estimate of scope, cost, and time. The information used to determine the estimates is uncertain, resulting in risky estimates. There are several robust risk evaluation techniques such as probability distributions and Monte Carlo simulations. These techniques are suitable for thorough evaluations, but there is not always time for thoroughness. A common simple risk assessment method is to estimate the best and worst cases along with the most likely and perform a weighting like that below to determine a more accurate risk-adjusted estimate.

$$\frac{(\text{BestCase} + (4 \times \text{MostLikely}) + \text{WorstCase})}{6}$$

Obtaining Decision Support Models

The first step in constructing decision support models is to establish metrics for scope, productivity, and reality factors. Some common metrics are below:

Scope metrics
- Hardware – Weight, Objects, Parts
- Software – SLOC, FPs, OPs, Use Cases

Productivity metrics
- Hardware – Cost/Weight, Cost/Object
- Software – Hours/SLOC

Reality Factor metrics

Hardware – Complexity, features, quantities, delivery rate, schedule compression, learning rate
Software – language, application, complexity, memory utilization
General – design reuse, engineering maturity, operating environment, quality

Once the metrics are determined, data can be collected from external and internal sources and analyzed to determine both simple and rigorous models (Exhibit 2). If you do not want to start from scratch, there are commercially available models supported by extensive metric databases that make the job easier. Also, these models have methods for determining uncertainty and quantifying risk.

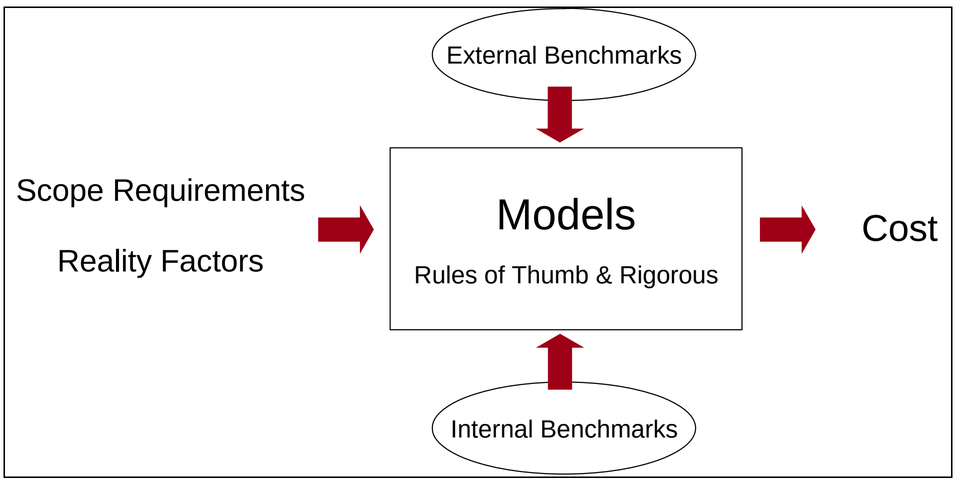

Exhibit 2: Project managers should develop models from internal and external benchmarks

The Five Questions a Project Manager Should Ask About Every Estimate

To establish an accurate estimating discipline and to continue metrics collection that refine the models, project managers should ask five questions about every estimate. What are the five questions? Well, they should be the metrics needed to run the models and evaluate the accuracy of the estimate.

The five questions most commonly asked are:

1. What is the measure of scope?
2. What is the productivity?
3. What is the resource availability assumption?
4. What are the most significant reality factors making this different than the norm?
5. What is the uncertainty of the parameters and the risk in the estimate?

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The answers to the questions should allow the project managers to establish a base of reference using their rules of thumb and rigorous models.

For example, what if an estimate of $300,000 is presented to a project manager for a software development project. The project manager asks five questions and quickly calculates a baseline estimate of $450,000 and a risk-adjusted estimate of $500,000. The project manager can now challenge variances from the modeled base of reference to identify possible estimating errors and to establish estimating credibility and confidence. Asking the five questions about completed projects supports model refinement and builds confidence. Over time, the project manager becomes an accurate estimator, comfortable with simple and rigorous models. Publishing the models and the five questions allow others in the organization to know that the models will be the baseline from which all estimates are judged. Soon all estimates are presented with an explanation of variances from the modeled baseline. This new estimating discipline breeds accuracy and project success.

Summary

Every day, project managers make decisions based on estimates. Estimating accuracy is critical to project success. Project managers can become accurate estimators and establish an estimating discipline in their organizations by asking five questions about every estimate and leveraging the answers through simple and complex estimating models.

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