projectmanagement

Project Planning and Estimating

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Project Planning and Estimating

Workshop Agenda

- Introduction: Review of Project Management and the Work Breakdown Structure (WBS)
- Estimating
- Scheduling Techniques
- Baselines

Workshop Objectives

By the end of this course, you will be able to—

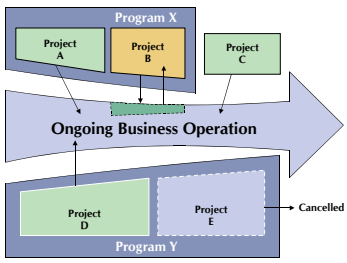
- Use the WBS to identify, assign, and tabulate resource requirements
- Predict costs and work times using specific levels and estimate types from the WBS
- Use the WBS to develop a network diagram
- Calculate schedules using the Precedence Diagramming Method (PDM)
- Interpret data gained from time-phased distribution of project costs

Introduction: Review of Project Management and the WBS

What Is a Project?

A temporary endeavor undertaken to create a unique product, service, or result.

—*PMBOK® Guide*, p. 5



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Project Management

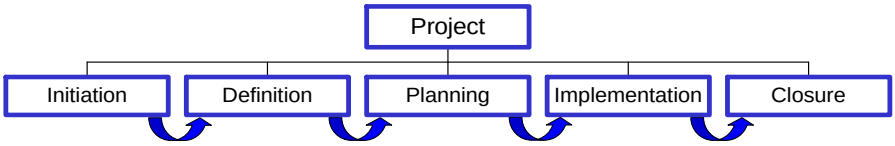
- *[T]he application of knowledge, skills, tools and techniques to project activities to meet [the] project requirements*
- *[A]ccomplished through the application and integration of the project management processes of initiating, planning, executing, monitoring and controlling, and closing.*

—PMBOK® Guide, p. 8

Sound project management helps ensure success.

Project Life Cycle

Project Life Cycle Used in this Workshop



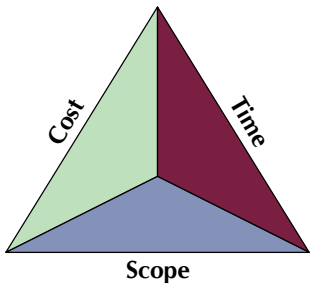
Phase	*Purpose*
Initiation	Introduce project to obtain approval and create project charter
Definition	Document project scope, deliverables, and methods for containing scope
Planning	Create plan to document the activities required to complete the project, the sequence of activities, the resources assigned to the activities, and the resulting schedule and budgets
Implementation	Execute and manage the plan, using artifacts created in the planning phase
Closure	Formally review the project, including lessons learned and turnover of project documentation

Why Scheduling and Cost Control?

The triple constraint—

- Has the most clearly measurable indexes for project management
- Delivers business results

It's what we do!



Organizing the WBS

- Define the project—
  - Scope
  - Tasks
  - Work packages
  - Technical baseline
- Organize the WBS to—
  - Allow for realistic estimating
  - Allow assignment to a single organizational unit or allow for exclusive responsibility
- Use tools consistent with your comfort level and project needs

WBS Review

The WBS should—

- Be consistent
- Be task-oriented and start with a verb, **or** be deliverables oriented and start with a noun
- Be decomposed to your level of control
- Ensure that each work package accomplishes a discrete work element
- Make work packages SMART

Exercise 1

Office Move

Use the following major categories to develop a WBS of those activities necessary to accomplish an office move: project management; pre-move activities; moving activities; post-move activities.

Arrange the following tasks as work packages under the four headings described above: select furniture; prepare office for move; hold kickoff meeting; set up utilities (wiring and so on); complete internal construction to final floor plan; plan move; move/relocate; install new furniture, communications equipment, and computers; install new signs; close out project.

Estimating

Estimating Basics

- An estimate—
  - Is a quantitative assessment of the likely amount or outcome
  - Is usually applied to project costs, resources, effort, and durations and is usually preceded by a modifier
  - Should always include some indication of accuracy
- "Resources" are—
  - Skilled human resources
  - Equipment
  - Supplies
  - Budgets or funds

Source: PMBOK® Guide, *pp. 360, 372*

Estimating Recommendations

- Use the most accurate method available
- Communicate the level of precision
- Gain agreement on the level of precision
- Involve the team
- Assess the environment
- Base estimates on history
- Use standards (if available)
- Do not develop estimates from the budget
- Base estimates on known or committed operational plans
- Account for likely conditions and circumstances
- Base estimates on assumptions of staff, team, and working conditions
- Include date and version stamp
- Do not pad the estimates

Resource Planning

Fundamental questions

- What needs to be done?
- Who and what do we need?
- Who can do the work?
- What can do the work?
- Who and what can we get?
- What level of excellence and competence is essential?
- How will we use the resources?
- How will the resources affect schedules and costs?

Roles and Responsibilities Matrix

Task \ Resource	Pat	Jean	Francis
1.1.1			
1.1.2			
1.1.3			

R—Responsible
A—Accountable
C—Consult
I—Inform

Source: PMBOK® Guide, *p. 206*

Resources as Sources for Estimates

Who provides the best estimates?

- Outside sources
- Those who know the work
- Those who are accountable
- Those who do the work

Estimating Durations

Duration Considerations

- ***Effort hours:*** Resource hours required to complete a task (24 effort hours = 3 resource days)
- ***Working time:*** Period of time in which actual work on a project or task can and should be completed (24 hours = 3 days)
- ***Elapsed time:*** Calendar duration, including weekends, holidays, and breaks (24 hours = 1 day)
- ***Productivity:*** Rate at which work is produced
- ***Availability:*** Resources present and ready to work
- ***Contiguous duration:*** Work time that is not interrupted
- ***Interruptible duration:*** Work time that may be interrupted

Productivity and Availability in Resource-Driven Estimates

$$\text{Cost} = \frac{\text{Effort}}{\text{Productivity}} \text{ x Unit Cost}$$

$$\text{Duration} = \frac{\text{Effort/Productivity}}{\text{Availability}}$$

Exercise 2

Estimating Task Cost and Duration

Three team members are being considered for an assignment. Your subject matter expert estimated that the task will take 90 effort hours for an individual with average productivity. The following resource matrix provides measures of individual productivity, availability, and unit cost for each team member.

	Bill			Kim			Juan		
Task	***Prod***	***Avail***	***$/Hr***	***Prod***	***Avail***	***$/Hr***	***Prod***	***Avail***	***$/Hr***
Install communications equipment	60%	50%	$45	120%	40%	$80	100%	40%	$60

Calculate the cost and duration for each person to accomplish the task.

Program Evaluation and Review Technique (PERT)

$$\text{Estimated Time} = \frac{\text{Optimistic} + (4 \times \text{Most Likely}) + \text{Pessimistic}}{6}$$

$$e_{(t)} = \frac{3 \text{ days} + (4 \times 5 \text{ days}) + 8 \text{ days}}{6} = 5.17 \text{ days}$$

NOTE: PERT is useful in estimating cost as well as schedule.

Scheduling Techniques

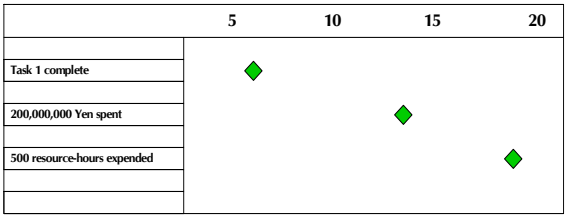
Scheduling Techniques

- Milestone charts
- Gantt charts
- Network diagrams

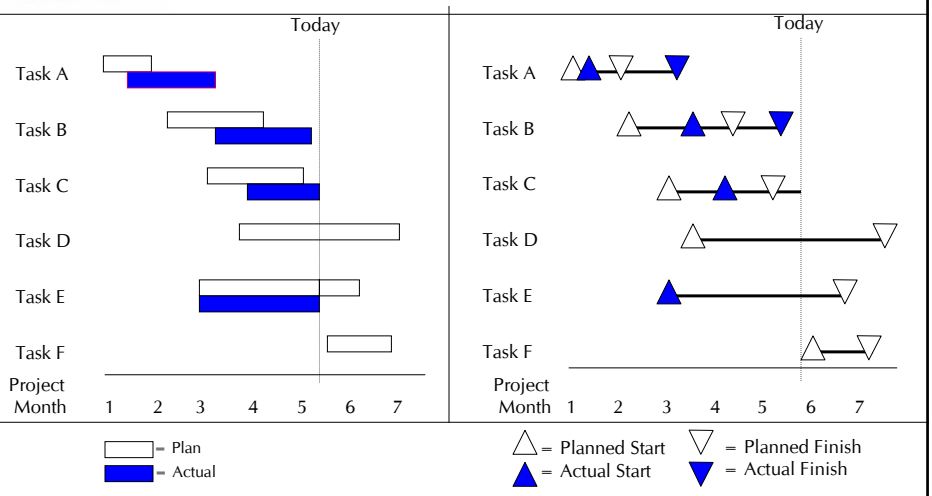
Setting Milestones

Milestones—

- Are significant events
- Denote achievements regarding time, money, and tasks
- Consume no time



Gantt Charts



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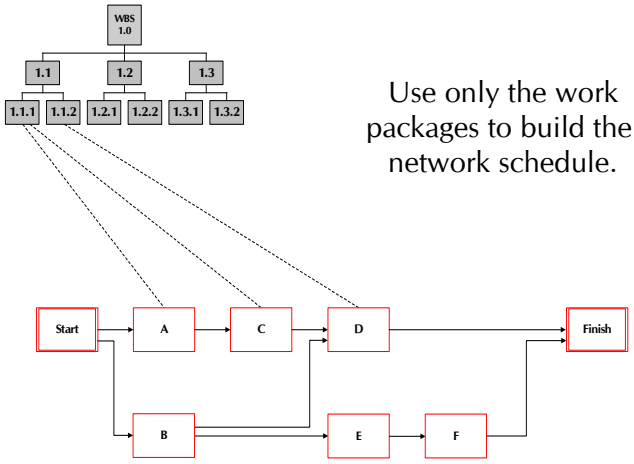
WBS and Network Diagramming



Use only the work packages to build the network schedule.

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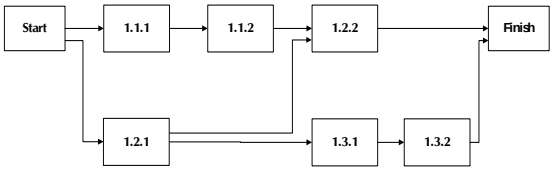
Precedence Diagramming Method (PDM)

A schedule network diagramming technique in which schedule activities are represented by boxes (or nodes). Schedule activities are graphically linked by one or more logical relationships ...

—PMBOK® Guide, p. 367



PDM uses activity-on-node (AON) diagrams

- Arrows show various relationships (finish-start, start-start, finish-finish, start-finish)
- Accommodates lag and lead

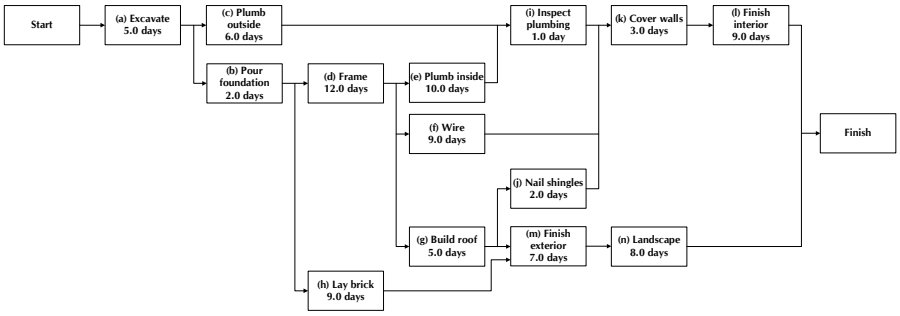
Scheduling Sample

- Construction chart for a house

Activities and Times to Build a House

Activity	*Immediately Preceding Activity*	*Expected Completion Time (days)*
(a) Excavate	—	5
(b) Pour foundation	a	2
(c) Plumb outside	a	6
(d) Frame	b	12
(e) Plumb inside	d	10
(f) Wire	d	9
(g) Build roof	d	5
(h) Lay brick	b	9
(i) Inspect plumbing	c, e	1
(j) Nail shingles	g	2
(k) Cover walls	f, i, j	3
(l) Finish interior	k	9
(m) Finish exterior	h, g	7
(n) Landscape	m	8

PDM Sample



Exercise 3

Network Diagram for the Office Move

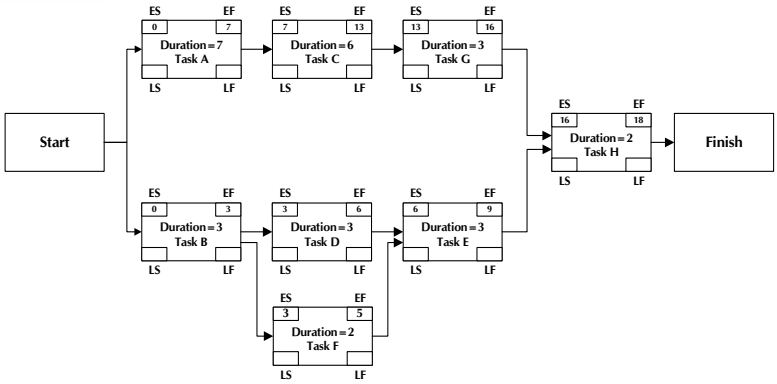
Using the WBS you developed for the office move and the durations provided below, build a network diagram for the office move.

Work Package/Activities	*Duration (days)*
Plan move	20
Hold kickoff meeting	1
Select furniture	25
Prepare office for move	20
Move/relocate	5
Set up utilities	30
Close out project	5
Install new signs	15
Complete internal construction to final floor plan (build out)	45
Install new furniture/communications equipment/computers	10

Basic Scheduling

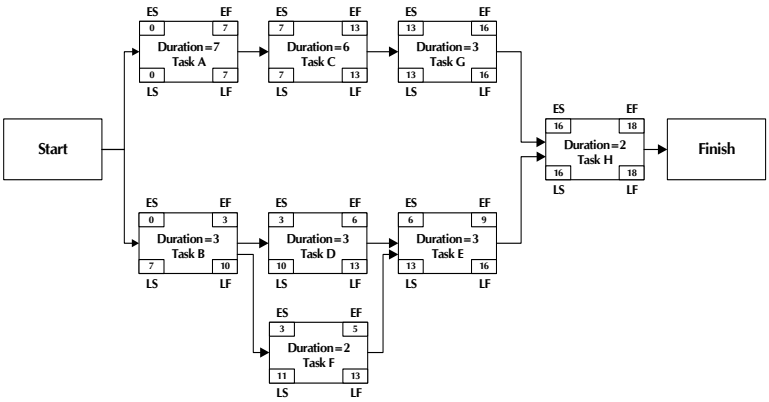
Early start (ES)	Early finish (EF)
How _____ can this activity _____ based on the network logic and constraints?	
Late start (LS)	**Late finish (LF)**

Forward Pass



ES + duration = EF

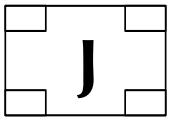
Backward Pass



Total Float

Activities—not projects—may have float.

- Total float (also called slack, float, or path float)
  - "The total amount of time that a schedule activity may be delayed from its early start date without delaying the project finish date"*
  - Late finish minus early finish ($LF_j - EF_j$)
  - Late start minus early start ($LS_j - ES_j$)

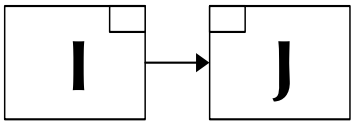


**Source:* PMBOK® Guide, *p. 378*

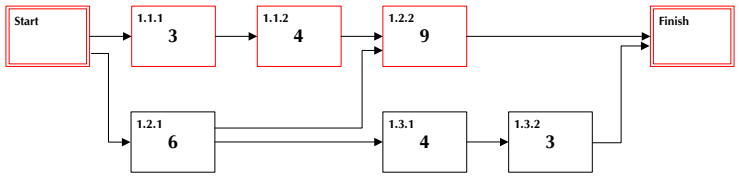
Free Float

The amount of time that a schedule activity can be delayed without delaying the early start of any immediately following schedule activities.

—PMBOK® Guide, p. 362



Critical Path



- Path on which any delay in project activities will affect the project schedule
- Longest of all paths through the project
- Path with the least float or slack time
- Shortest time to complete the project

Lag and Lead Times

Lag

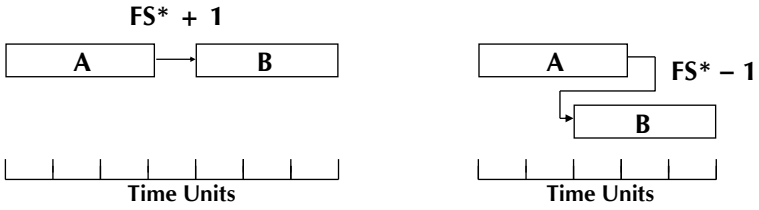
A modification of a logical relationship that directs a delay in the successor activity.

—PMBOK® Guide, p. 363

Lead

A modification of a logical relationship that allows an acceleration of the successor activity.

—PMBOK® Guide, p. 363

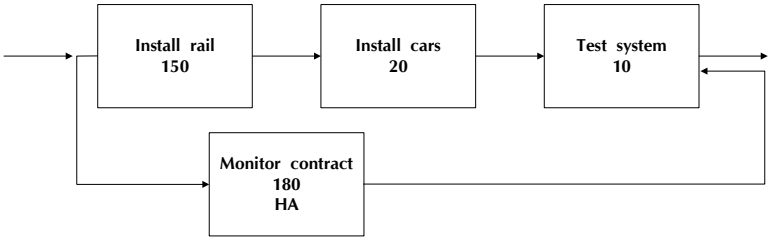


*FS = Finish–Start

Hammock Activity

A group of related schedule activities aggregated at some summary level, and displayed/reported as a single activity at that summary level.

—PMBOK® Guide, p. 362



Techniques for Decreasing Project Duration (Schedule Compression)

- ***Crashing tasks:*** Reducing the duration of activities on the critical path in any possible way
- ***Crashing a network:*** A "[s]chedule compression technique in which cost and schedule trade-offs are analyzed to determine how to obtain the greatest amount of compression for the least incremental cost"*
- ***Fast tracking:*** "A schedule compression technique in which phases or activities that normally would be done in sequence are performed in parallel"*

*Source: PMBOK® Guide, pp. 145-146

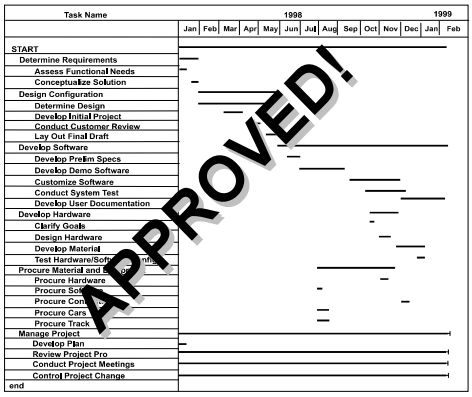
Resource Trade-Offs: Leveling

- Leveling is the rescheduling of tasks with float to resolve resource issues
- Steps:
  - Determine early and late schedules
  - Evaluate resource loading for each schedule
  - Identify free float
  - Adjust activities (tasks) on an activity-by-activity basis within the float to fit available resources
  - Determine new schedule

Baselines

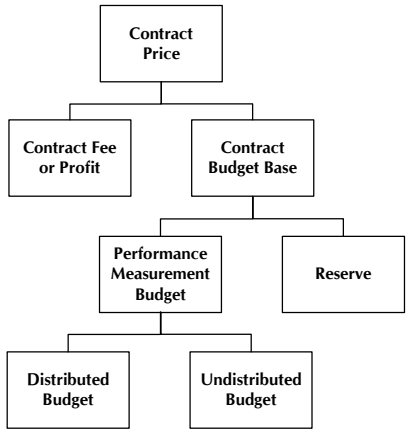
The Basics of Baselines

- A baseline is the original approved plan, plus approved scope changes
- The baseline establishes a reference against which project managers can measure actual project progress

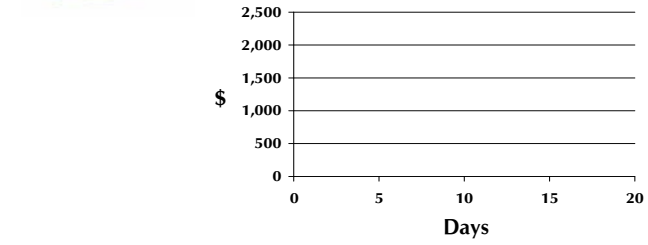


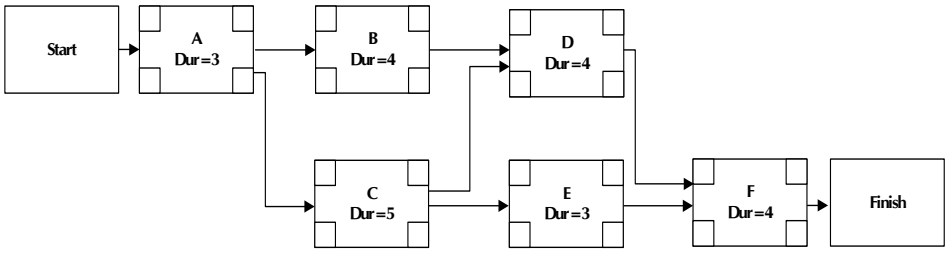
Cost Baseline

Project Budget Model



Cost Baseline Sample

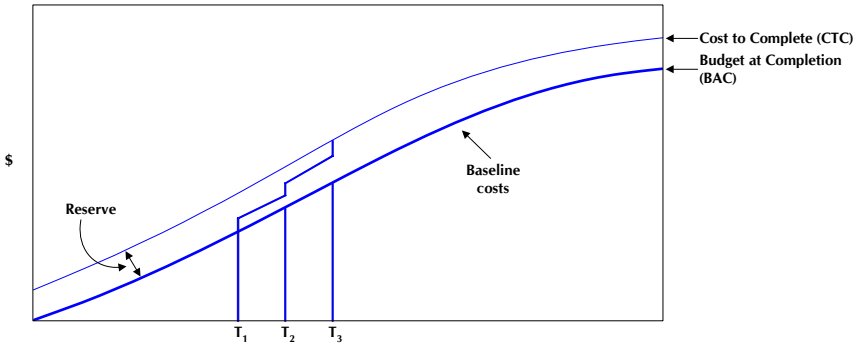




Baseline Costs Plus Reserve

Reserve is money or time provided for in the project plan to mitigate cost, schedule, or performance risk.

—Ward, p. 188



Exercise 4

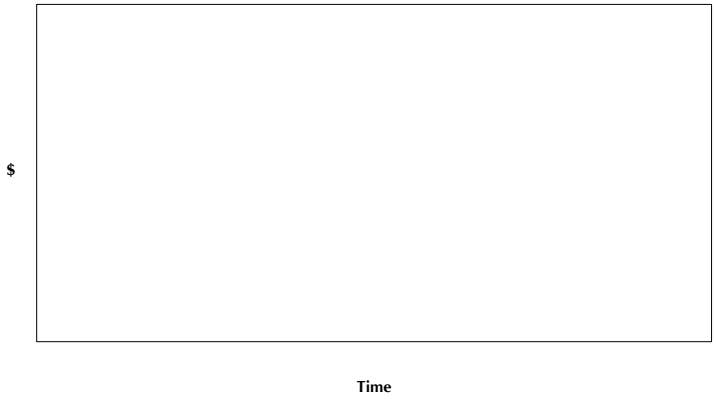
Develop a Baseline

Using the graph on the next slide, develop a cumulative cost curve based on the network diagram you created for the office move.

Work Package/Activities	*Estimated Cost*
Plan move	$0
Hold kickoff meeting	$50
Select furniture	$0
Prepare office for move	$1,100
Move/relocate	$10,000
Set up utilities	$150
Close out project	$0
Install new signs	$1,000
Complete internal construction to final floor plan (build out)	$20,000
Install new furniture/communications equipment/computers	$15,000

Exercise 4

Develop a Baseline (continued)



Workshop Review

By now, you should be able to—

- Use the WBS to identify, assign, and tabulate resource requirements
- Predict costs and work time using specific levels and estimate types from the WBS
- Use the WBS to develop a network diagram
- Calculate schedules using the Precedence Diagramming Method (PDM)
- Interpret data gained from time-phased distribution of project costs

Bibliography and Suggested Reading

- Project Management Institute. *A Guide to the Project Management Body of Knowledge*. Newtown Square, Pa.: Project Management Institute, 2004.
- Ward, LeRoy, ed. *Project Management Terms: A Working Glossary*. Arlington, Va.: ESI International, 2000.

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