

Lecture 2:

Estimating Project Times and Costs

Dr. Eng.
Abdullah Jameel Halawany



جامعة الجميع الذكية
EVERYONE'S SMART UNIVERSITY

PMG 605

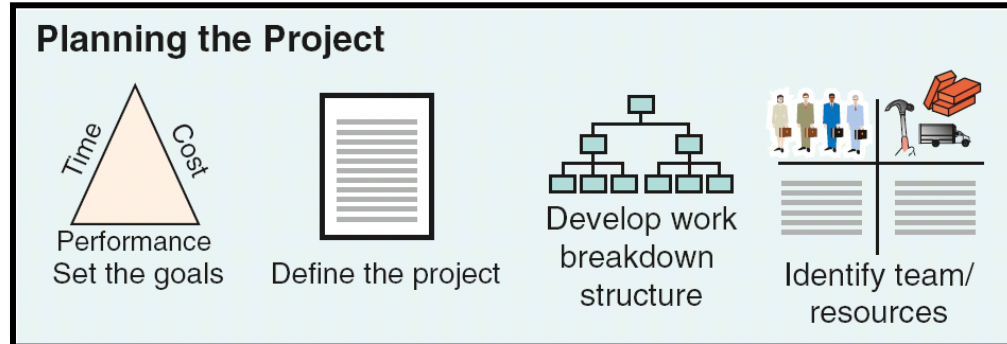
**Project Resources and
Time Management**

Session Outline

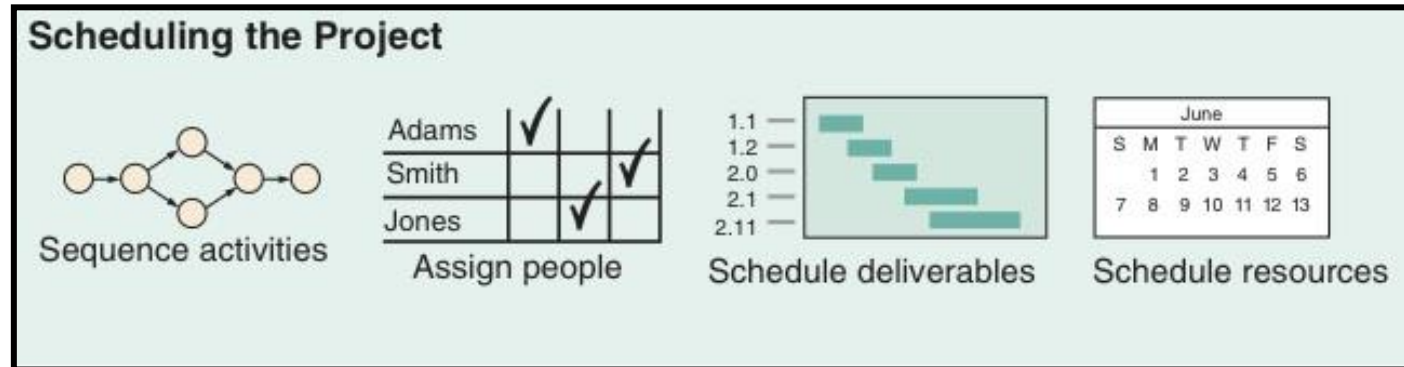
Estimating Project Times and Costs

- Why?
- Factors Influencing the Quality of Estimates
- Estimating Guidelines
- Estimating Processes
 - Top-down
 - Bottom-up
- Estimating Project: Preferred Approach
- Level of Detail
- Refining Estimates
- Creating a Database for Estimating
- Summary

Project Planning, Scheduling, and Controlling

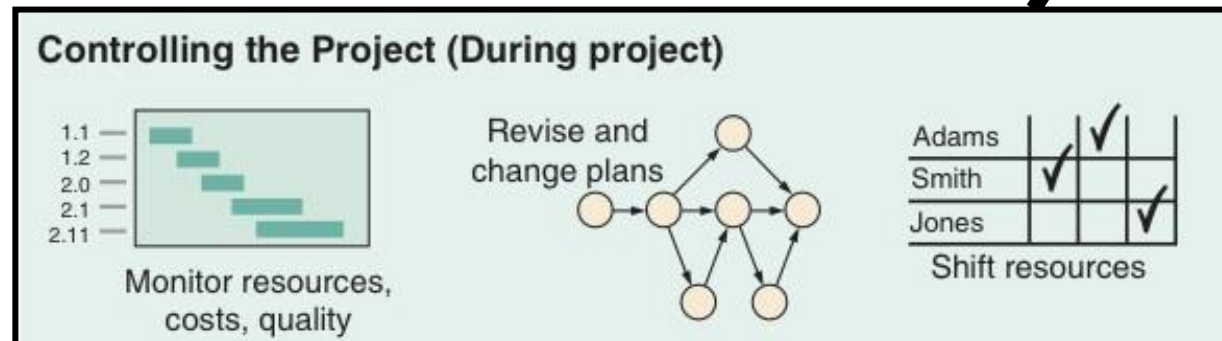


Time/cost estimates
Budgets
Engineering diagrams
Cash flow charts
Material availability details



Budgets
Delayed activities report
Slack activities report

CPM/PERT
Gantt charts
Milestone charts
Cash flow schedules



Resource of Investments

We need at least tow of them to have a business. So, we need to estimate them before start for planning purposes.

Manpower

(people – labors, mangers, etc.)

Machinery

(equipment)

Material

(include Money and Time)

Why Estimating Project Times and Costs are Important?



To support good decisions.



To schedule work.



To determine how long the project should take and its cost.



To determine whether the project is worth doing.



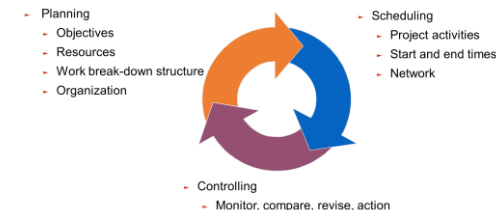
To develop cash flow needs.



To determine how well the project is progressing.



To develop time-phased budgets and establish the project baseline.



Estimating Costs Money!

- Project stakeholders prefer accurate cost and time estimates.
- They also understand the inherent **uncertainty** in all projects.
- *Inaccurate estimates* lead to false expectations and *consumer dissatisfaction*.
- Accuracy is improved with greater effort, but is it worth the time and cost?
- Project estimating becomes a trade-off, balancing the benefits of better accuracy against the costs for securing increased accuracy.

Factors Influencing the Quality of Estimates

A typical statement in the field is the desire to

“have a 95 percent probability of meeting time and cost estimates.”

- Experience is a good starting point for developing time and cost estimates.
- Experience estimates must almost always be *refined by other considerations* to reach the 95 percent probability level.
- Factors related to the uniqueness of the project will have a strong influence on the accuracy of estimates.

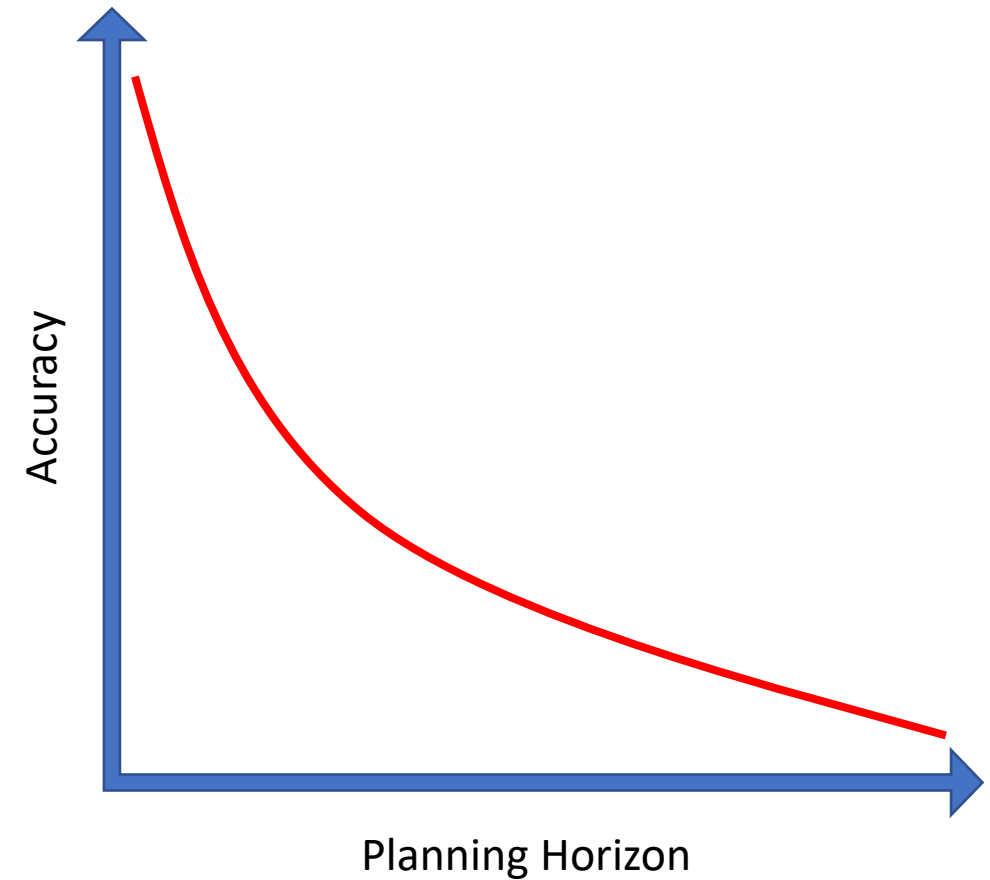
Factors Influencing the Quality of Estimates



Factors Influencing the Quality of Estimates

1. Planning Horizon

The quality of the estimate depends on the planning horizon; estimates of current events are close to 100 percent accurate but are reduced for more distant events. The accuracy of time and cost estimates should improve as you move from the conceptual phase to the point where individual work packages are defined.



Factors Influencing the Quality of Estimates

2. Project Duration

Time to implement new technology has a habit of expanding in an increasing, nonlinear fashion. Sometimes poorly written scope specifications for new technology result in errors in estimating times and costs. Long-duration projects increase the uncertainty in estimates.

Factors Influencing the Quality of Estimates

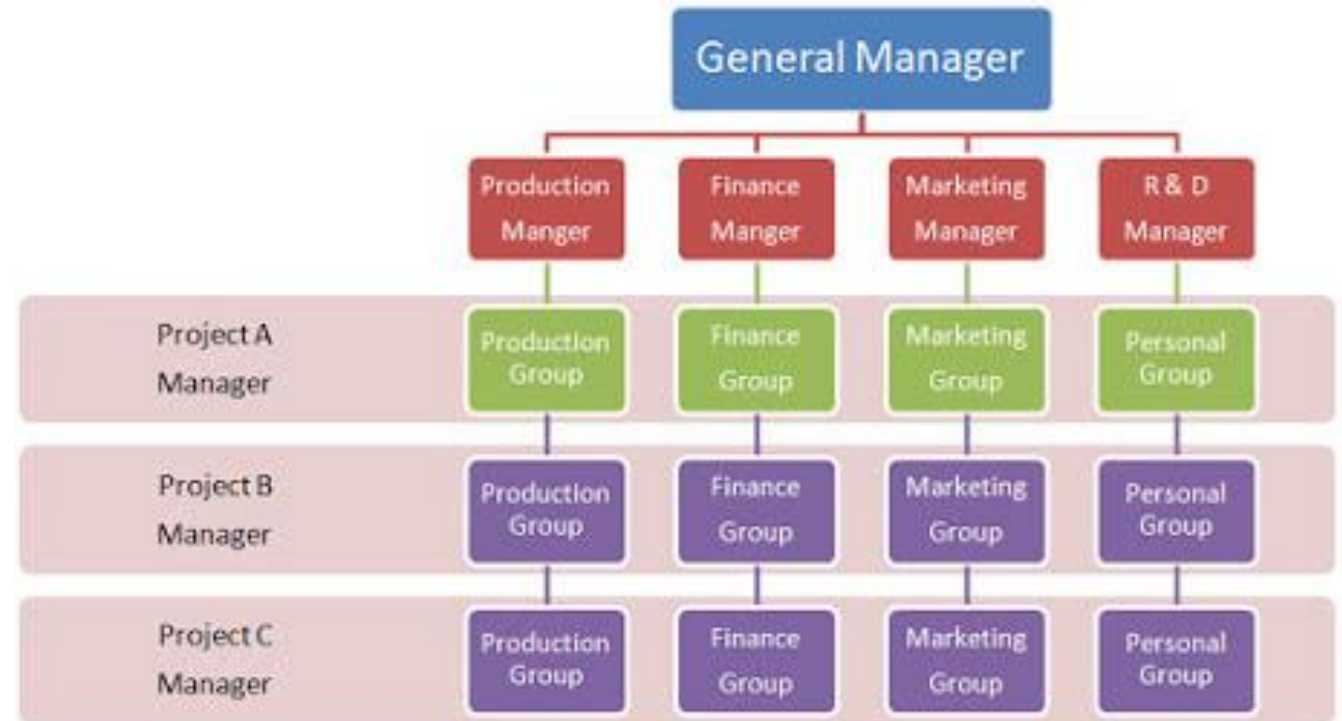
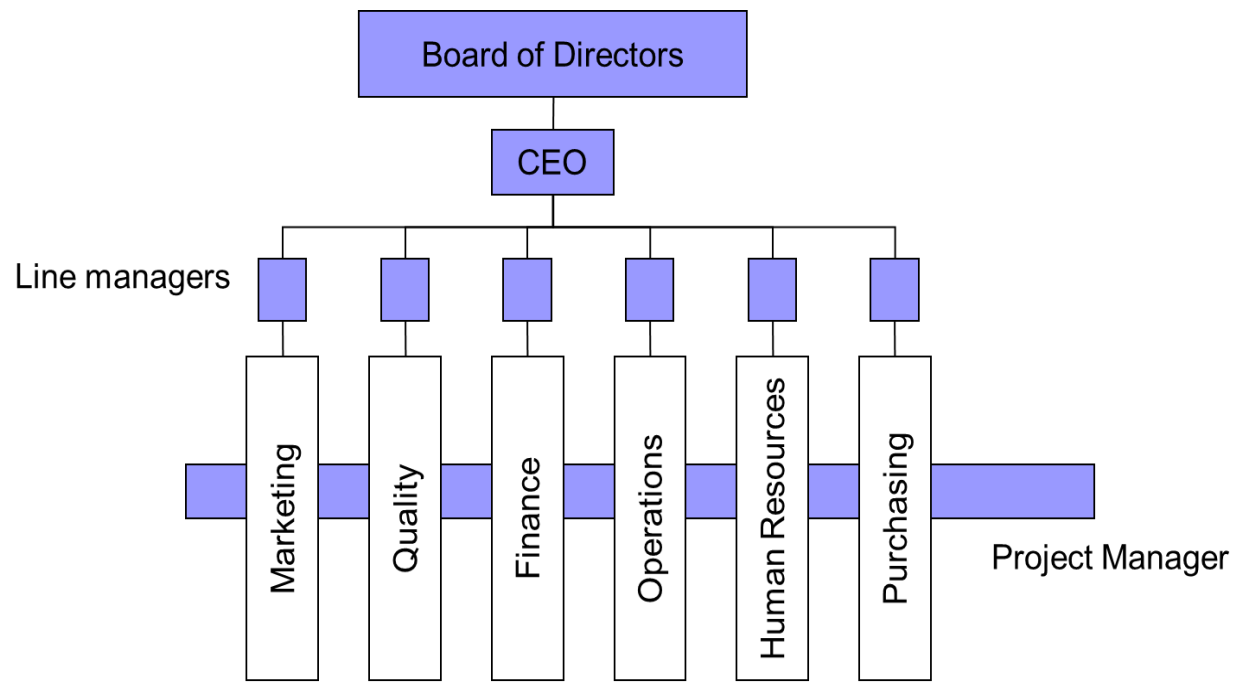
3. People

The people factor can also introduce errors in estimating times and cost. For example, accuracy of estimates depends on the skills of the people making the estimates. A close match of people skills to the task will influence productivity and learning time. Similarly, whether members of the project team have worked together before on similar projects will influence the time it takes to coalesce into an effective team. Sometimes factors such as staff turnover can influence estimates. It should be noted that adding new people to a project increases time spent communicating.

Factors Influencing the Quality of Estimates

4. Project Structure and Organization

Which project structure is chosen to manage the project will influence time and cost estimates. One of the major advantages of a dedicated project team discussed earlier is the speed gained from concentrated focus and localized project decisions. This speed comes at an additional cost of tying up personnel full time. Conversely, projects operating in a matrix environment may reduce costs by more efficiently sharing personnel across projects but may take longer to complete since attention is divided and coordination demands are higher.



Factors Influencing the Quality of Estimates

5. Padding Estimates

In some cases, people are inclined to pad estimates. For example, if you are asked how long it takes you to drive to the airport, you might give an average time of 30 minutes, assuming a 50/50 chance of getting there in 30 minutes. If you are asked the fastest you could possibly get there, you might reduce the driving time to 20 minutes. Finally, if you are asked how long the drive would take if you absolutely had to be there to meet with the president, it is likely you would increase the estimate to say 50 minutes to ensure not being late.

Factors Influencing the Quality of Estimates

6. Organization Culture

Organization culture can significantly influence project estimates. In some organizations padding estimates is tolerated and even privately encouraged. Other organizations place a premium on accuracy and strongly discourage estimating gamesmanship. Organizations vary in the importance they attach to estimates. The prevailing belief in some organizations is that detailed estimating takes too much time and is not worth the effort or that it's impossible to predict the future. Other organizations subscribe to the belief that accurate estimates are the bedrock of effective project management. Organization culture shapes every dimension of project management; estimating is not immune to this influence.

Factors Influencing the Quality of Estimates

7. Other Factors

Finally, nonproject factors can impact time and cost estimates. For example, equipment down-time can alter time estimates. National holidays, vacations, and legal limits can influence project estimates. Project priority can influence resource assignment and impact time and cost.

Estimating Guidelines for Times, Costs, and Resources



Responsibility
have people
familiar with
the tasks
make the
estimate



Use several
people to
make
estimates



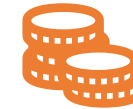
Base
estimates on
normal
conditions,
efficient
methods, and
a normal level
of resources



Use
consistent
time units in
estimating
task times



Treat each
task as
independent,
don't
aggregate.



Don't make
allowances for
contingencies



Adding a risk
assessment
helps avoid
surprises to
stakeholders

Estimating Guidelines for Times, Costs, and Resources

1. Responsibility.

At the work package level, estimates should be made by the person(s) most familiar with the task. Draw on their expertise! Except for super technical tasks, those responsible for getting the job done on schedule and within budget are usually first-line supervisors or technicians who are experienced and familiar with the type of work involved. These people will not have some preconceived, imposed duration for a deliverable in mind. A secondary benefit of using those responsible is the hope they will “buy in” to seeing that the estimate materializes when they implement the work package.

Estimating Guidelines for Times, Costs, and Resources

2. Use Several People to Estimate.

It is well known that a cost or time estimate usually has a better chance of being reasonable and realistic when several people with relevant experience and/or knowledge of the task are used. True, people bring different biases based on their experience. But discussion of the individual differences in their estimate leads to consensus and tends to eliminate extreme estimate errors. This approach is similar to the Delphi estimating method, which can also be used.

Estimating Guidelines for Times, Costs, and Resources

3. Normal Conditions.

When task time, cost, and resource estimates are determined, they are based on certain assumptions. Estimates should be based on normal conditions, efficient methods, and a normal level of resources. Normal conditions are sometimes difficult to discern, but it is necessary to have a consensus in the organization as to what normal conditions mean in this project.

Estimating Guidelines for Times, Costs, and Resources

4. Time Units.

Specific time units to use should be selected early in the development phase of the project network. All task time estimates need consistent time units. Estimates of time must consider whether normal time is represented by calendar days, workdays, workweeks, person days, single shift, hours, minutes, etc. In practice the use of workdays is the dominant choice for expressing task duration. However, in projects such as a heart transplant operation, minutes probably would be more appropriate as a time unit.

Estimating Guidelines for Times, Costs, and Resources

5. Independence.

Estimators should treat each task as independent of other tasks that might be integrated by the WBS. Use of first-line managers usually results in considering tasks independently; this is good. Top managers are prone to aggregate many tasks into one time estimate and then deductively make the individual task time estimates add to the total.

Estimating Guidelines for Times, Costs, and Resources

6. Contingencies.

Work package estimates should not include allowances for contingencies. The estimate should assume normal or average conditions even though every work package will not materialize as planned. For this reason, top management needs to create an extra fund for contingencies that can be used to cover unforeseen events.

Estimating Guidelines for Times, Costs, and Resources

7. Adding risk assessment to the estimate helps to avoid surprises to stakeholders.

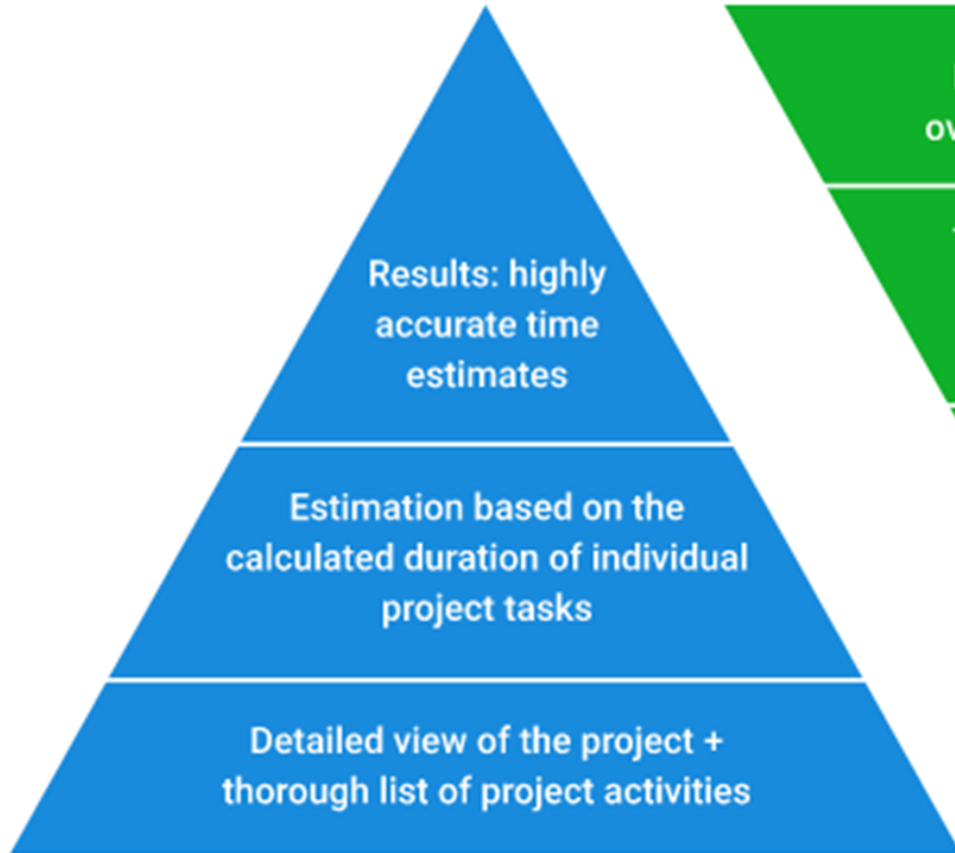
It is obvious some tasks carry more time and cost risks than others. For example, a new technology usually carries more time and cost risks than a proven process. Simply identifying the degree of risk lets stakeholders consider alternative methods and alter process decisions. A simple breakdown by optimistic, most likely, and pessimistic for task time could provide valuable information regarding time and cost.

As A Project Manager May Hear Statements Such As

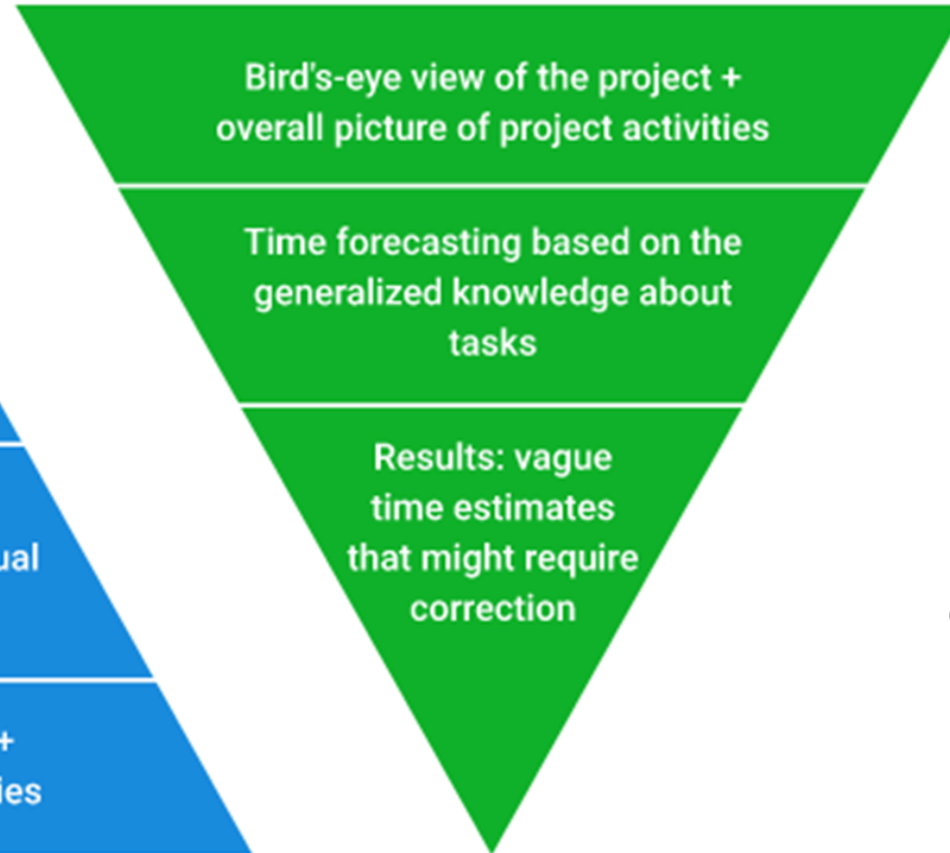
- **Rough order of magnitude is good enough.** Spending time on detailed estimating wastes money.
- **Time is everything;** our survival depends on getting there first! Time and cost accuracy is not an issue.
- **The project is internal.** We don't need to worry about cost.
- **The project is so small.** We don't need to bother with estimates. Just do it.
- **We were burned once.** I want a detailed estimate of every task by the people responsible.

NEVER
Skip
Estimating

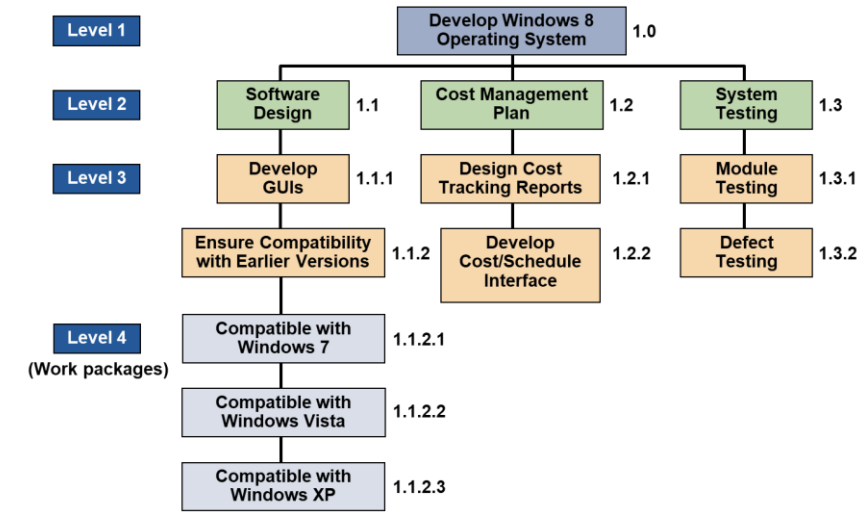
Estimating Processes



BOTTOM-UP ESTIMATION



TOP-DOWN ESTIMATION



Differences Between Top-down and Bottom-up Estimates

Top-Down Estimates	Bottom-Up Estimates
Intended Use Feasibility/conceptual phase Rough time/cost estimate Fund requirements Resource capacity planning	Intended Use Budgeting Scheduling Resource requirements Fund timing
Preparation Cost 1/10 to 3/10 of a percent of total project cost	Preparation Cost 3/10 of a percent to 1.0 percent of total project cost
Accuracy Minus 20%, to plus 60%	Accuracy Minus 10%, to plus 30%
Method Consensus Ratio Apportion Function point Learning curves	Method Template Parametric WBS packages Range estimates

Top-Down versus Bottom-Up Estimating

Top-Down Estimates

- Are usually derived from someone who uses experience and/or information to determine the project duration and total cost.
- Used at the strategic level to evaluate the project proposal. Sometimes much of the information needed to derive accurate time and cost estimates is not available in the initial phase of the project

Bottom-Up Approach

- Can serve as a check on cost elements in the WBS by rolling up the work packages and associated cost accounts to major deliverables at the work package level.

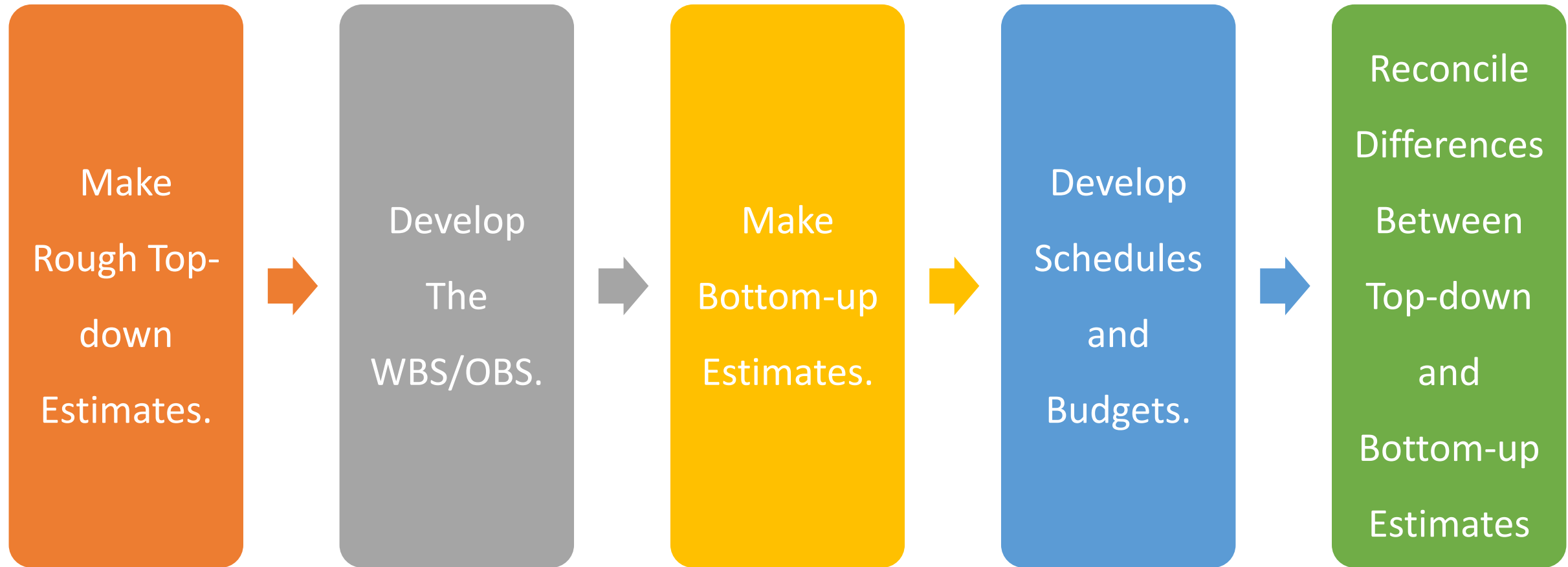
Top-Down versus Bottom-Up Estimating



Conditions that suggest when one approach is preferred over another

Condition	Top-Down Estimates	Bottom-Up Estimates
Strategic decision making	X	
Cost and time important		X
High uncertainty	X	
Internal, small project	X	
Fixed-price contract		X
Customer wants details		X
Unstable scope	X	

Estimating Project: Preferred Approach



Top-Down Approaches for Estimating Times and Costs

- Consensus methods
- Ratio methods
- Apportion method
- Function point methods for software and system projects

Top-Down Approach - Consensus Methods

- This method simply uses the pooled experience of senior and/or middle managers to estimate the total project duration and cost.
- Meeting where experts discuss, argue, and ultimately reach a decision as to their best guess estimate.
- Delphi Method to make these macro estimates.
- Occur in the “conceptual” stage of the project

Top-Down Approach - Ratio Methods

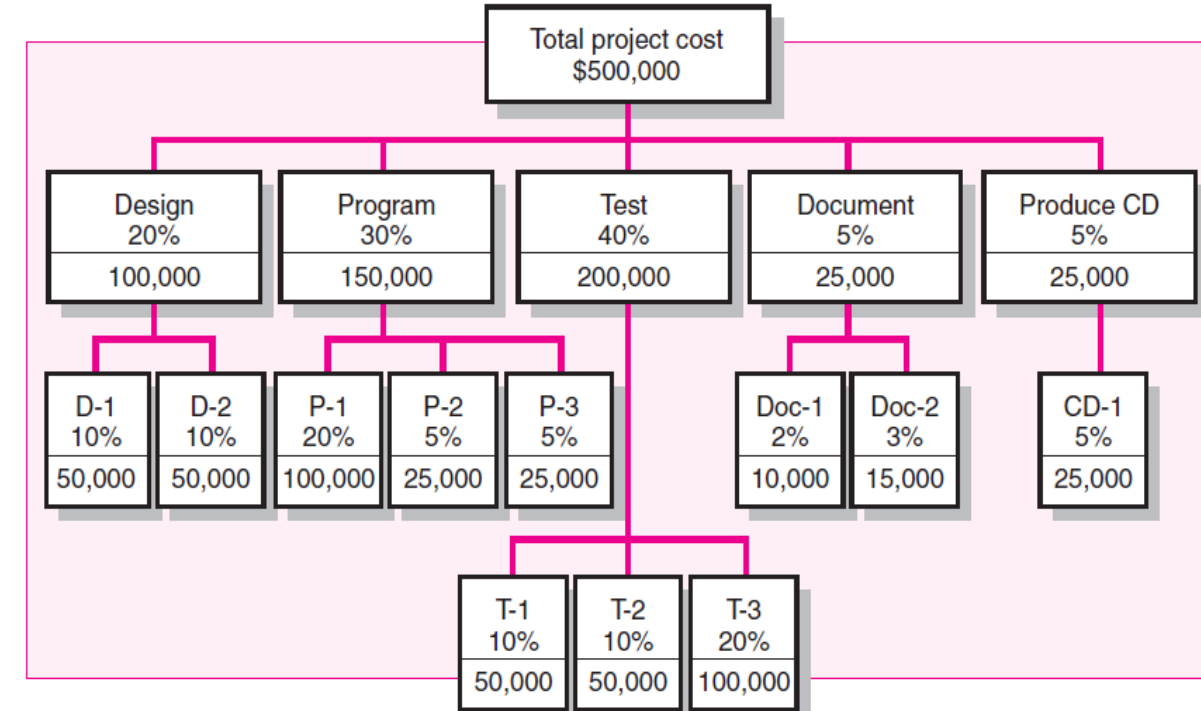
- Sometimes called **Parametric**

For example, contractors frequently use number of square feet to estimate the cost and time to build a house

- Cost per square foot = \$160
- House of 2,700 square feet cost = $2,700 \times \$160 = \$432,00$

Top-Down Approach - Apportion Methods

- Extension to the ratio method.
- Used when projects closely follow past projects in features and costs.
- Given good historical data, estimates can be made quickly with little effort and reasonable accuracy.
- This method is very common in projects that are relatively standard but have some small variation or customization.
- Authorize pay to the contractor by completion of specific segments of project



Top-Down Approach - Function Point Methods For Software And System Projects

- Software development projects are frequently estimated using weighted macro variables called “function points”

TABLE 5.2
Simplified Basic
Function Point Count
Process for a
Prospective Project
or Deliverable

Element	Complexity Weighting			Total
	Low	Average	High	
Number of <i>inputs</i>	_____ × 2 +	_____ × 3 +	_____ × 4	= _____
Number of <i>outputs</i>	_____ × 3 +	_____ × 6 +	_____ × 9	= _____
Number of <i>inquiries</i>	_____ × 2 +	_____ × 4 +	_____ × 6	= _____
Number of <i>files</i>	_____ × 5 +	_____ × 8 +	_____ × 12	= _____
Number of <i>interfaces</i>	_____ × 5 +	_____ × 10 +	_____ × 15	= _____

TABLE 5.3
Example: Function
Point Count Method

Software Project 13: Patient Admitting and Billing					
15	Inputs	Rated complexity as low			(2)
5	Outputs	Rated complexity as average			(6)
10	Inquiries	Rated complexity as average			(4)
30	Files	Rated complexity as high			(12)
20	Interfaces	Rated complexity as average			(10)
Application of Complexity Factor					
Element	Count	Low	Average	High	Total
Inputs	15	× 2			= 30
Outputs	5		× 6		= 30
Inquiries	10		× 4		= 40
Files	30			× 12	= 360
Interfaces	20		× 10		= 200
				Total	<u>660</u>

Top-Down Approach - Function Point Methods For Software And System Projects

- Given this count and the fact that one-person month has historically been equal to 5 function points, the job will require 132 person months ($660/5 = 132$).
- Assuming you have 10 programmers who can work on this task, the duration would be $(132/10)$ 13.2 months.
- The cost is easily derived by multiplying the labor rate per month times 132 person months.
- For example, if the monthly programmer rate is \$4,000, then the estimated cost would be \$528,000 ($132 \times 4,000$).

Bottom-Up Approaches for Estimating Times and Costs

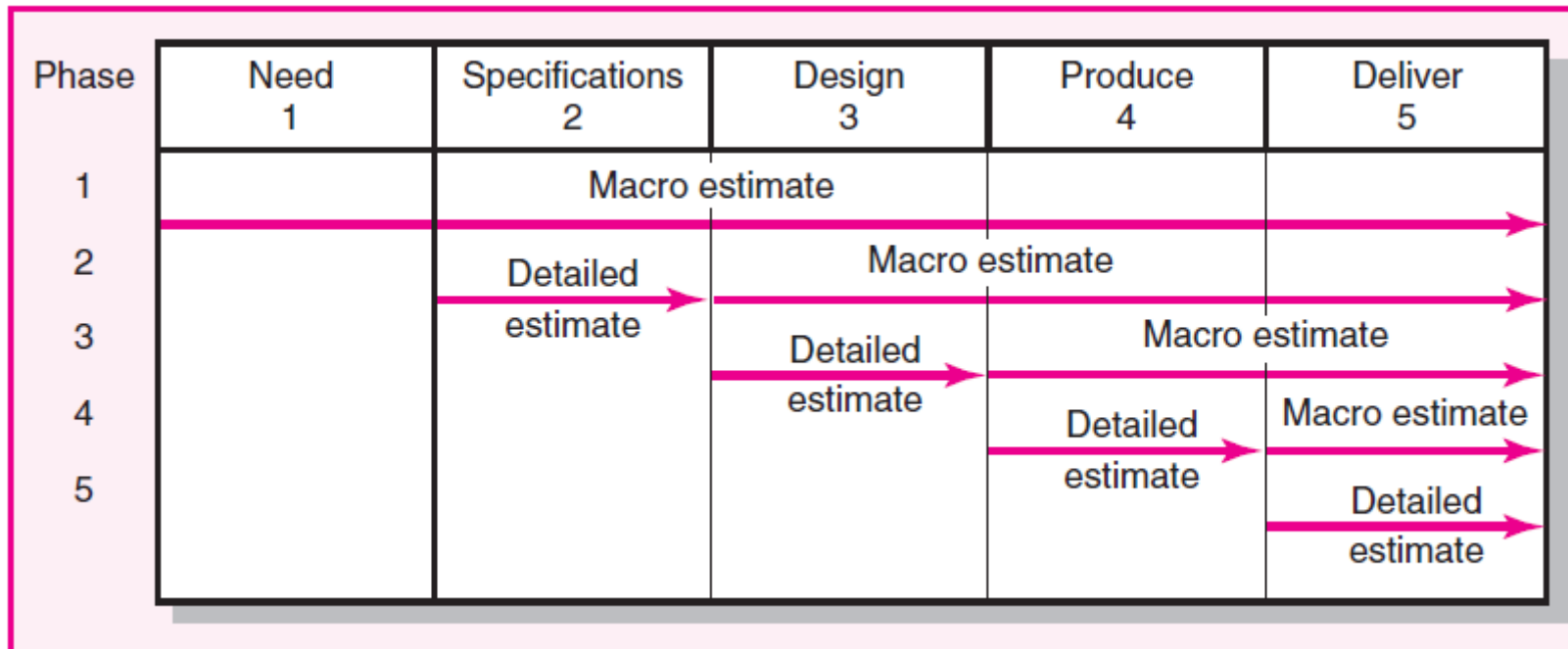
- Template methods
- Parametric procedures applied to specific tasks
- Range estimates for the WBS work packages
- Phase estimating: A hybrid

Bottom-Up Approaches for Estimating Times and Costs

- **Template methods**
 - If the project is like past projects, the costs from past projects can be used as a starting point for the new project. Differences in the new project can be noted and past times and costs adjusted to reflect these differences.
- **Parametric procedures applied to specific tasks**
- **Range estimates for the WBS work packages**
 - Significant uncertainty associated with the time or cost to complete

Bottom-Up Approaches - Phase estimating: A hybrid

- This approach begins with a top-down estimate for the project and then refines estimates for phases of the project as it is implemented.
- Some projects by their nature cannot be rigorously defined because of the uncertainty of design or the final product. Although rare, such projects do exist.



Level of Detail

- Level of detail is different for different levels of management.
- Level of detail in the WBS varies with the complexity of the project.
- Excessive detail is costly.
 - Fosters a focus on departmental outcomes
 - Creates unproductive paperwork
- Insufficient detail is costly.
 - Lack of focus on goals
 - Wasted effort on nonessential activities

Refining Estimates

- The practice of adjusting original estimates by 20 or even 100 percent.
- Why, after investing so much time and energy on detailed estimates, could the numbers be so far off?
- There are several reasons for this, most of which can be traced to the estimating process and the inherent uncertainty of predicting the future.
- Some of these reasons are:

Refining Estimates

- **Interaction costs are hidden in estimates.** According to the guidelines, each task estimate is supposed to be done independently. However, tasks are rarely completed in a vacuum. Work on one task is dependent upon prior tasks, and the hand-offs between tasks require time and attention. For example, people working on prototype development need to interact with design engineers after the design is completed, whether to simply ask clarifying questions or to make adjustments in the original design. Similarly, the time necessary to coordinate activities is typically not reflected in independent estimates.

Refining Estimates

- **Normal conditions do not apply.** Estimates are supposed to be based on normal conditions. While this is a good starting point, it rarely holds true in real life. This is especially true when it comes to the availability of resources. Resource shortages, whether in the form of people, equipment, or materials, can extend original estimates.

Refining Estimates

- **Things go wrong on projects.** Design flaws are revealed after the fact, extreme weather conditions occur, accidents happen, and so forth. Although you shouldn't plan for these risks to happen when estimating a particular task, the likelihood and impact of such events need to be considered.

Refining Estimates

- **Changes in project scope and plans.** As one gets further and further into the project, a manager obtains a better understanding of what needs to be done to accomplish the project. This may lead to major changes in project plans and costs. Likewise, if the project is a commercial project, changes often have to be made midstream to respond to new demands by the customer and/or competition. Unstable project scopes are a major source of cost overruns. While every effort should be made up front to nail down the project scope, it is becoming increasingly difficult to do so in our rapidly changing world.

Creating a Database for Estimating

- The best way to improve estimates is to collect and archive data on past project estimates and actuals. Saving historical data—estimates and actuals—provides a knowledge base for improving project time and cost estimating.
- Creating an estimating database is a “best practice” among leading project management organizations.



جامعة الجميع الذكية
EVERYONE'S SMART UNIVERSITY

Summary of Today Session

Summary of Today Session

- Quality time and cost estimates are the bedrock of project control.
- Experience is the best starting point for these estimates.
- The quality of estimates is influenced by other factors such as people, technology, and downtimes.
- Using top-down estimates is good for initial and strategic decision making or in situations where the costs associated with developing better estimates have little benefit.
- In most cases the bottom-up approach to estimating is preferred and more reliable because it assesses each work package, rather than the whole project, section, or deliverable of a project.
- Estimating time and costs for each work package facilitates development of the project schedule and a time-phased budget, which are needed to control the project as it is implemented.

Summary of Today Session (cont.)

- Using the estimating guidelines will help eliminate many common mistakes made by those unacquainted with estimating times and costs for project control.
- Establishing a time and cost estimating database fits well with the learning organization philosophy.
- The level of time and cost detail should follow the old saying of “no more than is necessary and sufficient.”
- The main disadvantage of top-down approaches to estimating is simply that the time and cost for a specific task are not considered. Grouping many tasks into a common basket encourages errors of omission and the use of imposed times and costs.
- Accurate estimates reduce uncertainty and support a discipline for effectively managing projects.

Resources

Project Management

The Managerial Process

Fifth Edition

By: Erik W. Larson

Oregon State University

Clifford F. Gray

Oregon State University