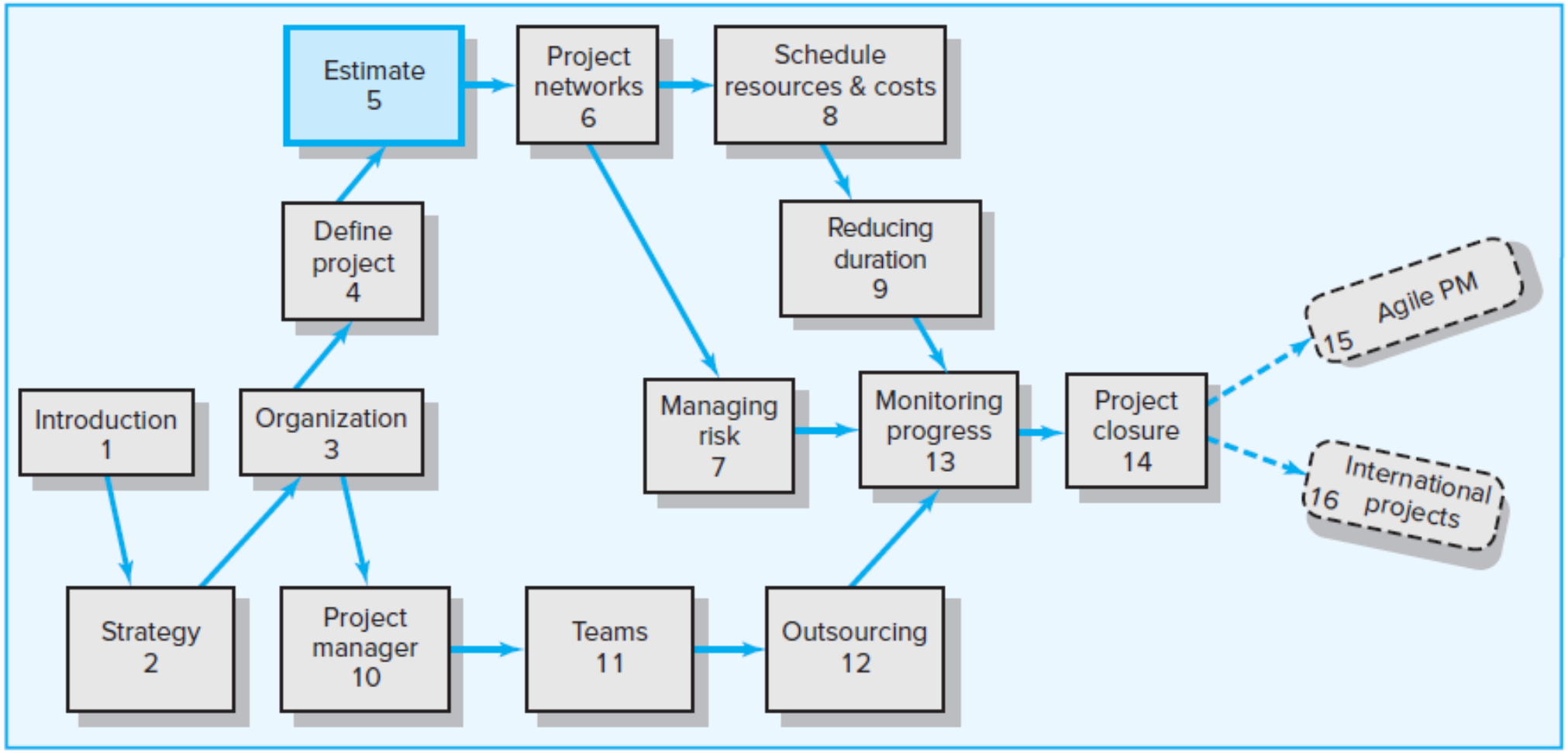
OntarioTech
Engineering
& Applied Science

Project Management for Engineers - ENGR 5410G
Fall 2024

Unit 3:
Cost and Time Estimation

Where We Are Now



Learning Objectives

05-01 Understand estimating project times and costs is the foundation for project planning and control.

05-02 Describe guidelines for estimating time, costs, and resources.

05-03 Describe the methods, uses, and advantages and disadvantages of top-down and bottom-up estimating methods.

05-04 Distinguish different kinds of costs associated with a project.

05-05 Suggest a scheme for developing an estimating database for future projects.

05-06 Understand the challenge of estimating mega projects and describe steps that lead to better informed decisions.

05-07 Define a “white elephant” in project management and provide examples.

Chapter Outline

5.1 Factors Influencing the Quality of Estimates

5.2 Estimating Guidelines for Times, Costs, and Resources

5.3 Top-Down versus Bottom-Up Estimating

5.4 Methods for Estimating Project Times and Costs

5.5 Level of Detail

5.6 Types of Costs

5.7 Refining Estimates

5.8 Creating a Database for Estimating

5.9 Mega Projects: A Special Case

Project Estimating

Estimating Defined

- Is the process of forecasting or approximating the time and cost of completing project deliverables.
- Is a trade-off, balancing the benefits of better accuracy against the costs of secured increased accuracy.

Types of Estimates

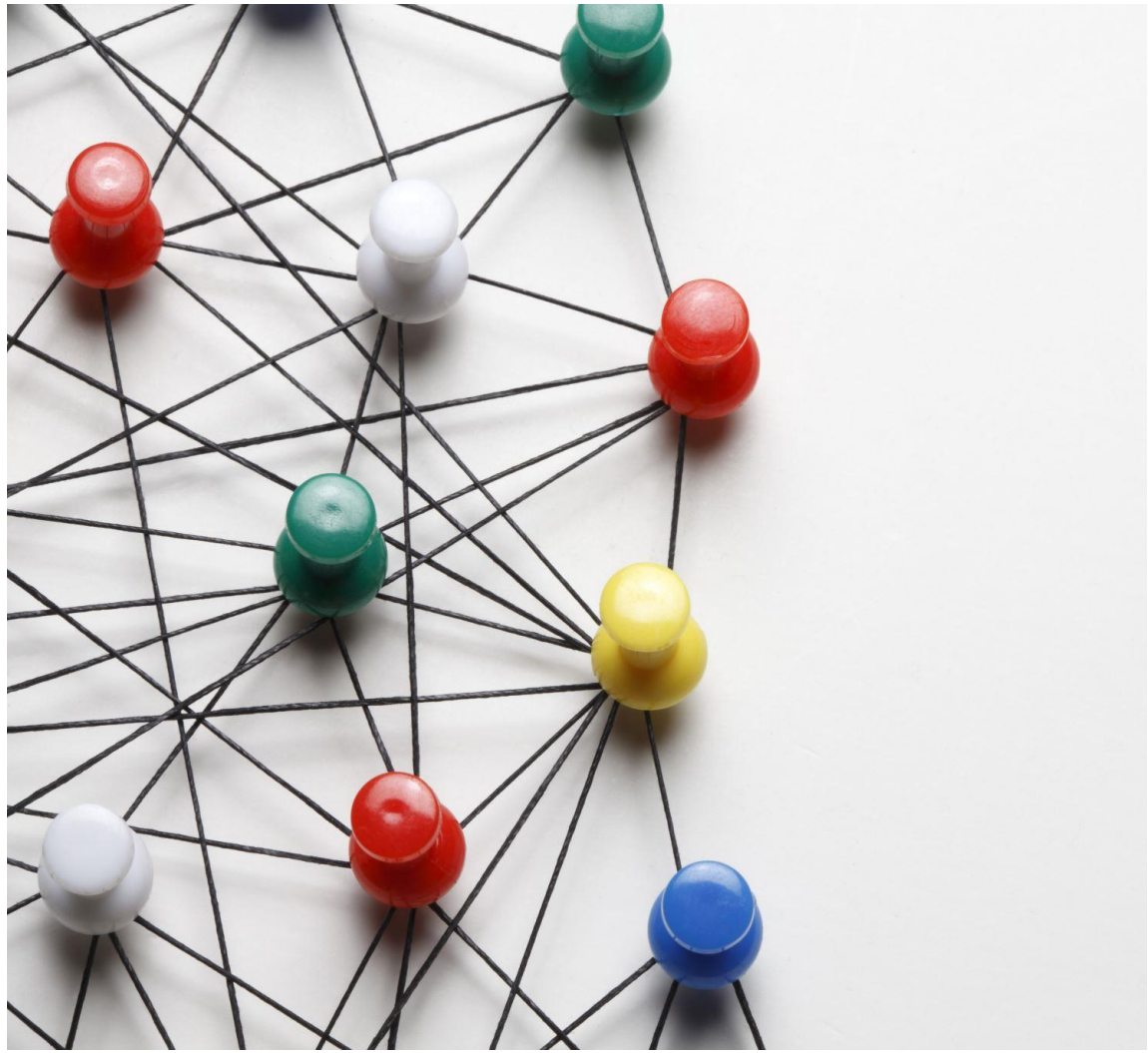
- Top-down (macro) estimates—analogy, group consensus, or mathematical relationships
- Bottom-up (micro) estimates—based on estimates of elements found in the work breakdown structure

Why Estimating Time and Cost Is Important

- Estimates are needed to support good decisions.
- Estimates are needed to schedule work.
- Estimates are needed to determine how long the project should take and its cost.
- Estimates are needed to determine whether the project is worth doing.
- Estimates are needed to develop cash flow needs.
- Estimates are needed to determine how well the project is progressing.

Factors Influencing the Quality of Estimates

- Planning Horizon
- Project Complexity
- People
- Project Structure and Organization
- Padding Estimates
- Organizational Culture
- Other Factors



Estimating Guidelines for Times, Costs, and Resources

1. Responsibility
2. The use of several people to estimate
3. Normal conditions
4. Time units
5. Independence
6. Contingencies
7. Risk assessment added to the estimate to avoid surprises to stakeholders

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.
- Are sometimes made by top managers who have very little knowledge of the component activities used to complete the project.

Bottom-Up Estimates

- Can take place after the project has been defined in detail.
- Can serve as a check on cost elements in the WBS by rolling up the work packages and associated cost accounts to major deliverables.
- Provide the customer with an opportunity to compare the low-cost, efficient method approach with any imposed restrictions.

Conditions for Preferring Top-Down or Bottom-Up Time and Cost Estimates

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	

The Preferred Approach in Defining the Project

- Make rough top-down estimates
- Develop the WBS/OBS
- Make bottom-up estimates
- Develop schedules and budgets
- Reconcile differences between top-down and bottom-up estimates

Methods for Estimating Project Times and Costs

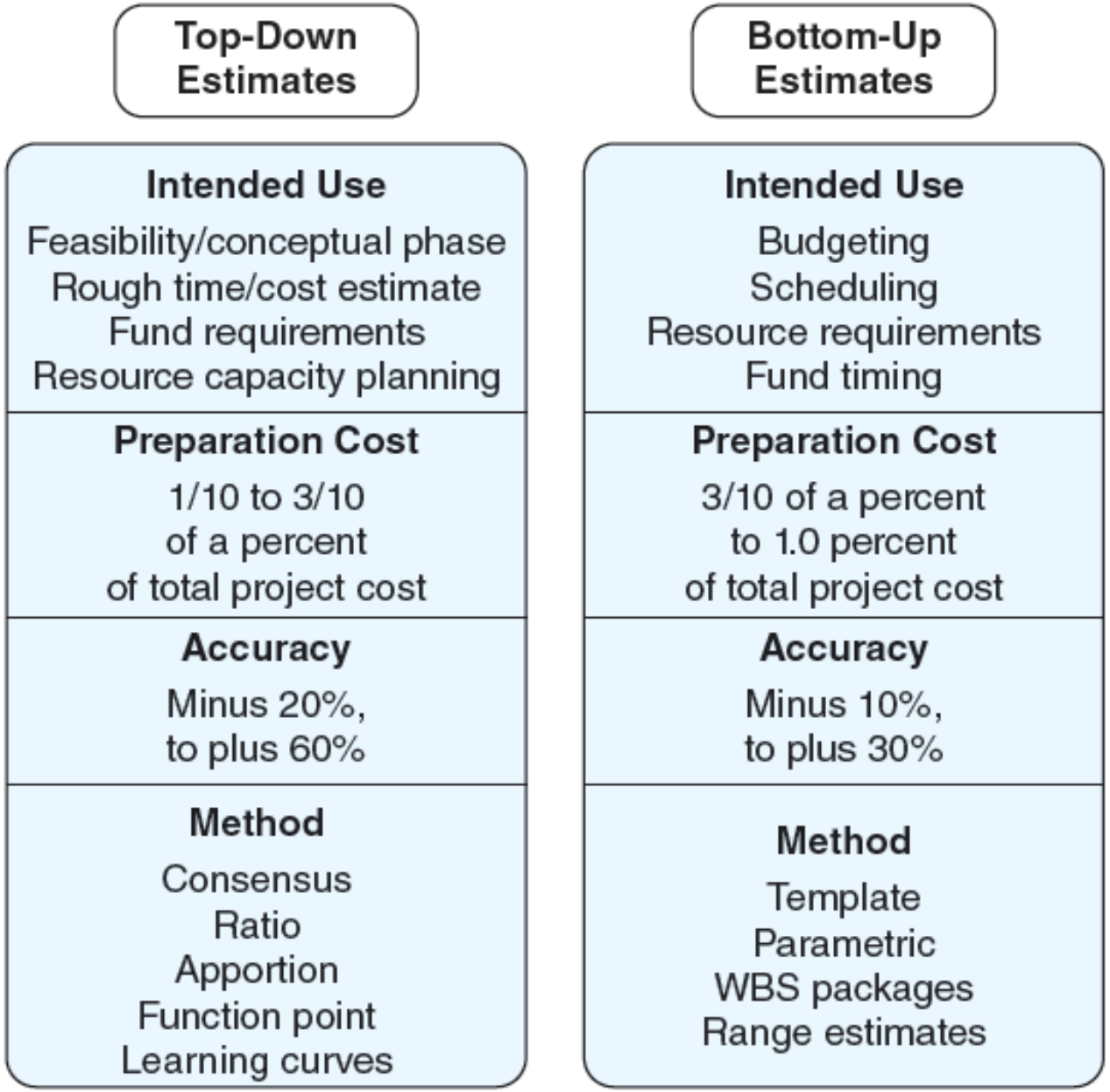
Top-Down Approaches

- Consensus Method
- Ratio Method
- Apportion Method
- Function Point Methods for Software and System Projects
- Learning Curves

Bottom-Up Approaches

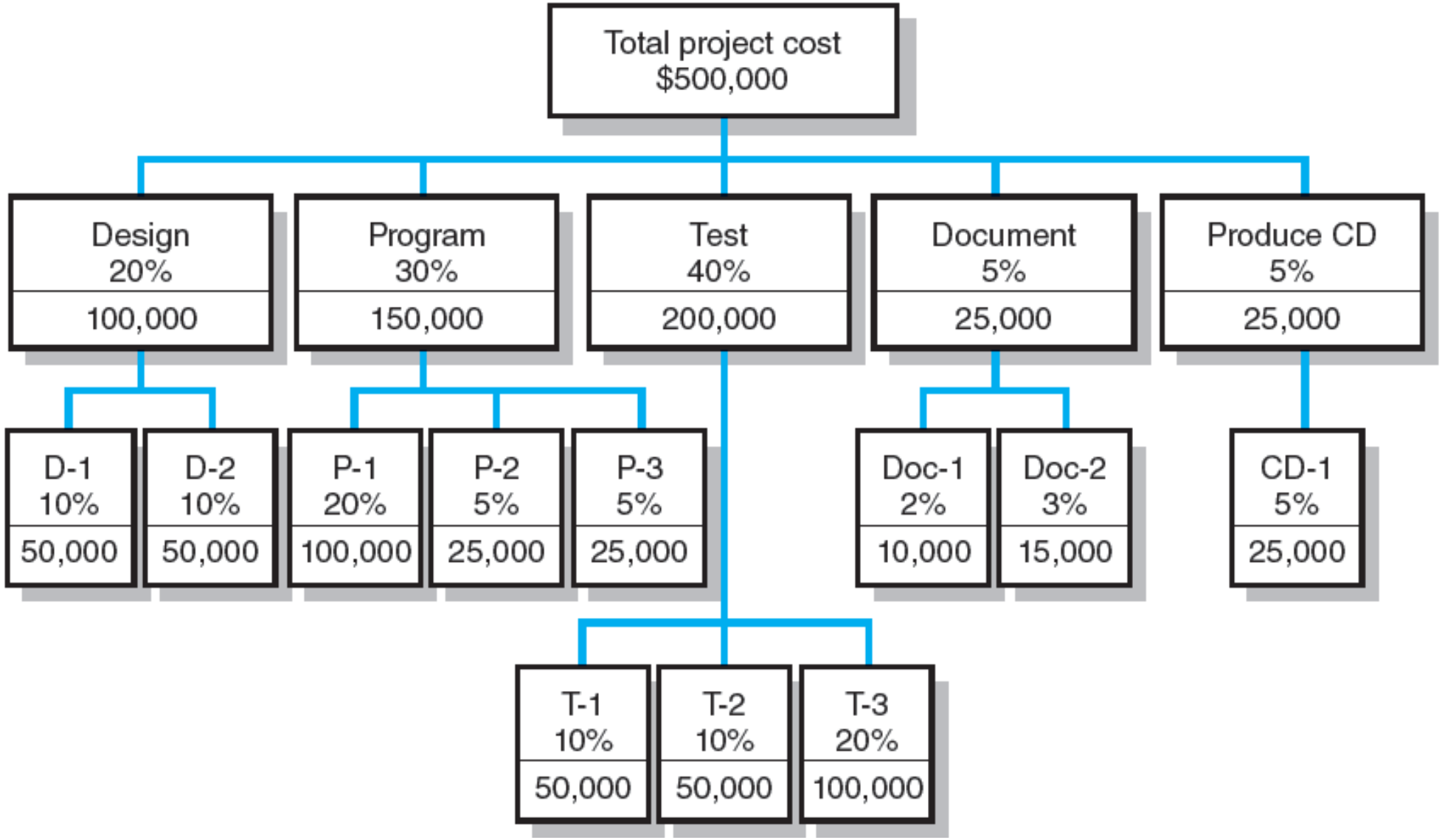
- Template Method
- Parametric Procedures Applied to Specific Tasks
- Range Estimating

Top-Down and Bottom-Up Estimates



FIG

Apportion Method of Allocating Project Costs Using the WBS



FIG

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

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

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)

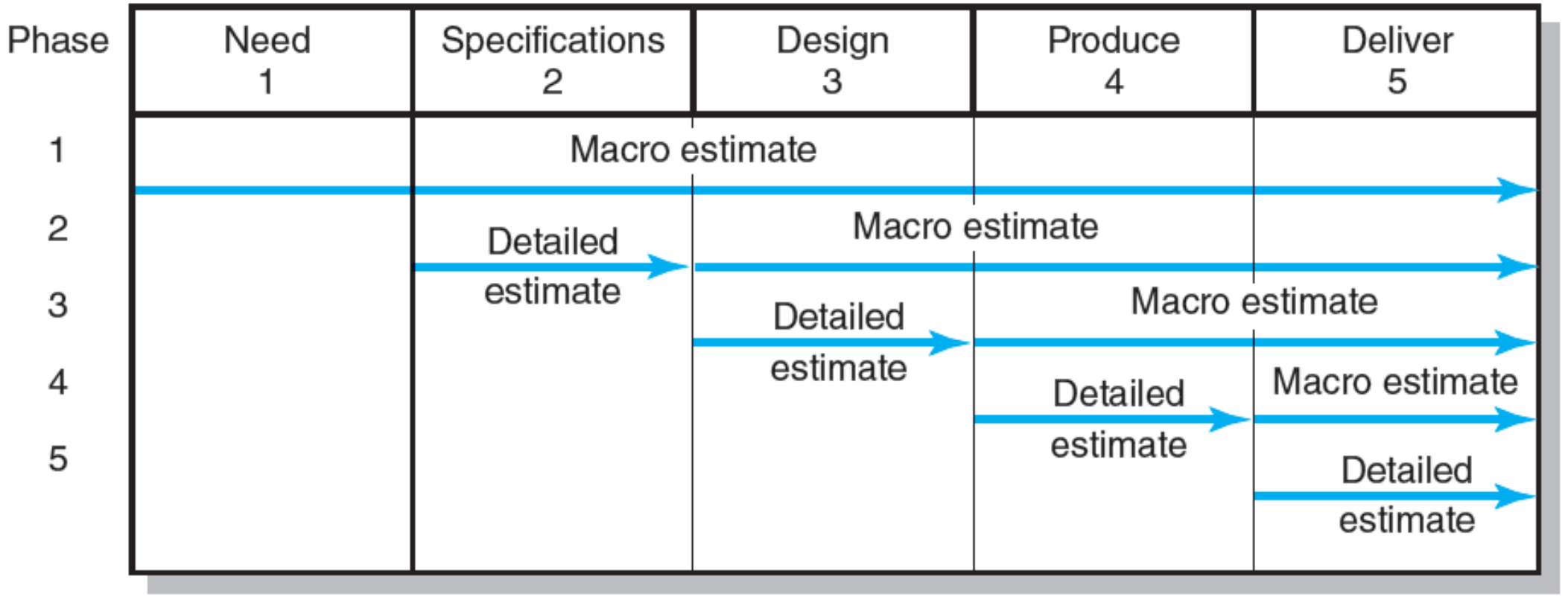
Application of Complexity Factor

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	660

Range Estimating Template

	A	B	C	D	E	F	G	H
1	Project number: 18				Project Manager: Dawn O'Connor			
2	Project description: New Organic Wine Launch				Date: 2/17/2xxx			
3			Organic Wine Launch Project					
4			Range Estimates					
5								
6	WBS	Description	Low	Average	High	Range	Risk	
7	ID		Estimate	Estimate	Estimate		Level	
8			Days	Days	Days	Days		
9								
10	102	Approval	1	1	3	2	low	
11	103	Design packaging	4	7	12	8	medium	
12	104	ID potential customers	14	21	35	21	high	
13	105	Design bottle logo	5	7	10	5	low	
14	106	Contract kiosk space	8	10	15	7	medium	
15	107	Construct kiosk	4	4	8	4	medium	
16	108	Design fair brochure	6	7	12	6	high	
17	109	Trade journal advertising	10	12	15	5	medium	
18	110	Production test	10	14	20	10	high	
19	111	Produce to inventory	5	5	10	5	high	
20	112	Business card scanner hookup	1	2	3	2	low	
21	113	Video hook up	2	2	4	2	medium	
22	114	Event rehearsal	2	2	5	3	high	

A Hybrid: Phase Estimating



FIG

Level of Detail

The level of detail in the WBS varies with:

- The complexity of the project
- The need for control
- The project size, cost, and duration
- Other factors

Excessive detail:

- Emphasizes departmental outcomes rather than deliverable outcomes
- Creates more unproductive paperwork

Inadequate detail:

- Falls short of meeting the structure’s needs

Types of Costs

Direct Costs

- Are clearly chargeable to a specific work package
  - Examples: Labor, materials, equipment, and other

Direct Project Overhead Costs

- Can be tied to project deliverables or work packages
  - Examples: Salary of the project manager, temporary rental space for the project team, supplies, specialized machinery

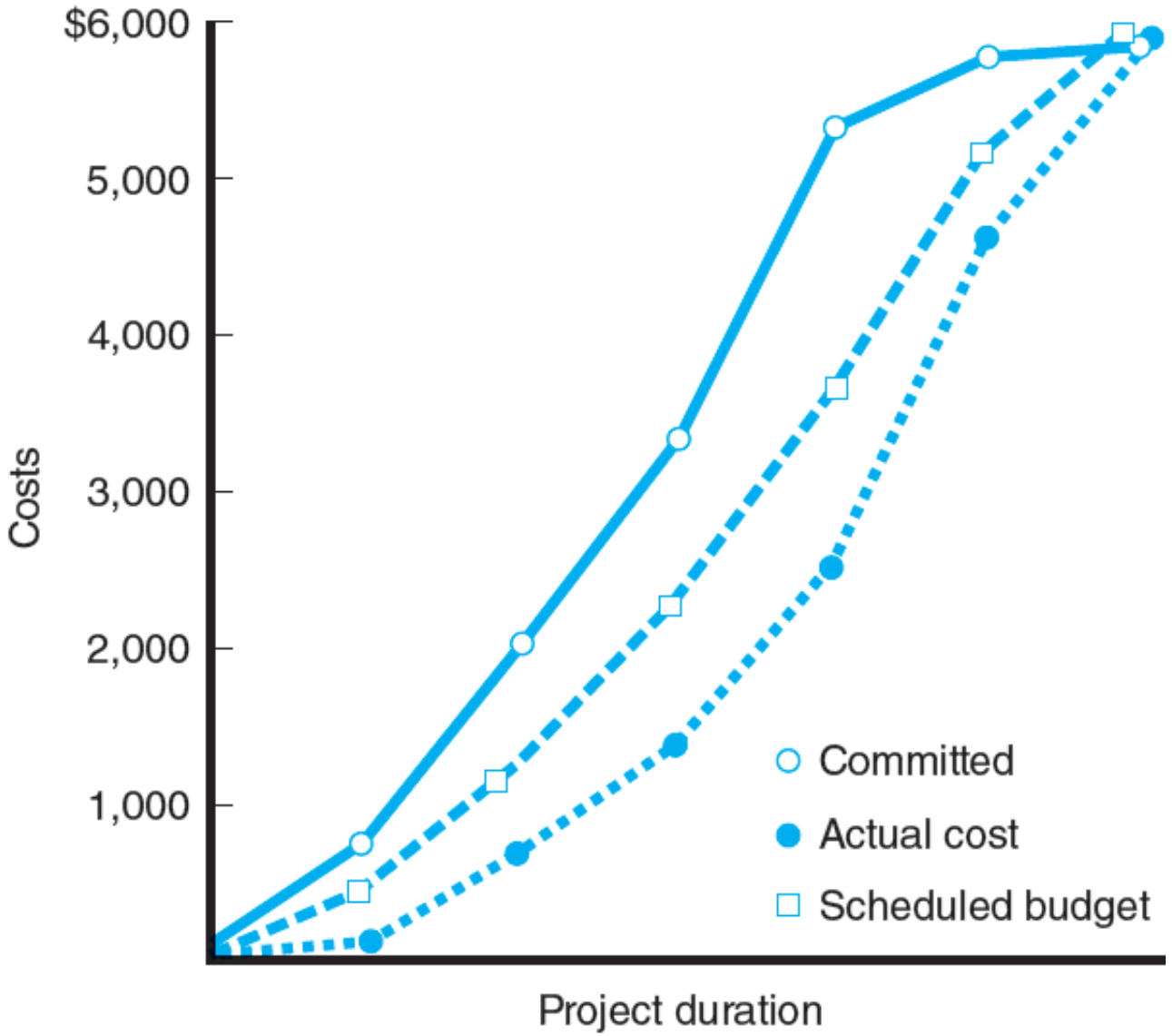
General and Administrative (G&A) Overhead Costs

- Are not directly linked to a specific project
  - Examples: Advertising, accounting, salary of senior management above the project level

Contract Bid Summary Costs

Direct costs	$80,000
Direct overhead	$20,000
Total direct costs	$100,000
G&A overhead (20%)	$20,000
Total costs	$120,000
Profit (20%)	$24,000
Total bid	$144,000

Three Views of Cost



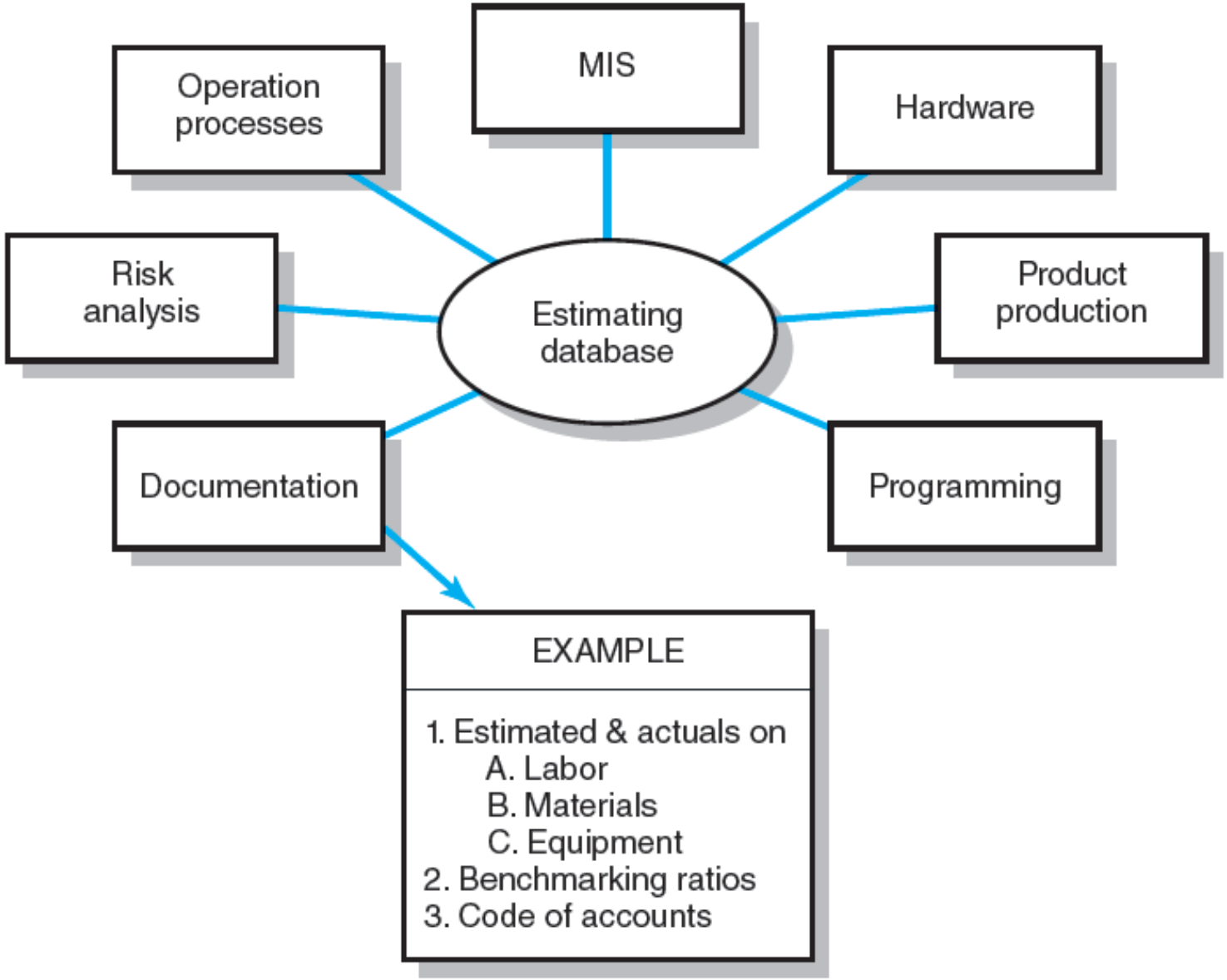
FIG

Refining Estimates

Reasons for adjusting estimates

- Interaction costs are hidden in estimates.
- Normal conditions do not apply.
- Things go wrong on projects.
- Project scope and plans change.
- People are overly optimistic.
- People engage in strategic misrepresentation.

Creating a Database for Estimating



FIG

Mega Projects: A Special Case

Mega Projects Defined

- Are large-scale, complex ventures that typically cost $1 billion or more, take many years to complete, and involve multiple private and public stakeholders.
  - Examples: High-speed rail lines, airports, healthcare reform, the Olympics, development of new aircraft
- Often involve a double whammy.
  - Projects cost much more than expected and under-deliver on benefits the projects were to provide.
- Are sometimes referred to as “white elephant.”
  - Projects are over budget, under value and the costs of maintaining the project exceed the benefits received.

The Reference Class Forecasting (RCF)

Three Major Steps:

1. Select a reference class of projects similar to your potential project.
2. Collect and arrange outcome data as a distribution. Create a distribution of cost overruns as a percentage of the original project estimate (low to high).
3. Use the distribution data to arrive at a realistic forecast. Compare the original cost estimate for the project with the reference class projects.

Benefits:

- Outside empirical data mitigates human bias.
- Politics, strategic, and promoter forces have difficulty ignoring outside RCF information.
- RCF serves as a reality check for funding large projects.
- RCF helps executives avoid unsound optimism.
- RCF leads to improved accountability.
- RCF provides a basis for project contingency funds.

Key Terms

Apportionment

Bottom-up estimates

Delphi Method

Direct costs

Function points

Learning curve

Overhead costs

Phase estimating

Range estimating

Ratio method

Reference class forecasting (RCF)

Template method

Time and cost databases

Top-down estimates

White elephant

Any Questions!