

ECTE250

ENGINEERING DESIGN AND MANAGEMENT 2

Winter 2025 / Spring 2025

Project Management III

Textbook and Readings

Textbook

- Project Management: the Managerial Process, 6th Edition, by Erik W Larson & Clifford F Gray, McGraw Hill
 - Chapter 5

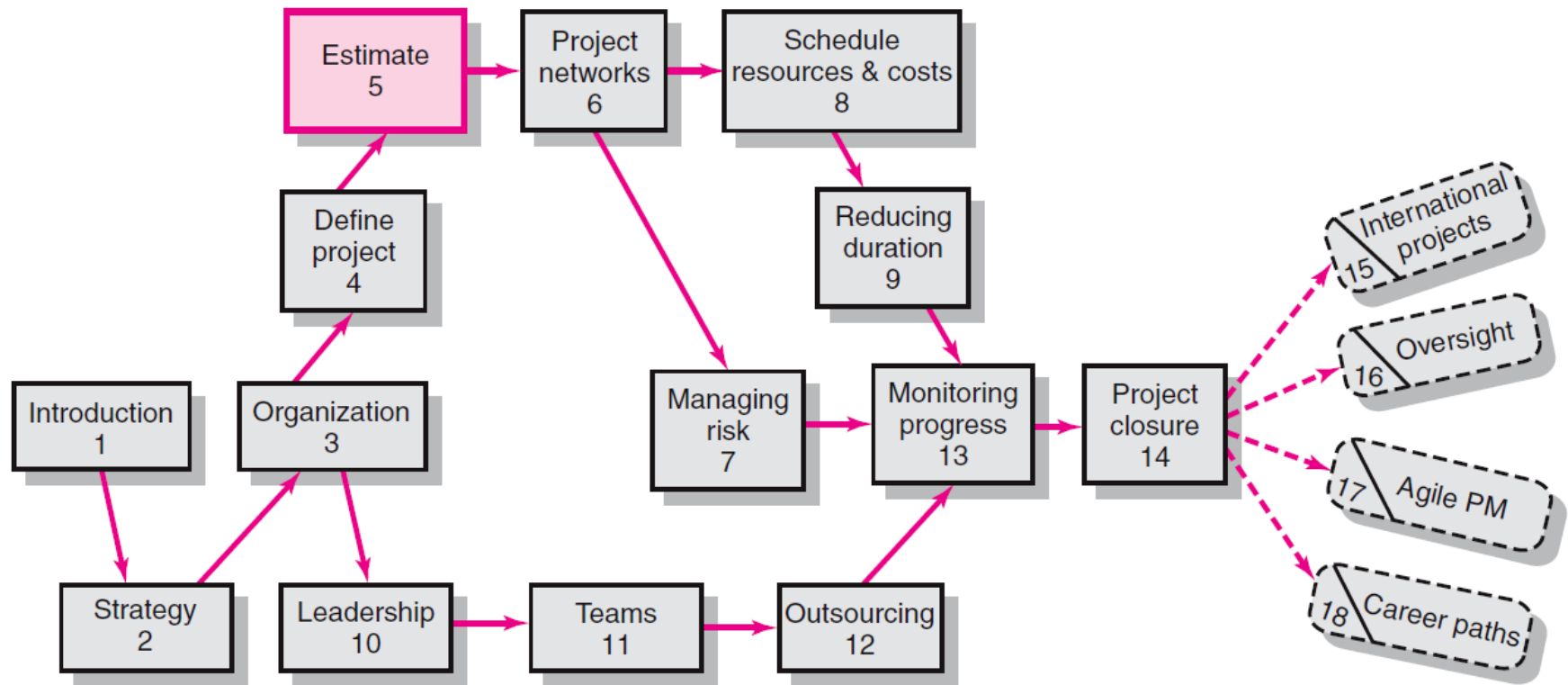
Acknowledgement

- Slides from Project Management: the Managerial Process, by Erik W Larson & Clifford F Gray

Ch. 5

Estimating Project Times and Costs

Where We Are Now



Estimating Projects

□ Estimating

- The process of forecasting or approximating the **time** and **cost** (budget and resources) of completing project deliverables.
- The task of balancing expectations of stakeholders and need for control while the project is implemented.
- *Poor estimate are major contributors to failed projects*

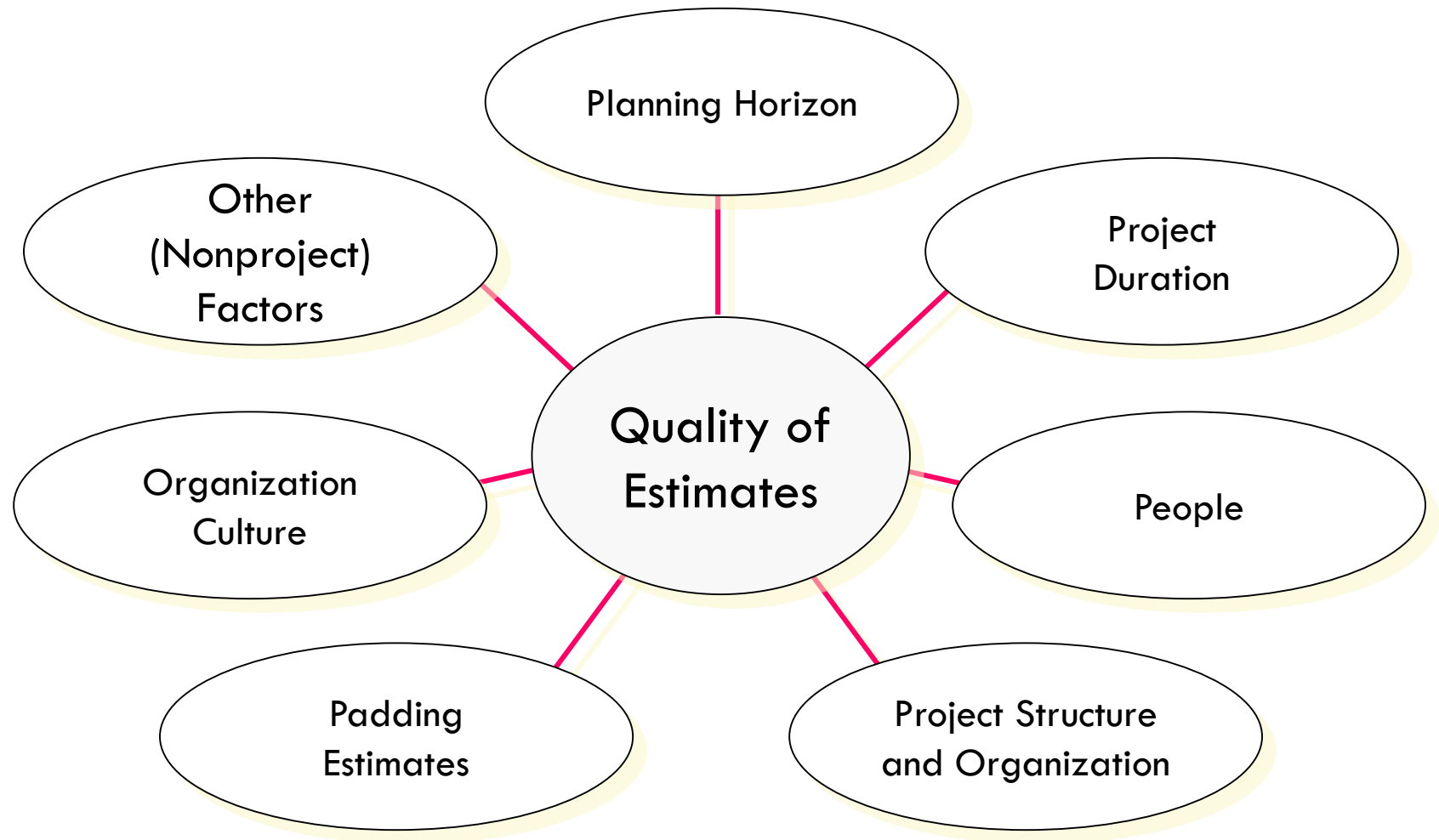
□ Types of Estimates

- **Top-down** (macro) estimates: analogy, group consensus, or mathematical relationships
- **Bottom-up** (micro) estimates: estimates of elements of the work breakdown structure

Why Estimating Time and Cost 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.

Factors Influencing the Quality of Estimates



Estimating Guidelines for Times, Costs, and Resources

1. Have people familiar with the tasks make the estimate (responsibility, build communication channels early).
2. Use several people to make estimates.
3. Base estimates on normal conditions, efficient methods, and a normal level of resources.
4. Use consistent time units in estimating task times.
5. Treat each task as independent, don't aggregate.
6. Don't make allowances for contingencies.
7. Adding a risk assessment helps 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 made by top managers who have little knowledge of the processes used to complete 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 for Preferring Top-Down or Bottom-up Time and Cost Estimates

Condition	Macro Estimates	Micro 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 Projects: Preferred Approach

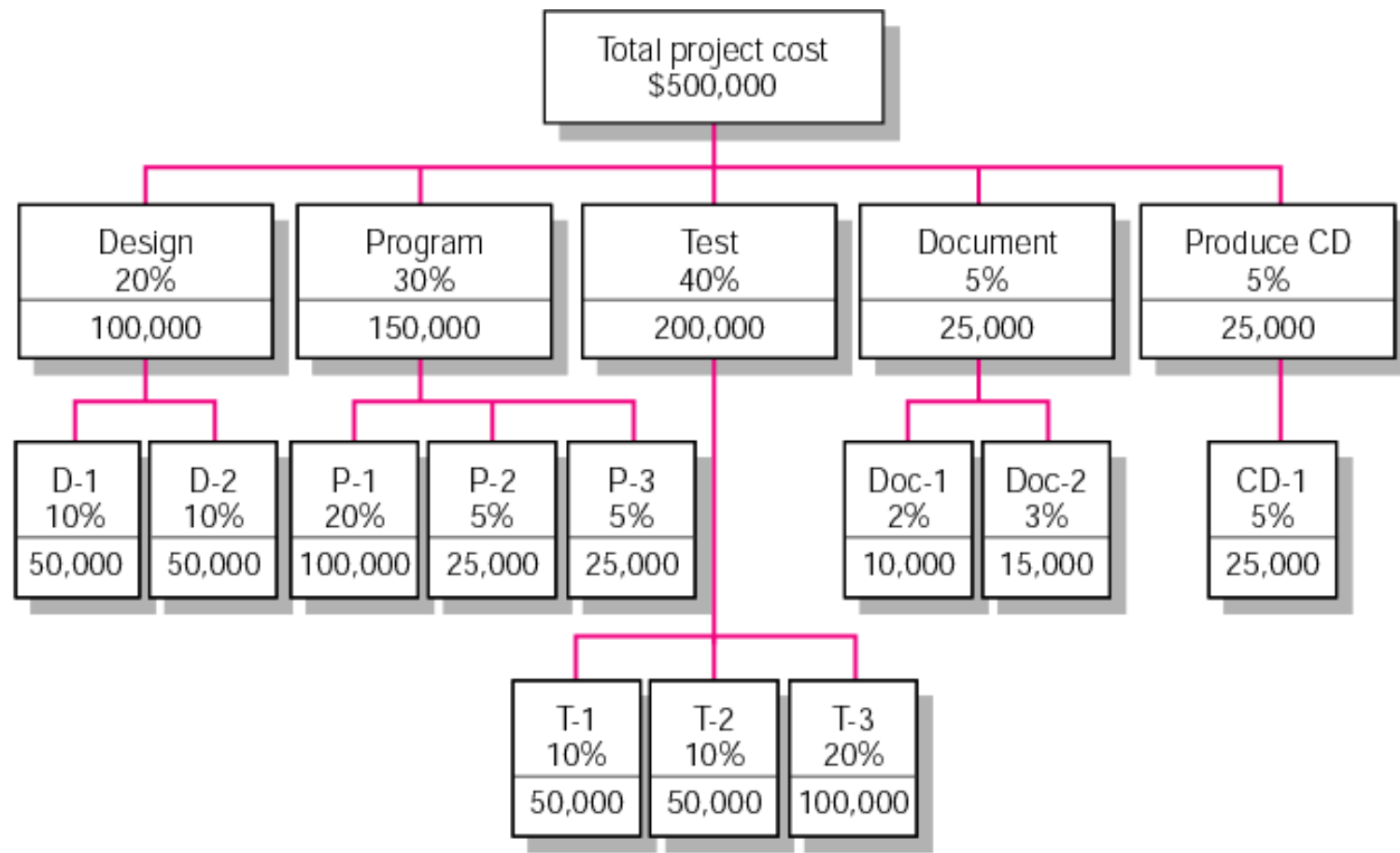
- Make rough top-down estimates.
- Develop the WBS/OBS.
- Make bottom-up estimates.
- Develop schedules and budgets.
- Reconcile differences between top-down and bottom-up estimates

Top-Down Approaches for Estimating Project Times and Costs

- Consensus methods (pool of experienced seniors)
 - Do not dictate to lower levels
- Ratio methods
 - E.g. sqm of a house
- Apportion method
 - Project follow closely previous completed projects (standard projects)
- Function point methods for software and system projects
 - Count and weight features
- Learning curves
 - For projects with repetitive tasks / labor intensive (time decreases)



Apportion Method of Allocating Project Costs Using the Work Breakdown Structure



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	= _____

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>

Approximate duration (months) = total function point / (n x m)

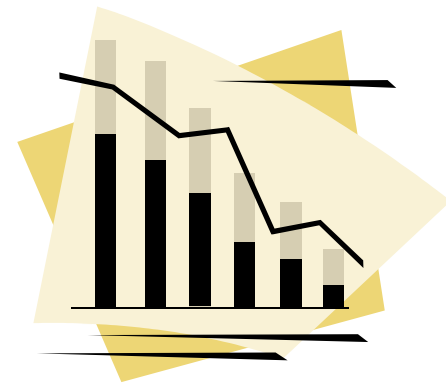
n = 5 function points = 1 person
m = number of persons in the project

TABLE 5.3



Bottom-Up Approaches for Estimating Project Times and Costs

- Template methods
 - Project similar to previous project (use as starting point), update only minor differences
- Parametric procedures applied to specific tasks
 - Similar to Ratio (E.g. sqm of a house) but at lower level
- Range estimates for the WBS work packages
 - Best when significant uncertainty (group estimating low, average, high)
- Phase estimating: A hybrid
 - When project nature cannot be rigorously defined (uncertain design / final product, or very large project). Easy to change features.



Support Cost Estimate Worksheet

Microsoft Excel - Book1

Type a question for help

125

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

Sheet1

Ready

NUM



Phase Estimating over Product Life Cycle

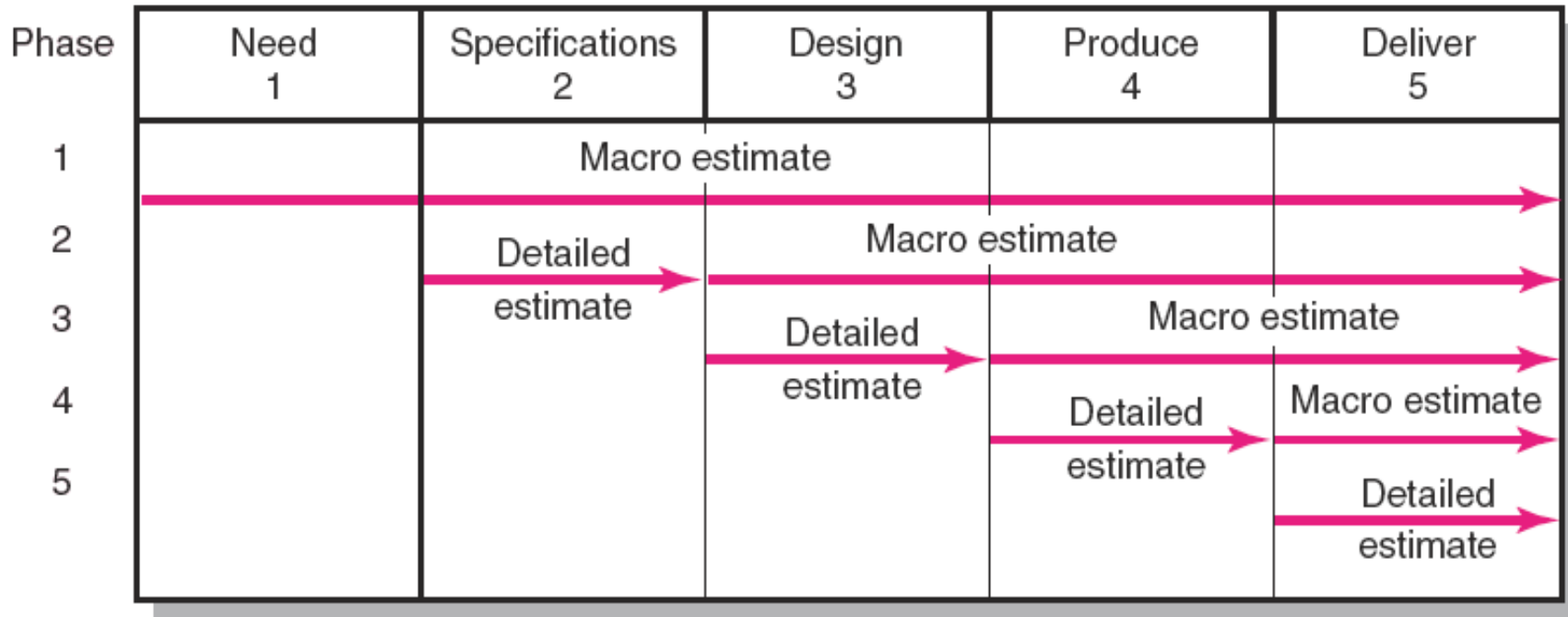


FIGURE 5.3

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

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

Types of Costs

□ Direct Costs

- ▣ Costs that are clearly chargeable to a specific work package.

- Labor, materials, equipment, and other

□ Direct (Project) Overhead Costs

- ▣ Costs incurred that are directly tied to an identifiable project deliverable or work package.

- Salary, rents, supplies, specialized machinery

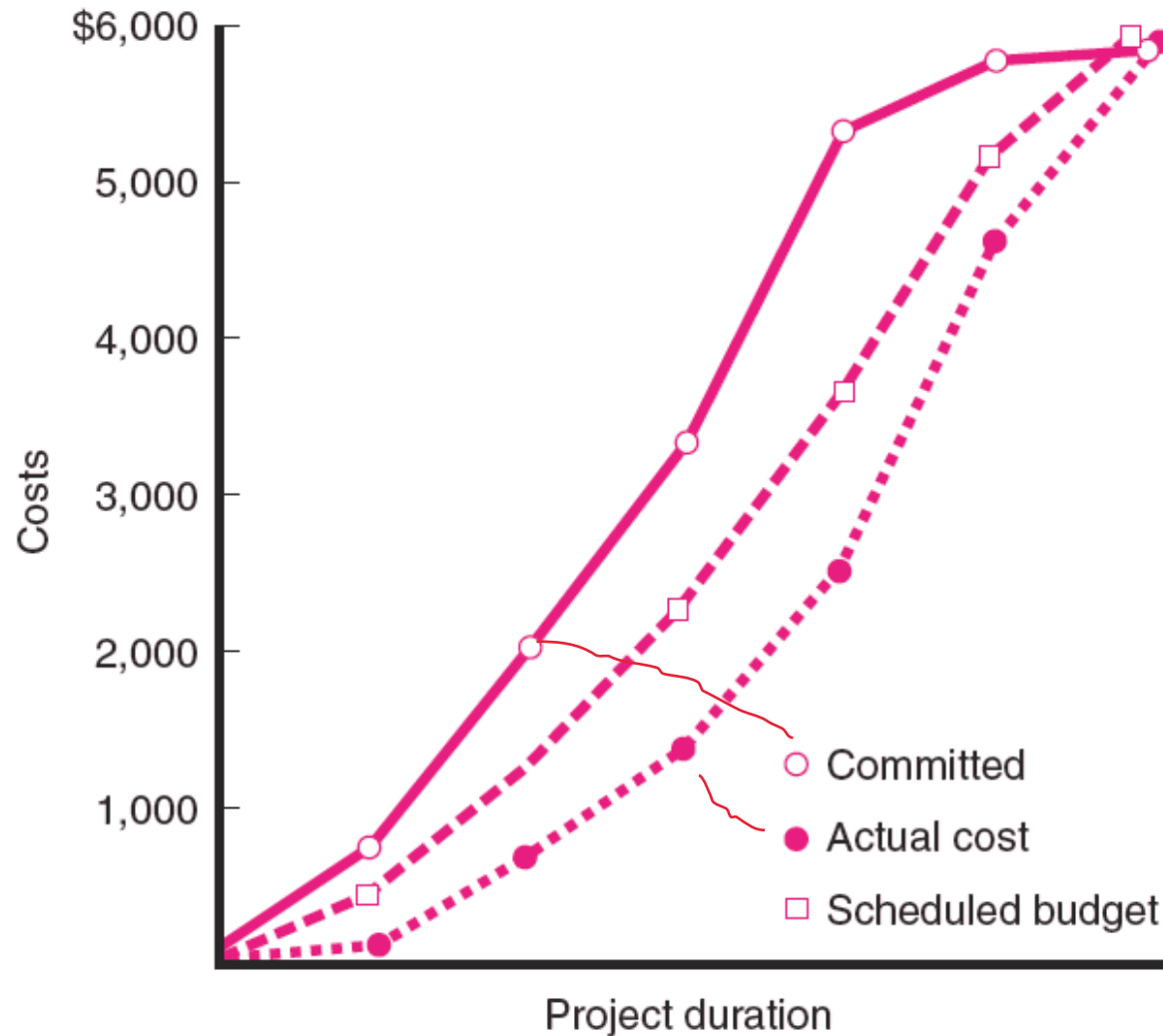
□ General and Administrative Overhead Costs

- ▣ Organization costs indirectly linked to a specific package that are apportioned to the project

Contract Bid Summary Costs

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

Three Views of Cost



Refining Estimates

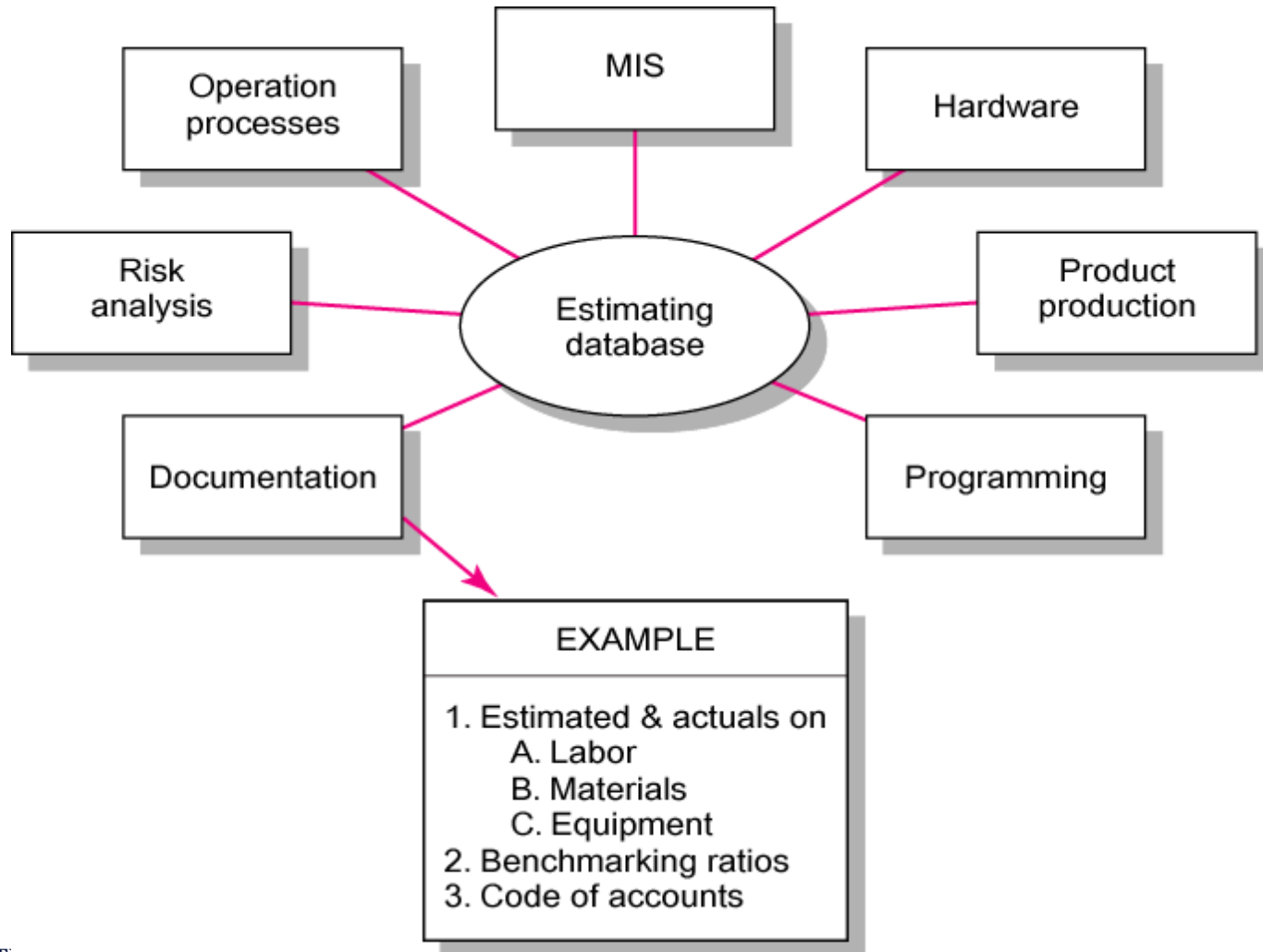
□ Reasons for Adjusting Estimates

- ▣ Interaction costs are hidden in estimates (independent estimate).
- ▣ Normal conditions do not apply.
- ▣ Things go wrong on projects.
- ▣ Changes in project scope and plans.
- ▣ Overly optimistic.
- ▣ Strategic misrepresentation.

□ Adjusting Estimates

- ▣ Time and cost estimates of specific activities are adjusted as the risks, resources, and situation particulars become more clearly defined (update of project planning).

Creating a Database for Estimating



Key Terms

Apportionment methods

Bottom-up estimates

Contingency funds

Delphi method

Direct costs

Function points

Learning curves

Overhead costs

Padding estimates

Phase estimating

Range estimating

Ratio methods

Template method

Time and cost databases