Project Management

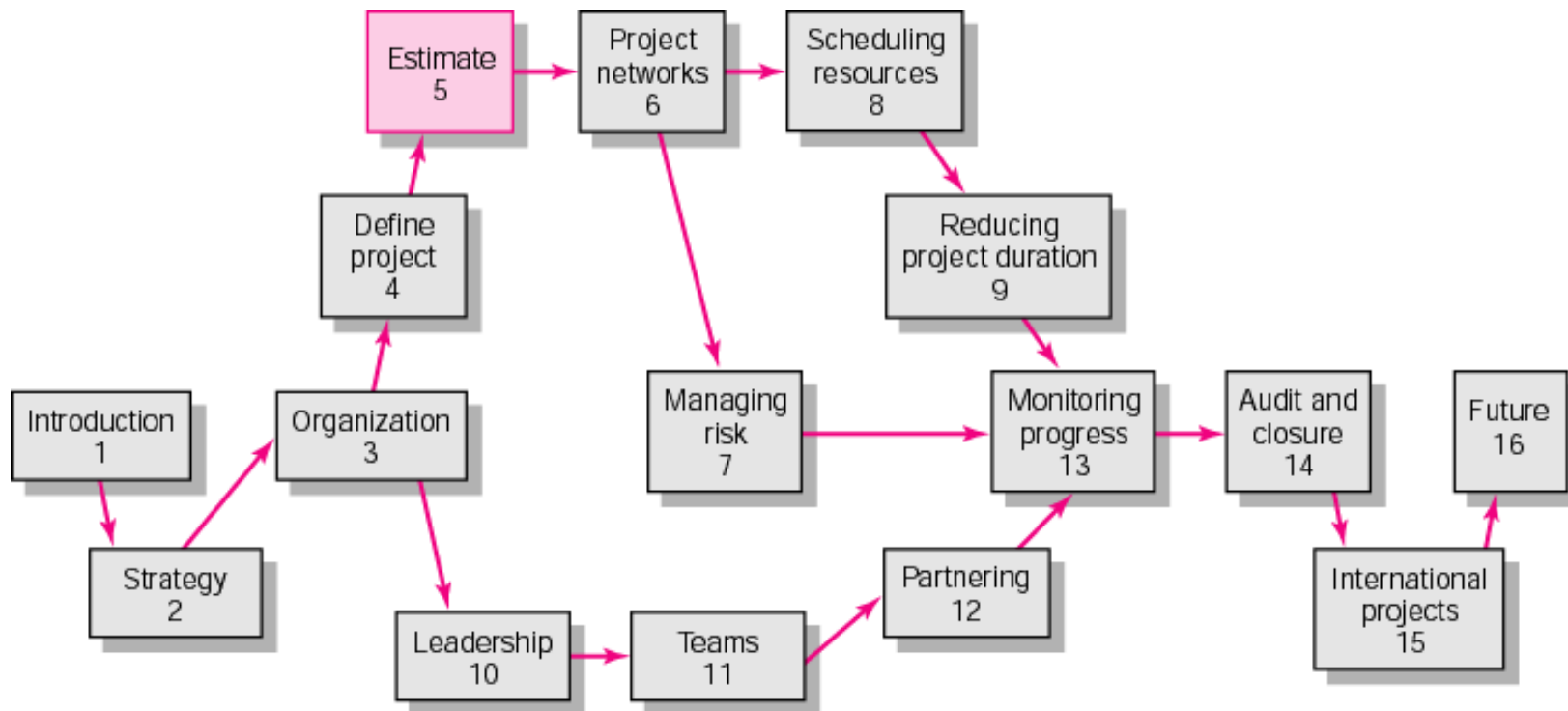## THE MANAGERIAL PROCESS

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Third Edition

Chapter 5

Estimating Project Times and Costs

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Estimating Projects

- ## Estimating

  - The process of forecasting or approximating the time and cost of completing project deliverables.

  - The task of balancing the expectations of stakeholders and the need for control while the project is implemented

- ## 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

- 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.
- Estimates are needed 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.

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.

Macro versus Micro 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	

TABLE 5.1

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

Methods for Estimating Project Times and Costs

- Macro (Top-down) Approaches

  – Consensus methods

  – Ratio methods

  – Apportion method

  – Function point methods for software and system projects

  – Learning curves

Project Estimate
Times
Costs
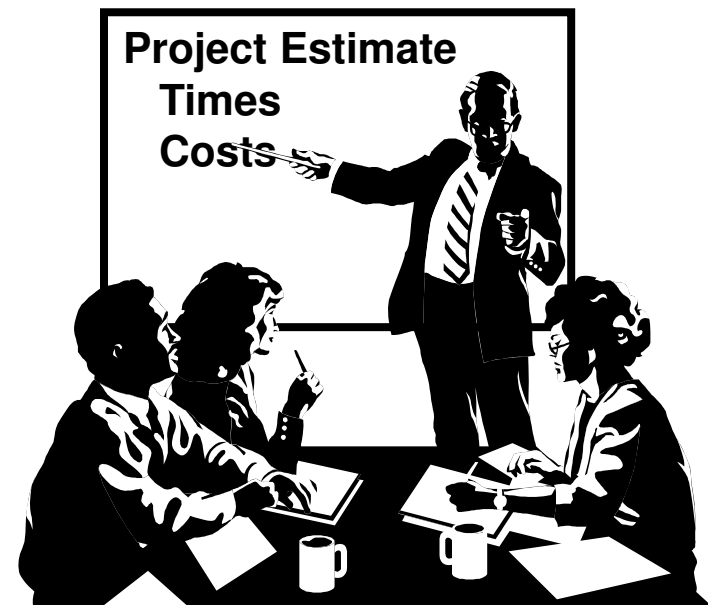
Apportion Method of Allocating Project Costs Using the Work Breakdown Structure
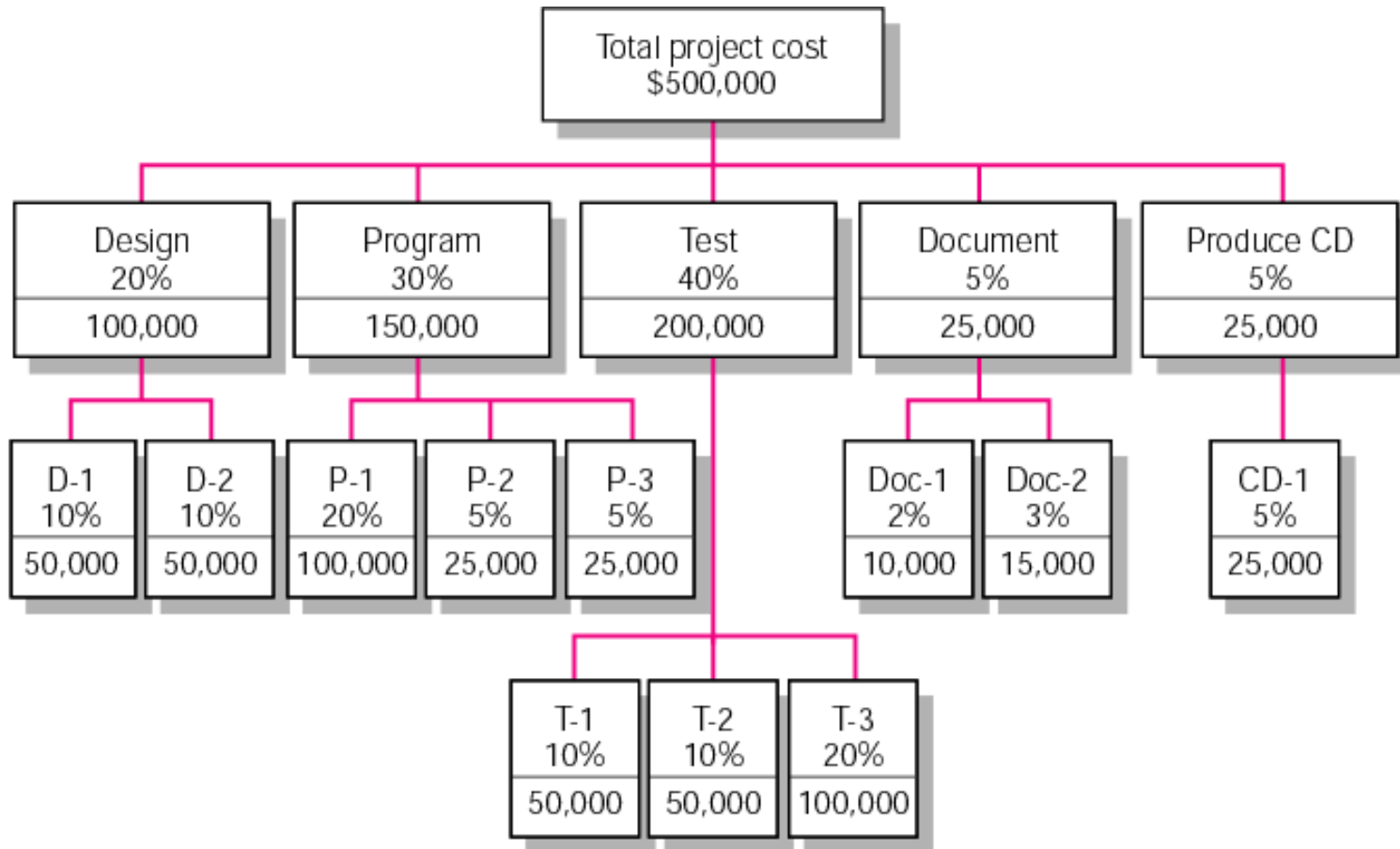
FIGURE 5.1

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

Element	Complexity Weighting			Total
	Low	**Average**	**High**	
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	= _____

TABLE 5.2

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	$\times 2$			= 30
Outputs	5		$\times 6$		= 30
Inquiries	10		$\times 4$		= 40
Files	30			$\times 12$	= 360
Interfaces	20		$\times 10$		= 200
				Total	660

TABLE 5.3

Methods for Estimating Project Times and Costs (cont'd)

- ## Micro (Bottom-up) Approaches

  - –Template method

  - –Parametric Procedures Applied to Specific Tasks

  - –Detailed Estimates for the WBS Work Packages

  - –Phase Estimating: A Hybrid
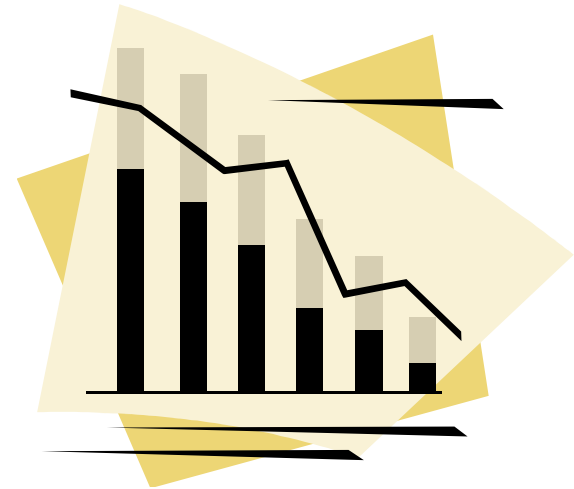
SB45 Support Cost Estimate Worksheet

Project Number: *17*

Project Manager: *Kathleen Walling*

Project Description: *Road Diversion Project*

Date: 5 - 07

WBS ID	Description	Estimator 1			Estimator 2			Estimator 3			Estimator Averages			Ratio*
		Low Est. Days	Aver. Est. Days	High Est. Days	Low Est. Days	Aver. Est. Days	High Est. Days	Low Est. Days	Aver. Est. Days	High Est. Days	Aver. Low Days	Aver. Days	Aver. High Days	Range/ Aver.
102	Engineering	95	100	105	97	100	103	93	96	100	95.0	98.7	102.7	0.08
103	Project Management	14	15	17	14	16	18	13	14	15	13.7	15.0	16.7	0.20
104	R/W Property Acceptances	44	48	52	45	50	52	43	46	49	44.0	48.0	51.0	0.15
105	Base Maps	36	38	40	36	37	39	35	36	37	35.7	37.0	38.7	0.08
106	Coordinate Utilities	7	8	9	7	8	9	8	9	10	7.3	8.3	9.3	0.24
107	EPA Acceptance	13	14	15	14	15	16	13	15	17	13.3	14.7	16.0	0.18
108	Alignment Surveys	32	35	38	32	35	37	32	34	35	32.0	34.7	36.7	0.13

* Note: = ABS (Average Low - Average High)/Average

This ratio indicates the degree of variability in the estimates

FIGURE 5.2

Phase Estimating over Product Life Cycle

Phase	Need 1	Specifications 2	Design 3	Produce 4	Deliver 5
1			Macro estimate		
2		Detailed estimate	Macro estimate		
3			Detailed estimate	Macro estimate	
4				Detailed estimate	Macro estimate
5					Detailed estimate

FIGURE 5.3

McGraw-Hill/Irwin 5–15

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

Developing Budgets

- ## Time-Phased Budgets

  - A cost estimate is not a budget unless it is time-phased.

    - Time phasing begins with the time estimate for a project.

    - Time-phased budgets mirror how the project's cash needs (costs) will occur or when cash flows from the project can be expected.

    - Budget variances occur when actual and forecast events do not coincide.

Work Package Estimates

WP Description **Final version**

WP ID **1.1.3.2**

Deliverable **Circuit board**

Original Unit **Software**

WP Duration **3** Work Weeks

Page **1** of **1**

Project **PC Proto**

Date **9/29/XX**

Estimator **RMG**

Total Budget $ **265**

Time-Phased Budget ($)

Work periods

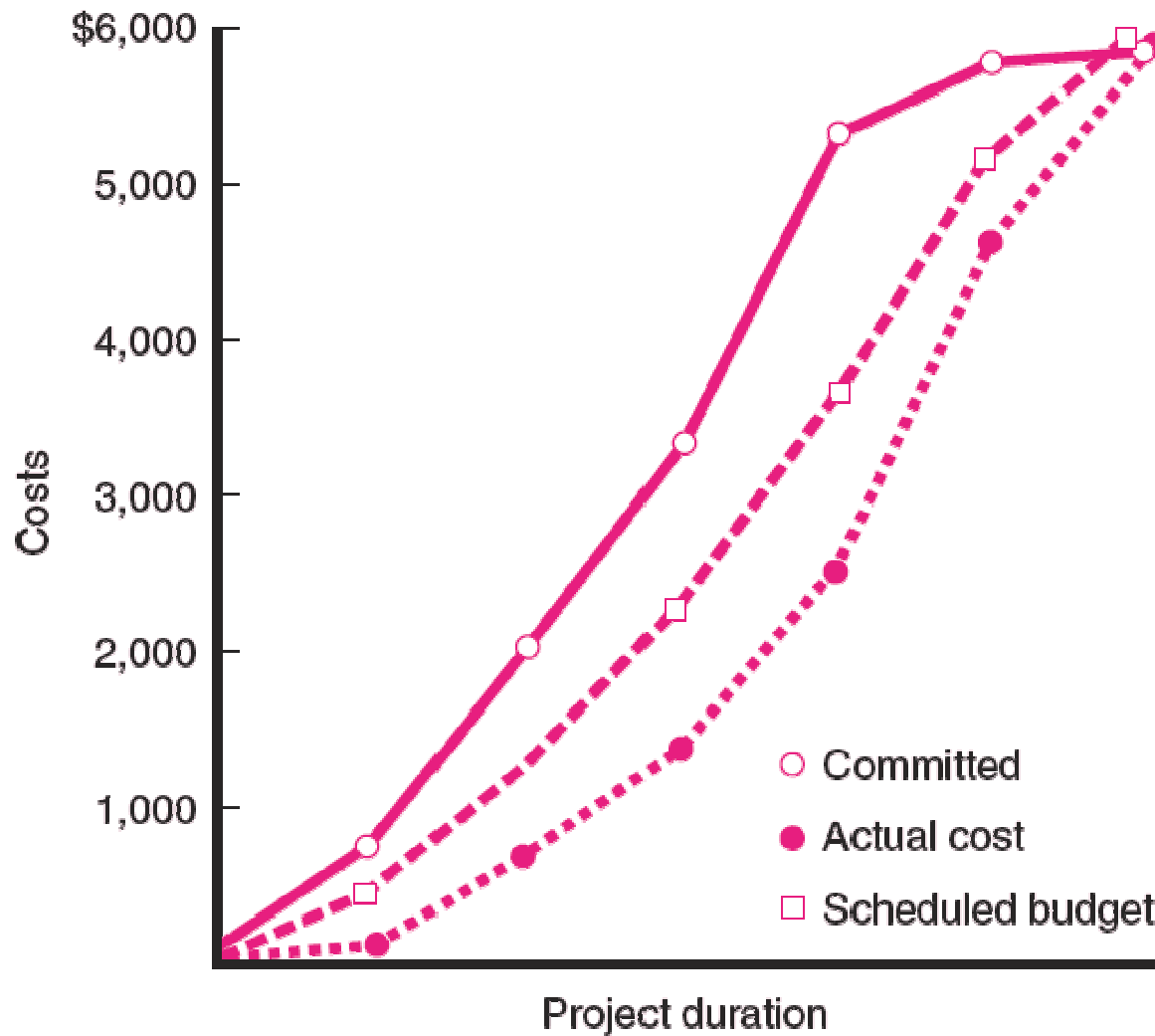| Direct costs	Rate	1	2	3	4	5	Total
Code	$ XX/hr	50	30	20			$100
Document	$ XX/hr		10	15			25
Publish	$ XX/hr			5			5
Total labor		50	40	40			$130
Materials			20				20
Equipment	$ XX/hr	50	15	50			115
Other _____							
Total direct		100	75	90			$265

FIGURE 5.4

Three Views of Cost

FIGURE 5.5

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

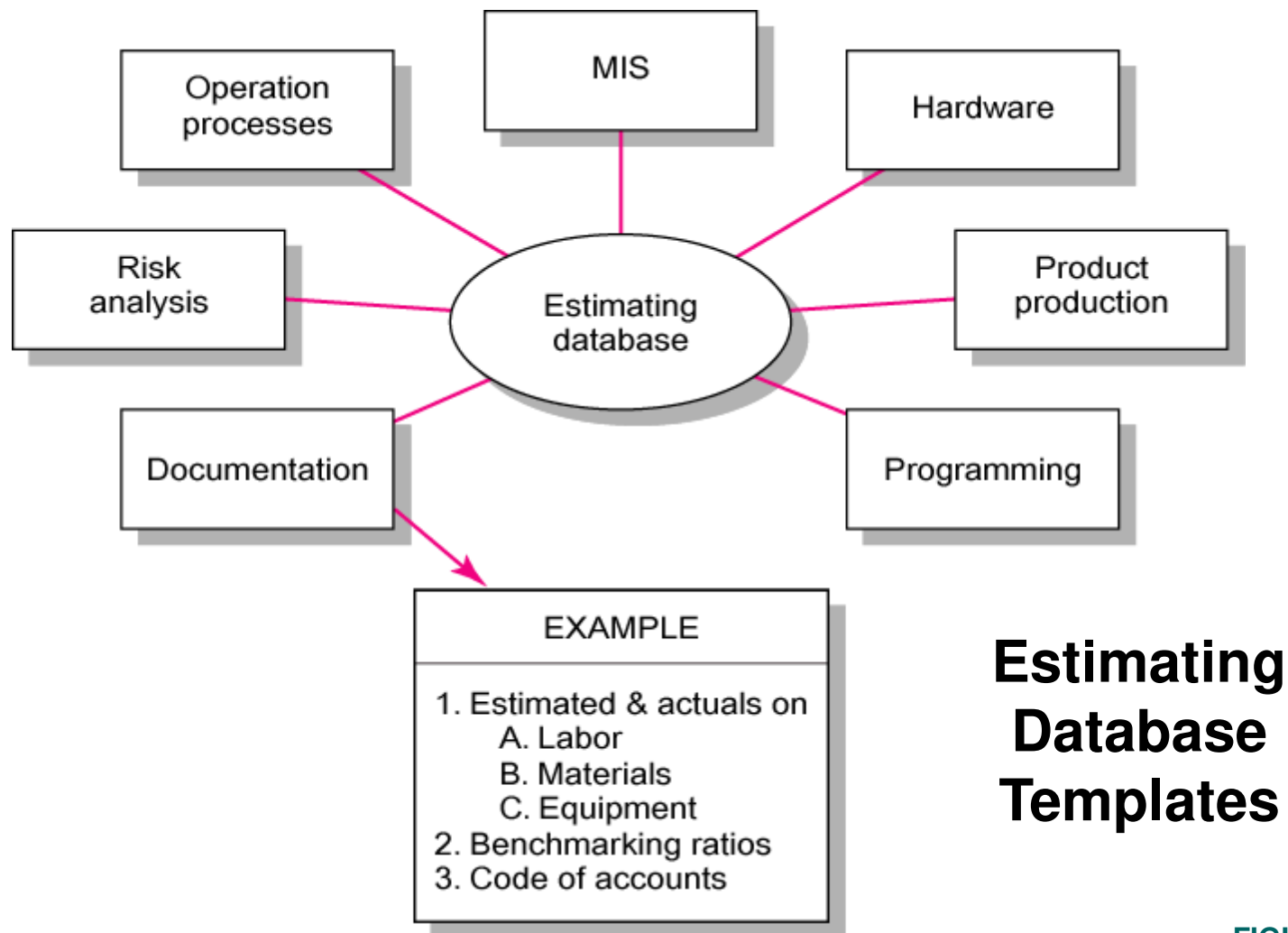|	
Direct costs	$80,000
Direct overhead	$20,000
G&A overhead (20%)	$20,000
Profit (20%)	$24,000
Total bid	$144,000

FIGURE 5.6

Refining Estimates

- ## Reasons for Adjusting Estimates
  - Interaction costs are hidden in estimates.
  - Normal conditions do not apply.
  - Things go wrong on projects.
  - Changes in project scope and plans.

- ## Adjusting Estimates
  - Time and cost estimates of specific activities are adjusted as the risks, resources, and situation particulars become more clearly defined.

Refining Estimates (cont'd)

- ## Contingency Funds and Time Buffers
  - Are created independently to offset uncertainty.
  - Reduce the likelihood of cost and completion time overruns for a project.
  - Can be added to the overall project or to specific activities or work packages.
  - Can be determined from previous similar projects.

- ## Changing Baseline Schedule and Budget
  - Unforeseen events may dictate a reformulation of the budget and schedule.

Creating a Database for Estimating

MIS

Operation processes

Hardware

Risk analysis

Estimating database

Product production

Documentation

Programming

EXAMPLE

1. Estimated & actuals on
   A. Labor
   B. Materials
   C. Equipment
2. Benchmarking ratios
3. Code of accounts

Estimating Database Templates

FIGURE 5.7

Key Terms

Apportionment methods

Contingency funds

Delphi method

Direct costs

Function points

Interaction costs

Learning curves

Macro and micro estimating

Overhead costs

Padding estimates

Phase estimating

Ratio methods

Template method

Time and cost databases

Time-phased budgets