Managing Projects

Project Planning and Acquisition

What Is a Project?

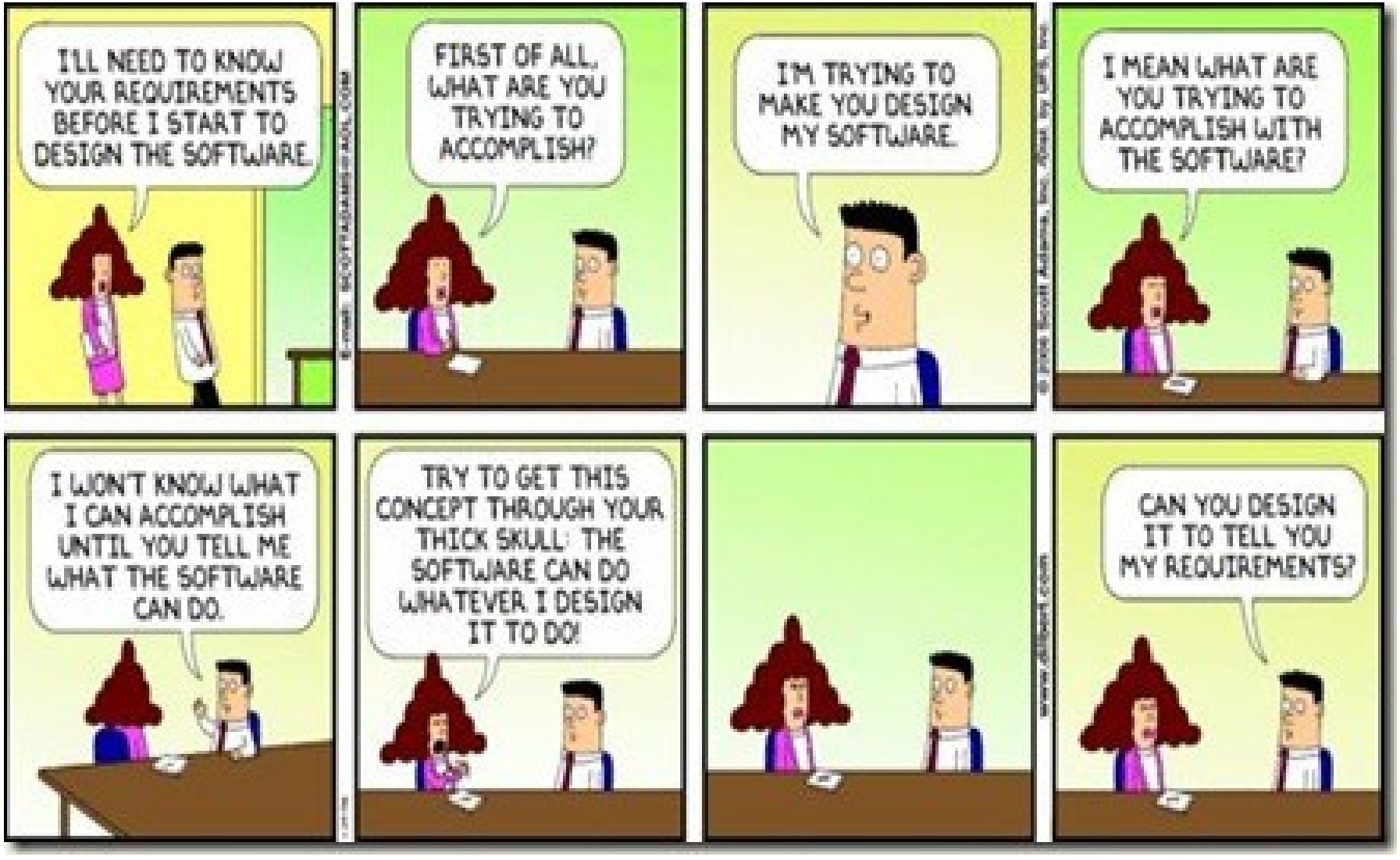
- Definition
  - A complex, nonroutine, one-time effort limited by time, budget, resources, and performance specifications designed to meet customer needs.
- Major Characteristics of a Project
  - Has an established objective.
  - Has a defined life span with a beginning and an end.
  - Typically requires across-the-organizational participation.
  - Involves doing something never been done before.
  - Has specific time, cost, and performance requirements.

Characteristics of Project

A **project** represents a collection of tasks aimed toward a single set of objectives, culminating in a definable end point and having a finite life span and budget.

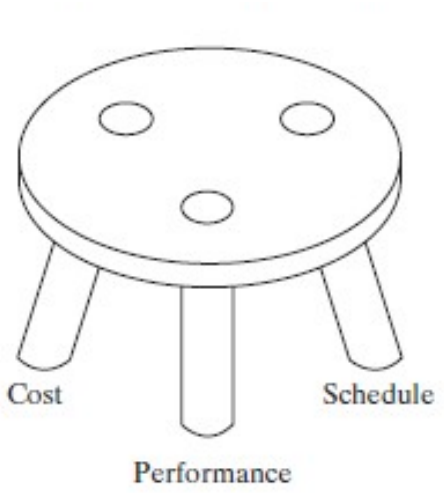
A project is a *one-of-a-kind activity*, aimed at producing some product or outcome that has never existed before.

In contrary, a “**program**” is a more comprehensive undertaking, which may in turn consist of a number of projects.


I'LL NEED TO KNOW YOUR REQUIREMENTS BEFORE I START TO DESIGN THE SOFTWARE.
FIRST OF ALL, WHAT ARE YOU TRYING TO ACCOMPLISH?
I'M TRYING TO MAKE YOU DESIGN MY SOFTWARE.
I MEAN WHAT ARE YOU TRYING TO ACCOMPLISH WITH THE SOFTWARE?
I WON'T KNOW WHAT I CAN ACCOMPLISH UNTIL YOU TELL ME WHAT THE SOFTWARE CAN DO.
TRY TO GET THIS CONCEPT THROUGH YOUR THICK SKULL: THE SOFTWARE CAN DO WHATEVER I DESIGN IT TO DO!
CAN YOU DESIGN IT TO TELL YOU MY REQUIREMENTS?

The “three-legged-stool” of successful project management

- Time (project schedule)
- Cost
- Performance and quality



- The successful project manager will attempt to keep these three in balance.
- To achieve this balance, all projects will have scope, schedule, and budget
- Since achieving maximum performance is often possible only at the expense of cost and schedule, difficult trade-off decisions involving compromises are often necessary.

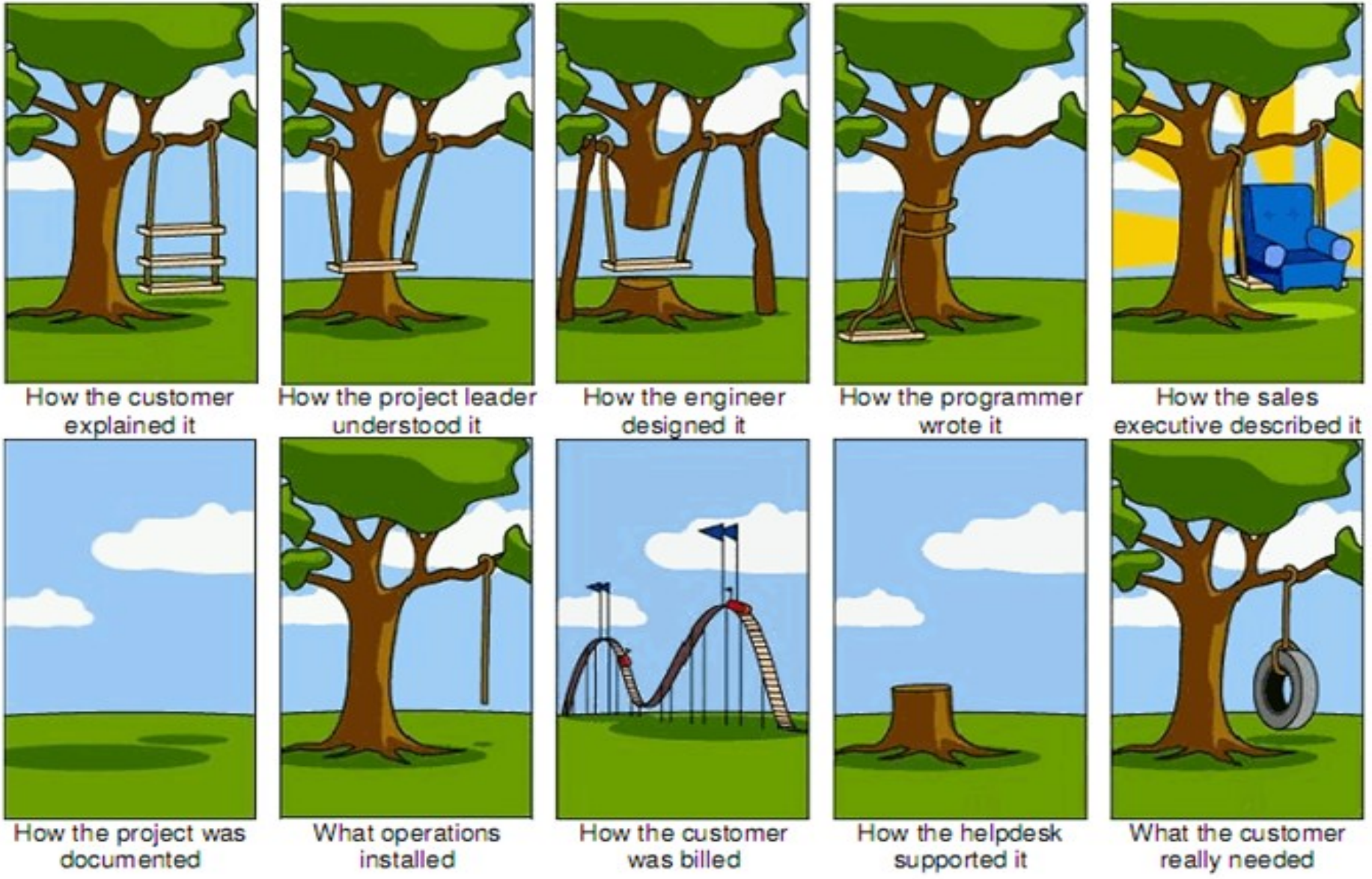
Programs and Projects

To achieve their strategic objectives, organizations will define and implement new programs. A program will consist of a series of related projects that collectively make up the program. Projects differ from an organization's normal operations in that operations are continuous, while projects have a fixed scope. When the scope of work is completed, the project ends and those working on it move on to other work. In addition to a defined scope, all projects will also have a schedule and a budget.

For example, General Motors might have a program to design new cars that utilize new technology, meet new environmental and safety standards, and appeal to the customer. A specific project within this program might be for Chevrolet to develop a new mid-sized, four-door sedan with a target sale price of $16,000. Programs and projects may also be service oriented. For example, a Fortune 500 firm might have a strategic objective and related program to energize and train its workforce. One project within this program might be to train all engineers in the firm's approach to, policies regarding, and procedures for project management.

Source: Charles "Chick" Keller, retired University of Kansas professor, and Black & Veatch senior executive. 2012.

How Projects Really Works?



The Project Proposal Process

Pre-proposal Effort

- Continuous identification of new business opportunities
- Resources and capabilities
- Expected future needs of potential customers

Proposal Preparation

Proposal Contents

- The RFP (request for proposal) will often specify separate management, technical, and cost proposals and their expected contents

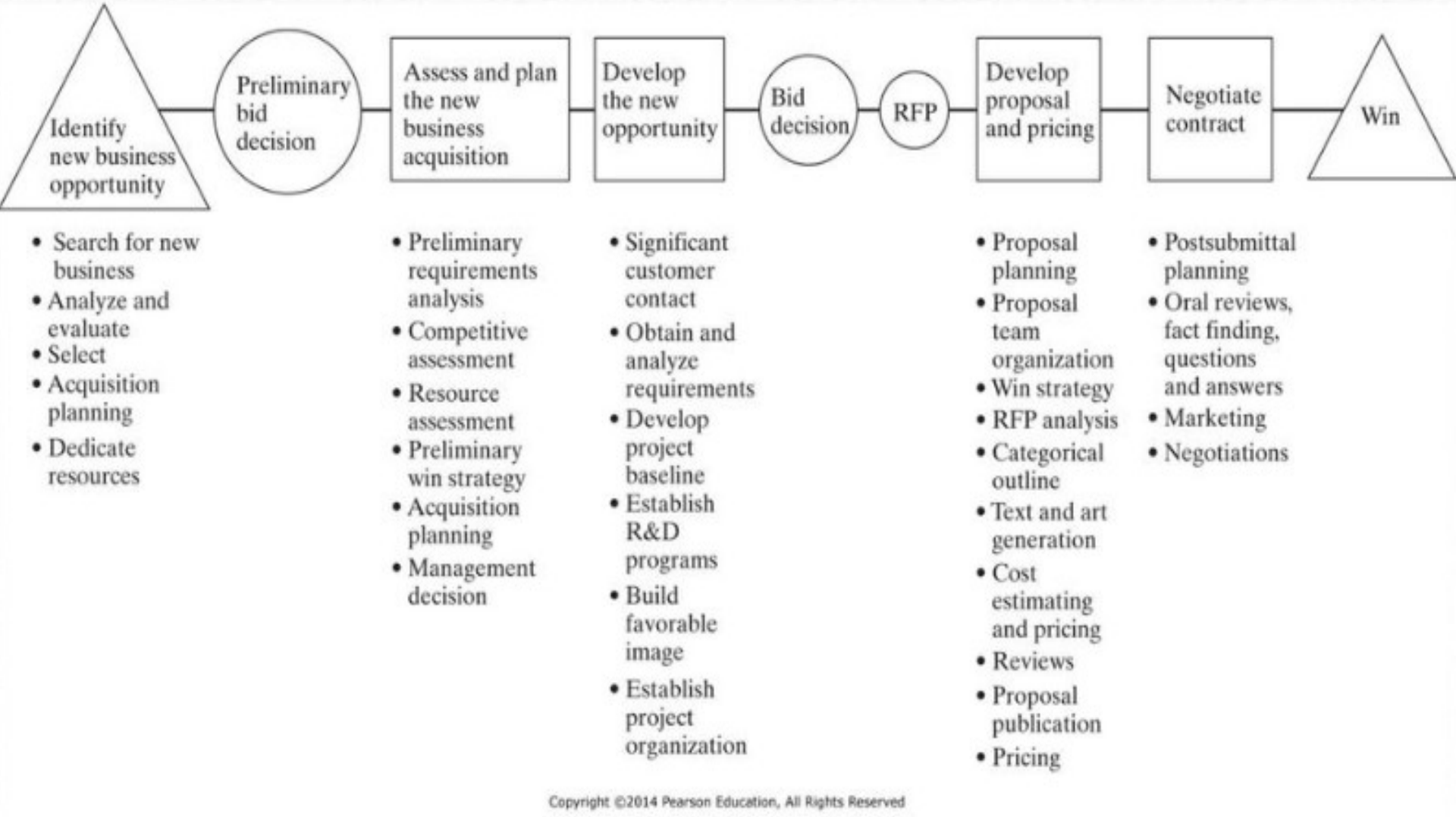


Figure 14-2 Phases in winning new contracts in a project-oriented business.
(From Hans J. Thamhain, *Engineering Project Management*, © John Wiley & Sons, Inc., New York, 1984, p. 55. Reprinted by permission of John Wiley & Sons, Inc.)

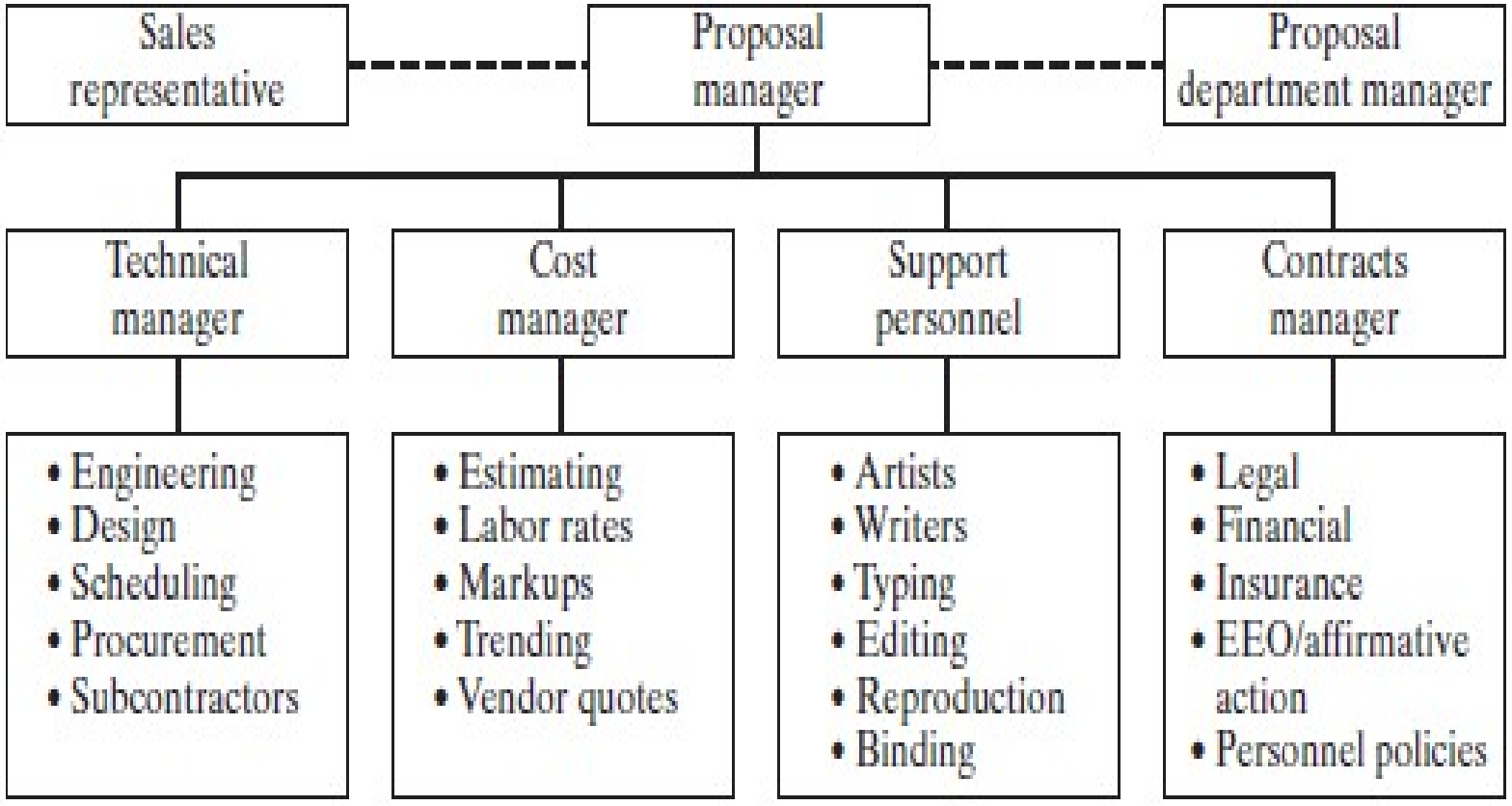
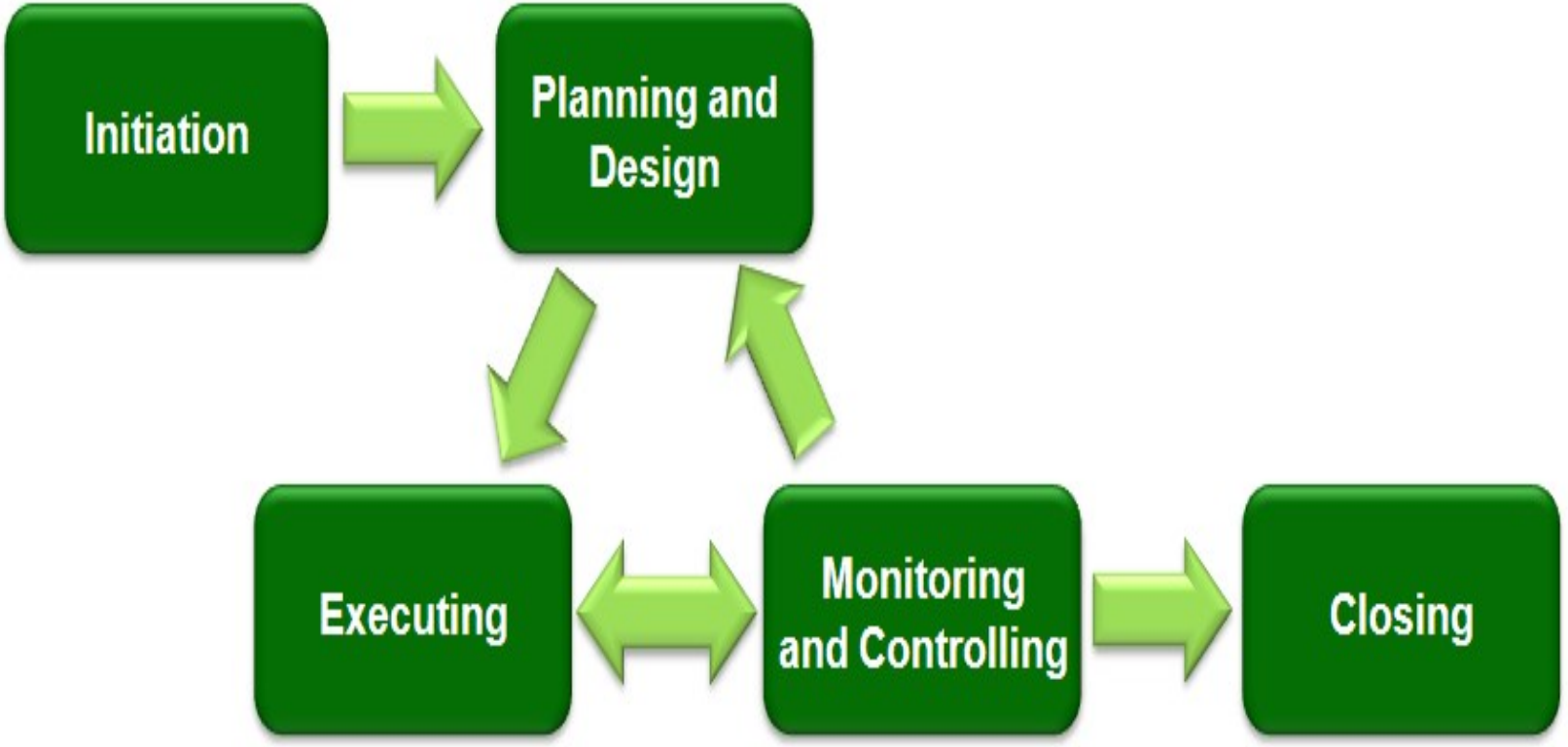


Figure 14-3 Typical organization chart for a major proposal. (Adapted from Harold Kerzner, *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*, 2nd ed., Van Nostrand Reinhold, Inc., New York, 1984, p. 823.)

Project Planning Tools

The Project Management Institute (PMI) identifies five phases in project management:

- **Initiating** the project includes the steps previously described and the preliminary scope.
- **Planning** includes refining the scope and scheduling, which are described in the next section.
- **Executing** has the project manager as the leader of the project team, as described in Chapter 15.
- **Monitoring and controlling** the progress is done on a continuous process with a reporting process and a change process.
- **Closing** the project includes obtaining the customer acceptance, final documentation, and a final report.


Initiation
Planning and Design
Executing
Monitoring and Controlling
Closing

Project Management Processes – Key Activities

INITIATING	PLANNING	EXECUTING	MONITORING & CONTROLLING	CLOSING
• Identifying business needs • Creating a Project Charter • Formal authorization to start project • Articulate the high-level project scope, deliverables, duration, cost, assumption and constrain etc. • Identify stakeholder and create register	• Business Requirement Gathering • Break down work and create WBS • Select and define project team roles • Develop project Schedule • Determine Budget and Quality Standards • Identify risks and create risk response plan	• Complete work packages • Perform QA • Acquire and develop project team • Organize team building activities • Vendor solicitation and selection • Implement approved changes and defect repair. • Project meetings and creating status reports	• Measure against performance baseline • Recommend preventive/corrective actions • Ensuring Quality Control • Implementing change control • Controlling key parameters like cost, schedule and scope • Identify root cause • Conflict Resolution	• Obtain acceptance by the customer or sponsor to formally closing the project. • Complete contract closure • Update lesson learned database • Archiving project records in the PMIS • Perform team member's assessments and release project resources

Three essential elements on every project plan: *scope*, *schedule*, and *budget*.

These elements are interdependent, and a change in one may cause a change in another to restore the balance of the project.

All of these elements are tied together by quality:

- Quality of the deliverables of the project—do these deliverables meet the expectations of the customer?
- Quality of the project process—how well does the project management process work, and how should it be improved?

Project Charter

Project Name			
Project Description			
Project Manager		Date Approved	
Project Sponsor		Signature	

Business Case	Expected Goals/Deliverables

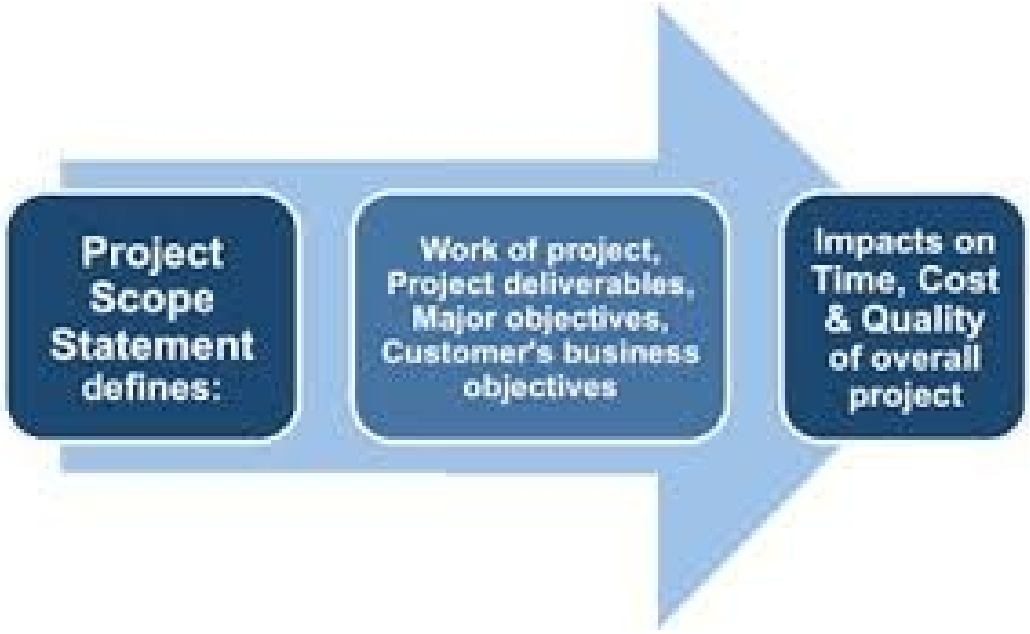
Team Members

Name	Role

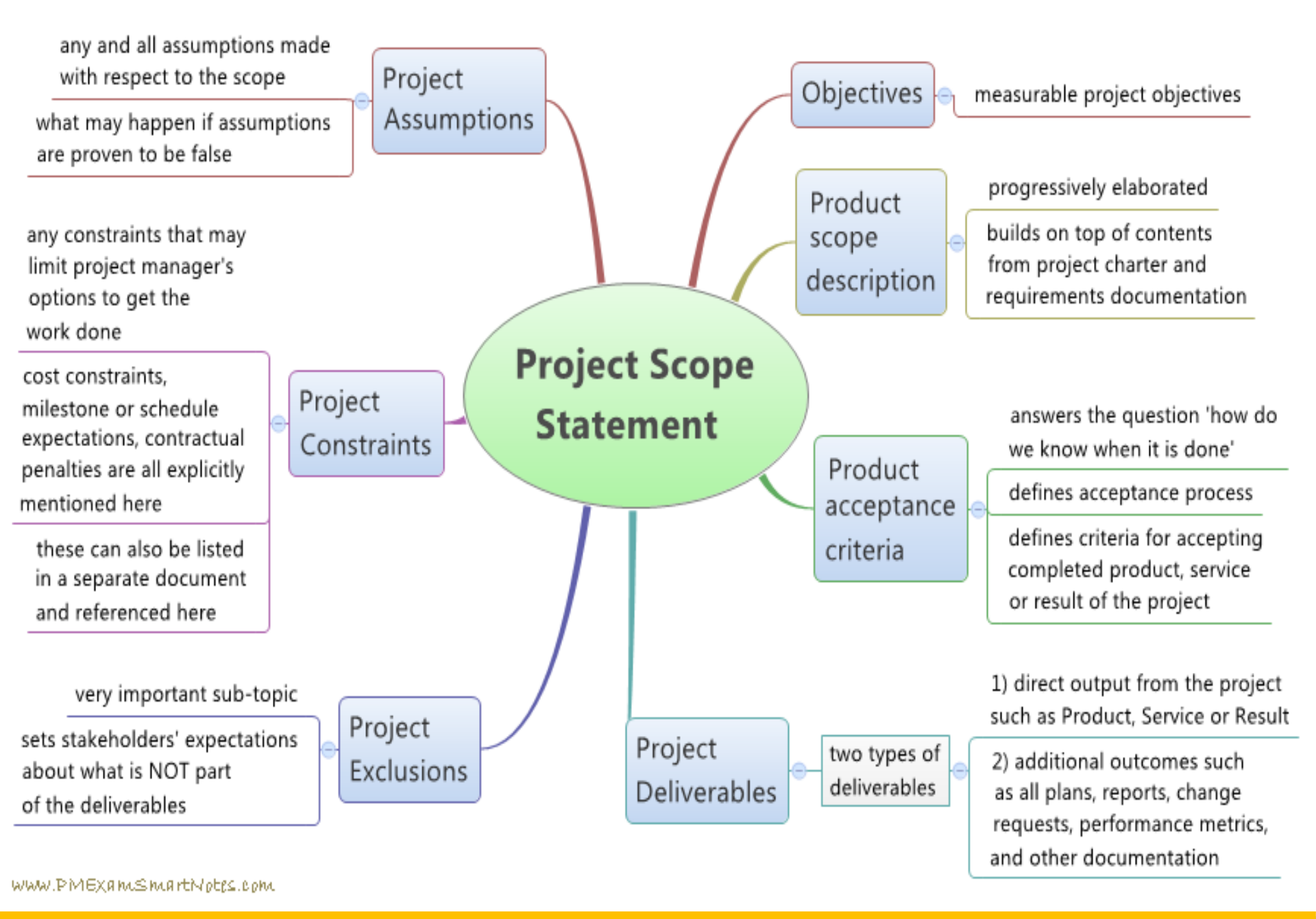
Risks and Constraints	Milestones

Scope

Project Scope Statement: The project scope statement describes, ***in detail***, the project's deliverables and the work required to create those deliverables. The project scope statement also provides a ***common understanding*** of the project scope among all project stakeholders and describes the project's major objectives. It also enables the project team to perform more detailed planning, guides the project team's work during execution, and provides the baseline for evaluating whether requests for changes or additional work are contained within or outside the project's boundaries.


Project Scope Statement defines:
Work of project, Project deliverables, Major objectives, Customer's business objectives
Impacts on Time, Cost & Quality of overall project

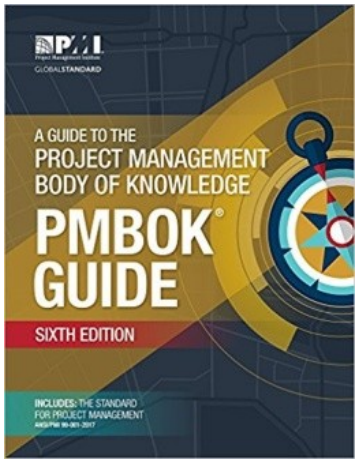

Scope must be constantly monitored to avoid:
Exceeding Project Budget
Overrun Project Timescale
Contravene Stakeholders Expectations



Scope creep is a term that refers to the incremental expansion of the scope of a project, which may include and introduce more requirements that may not have been a part of the initial planning of the project, while nevertheless failing to adjust schedule and budget.

Scope creep may happen in small projects, as well as large projects. Scope creep may be introduced by technologists adding features not originally contem

Scope creep may also occur w
the customer has a difficult ti
making a decision.



Adding features and functionality (project scope) without addressing the effects on time, costs, and resources, or without customer approval.

Scope Creep

Causes rising

- Costs
- Resources
- Time scales

Leading to

- Stakeholders expectations not met
- Poor quality of end product
- Objective missed

Managing scope creep

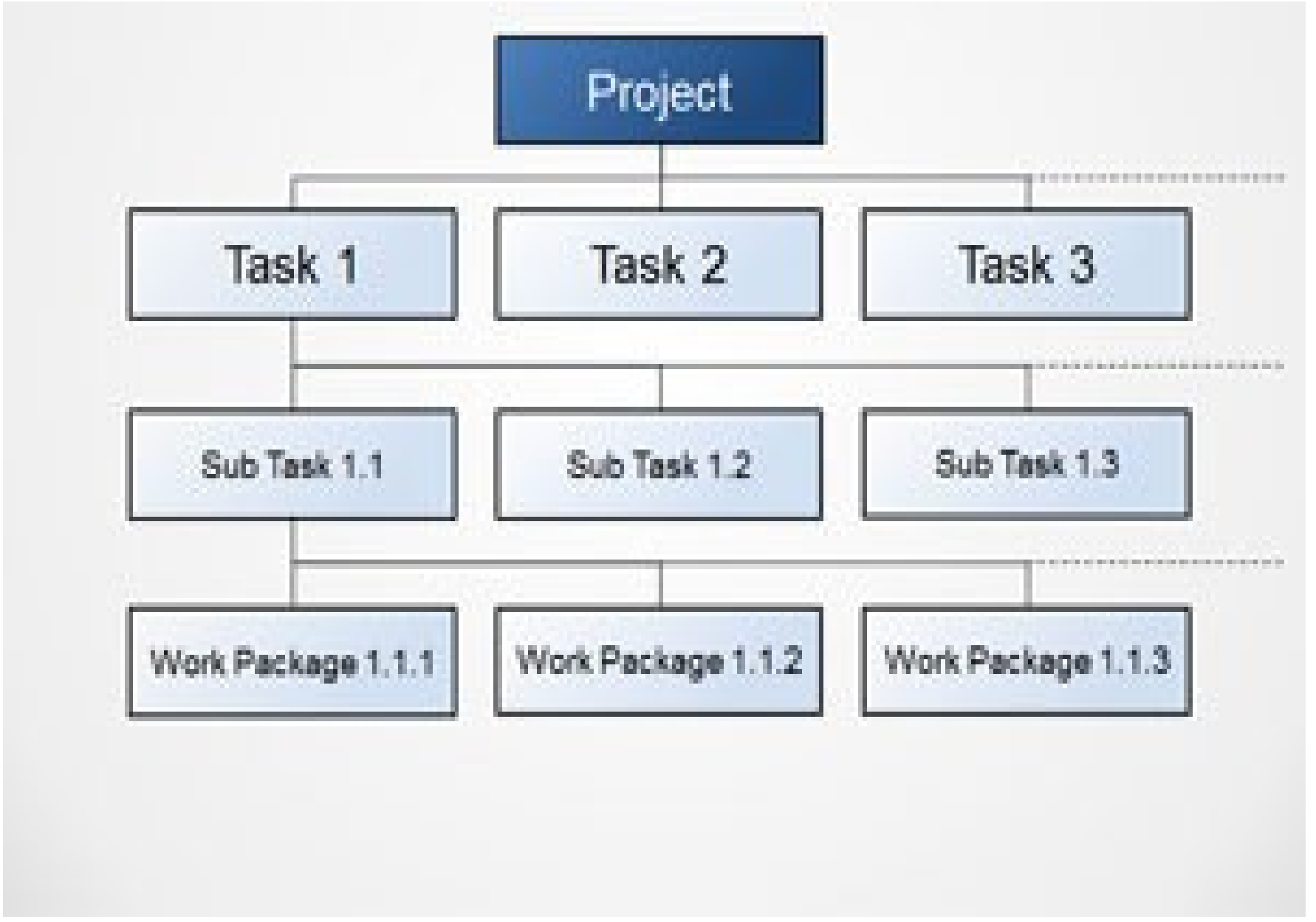
Scope creep is likely to happen when:

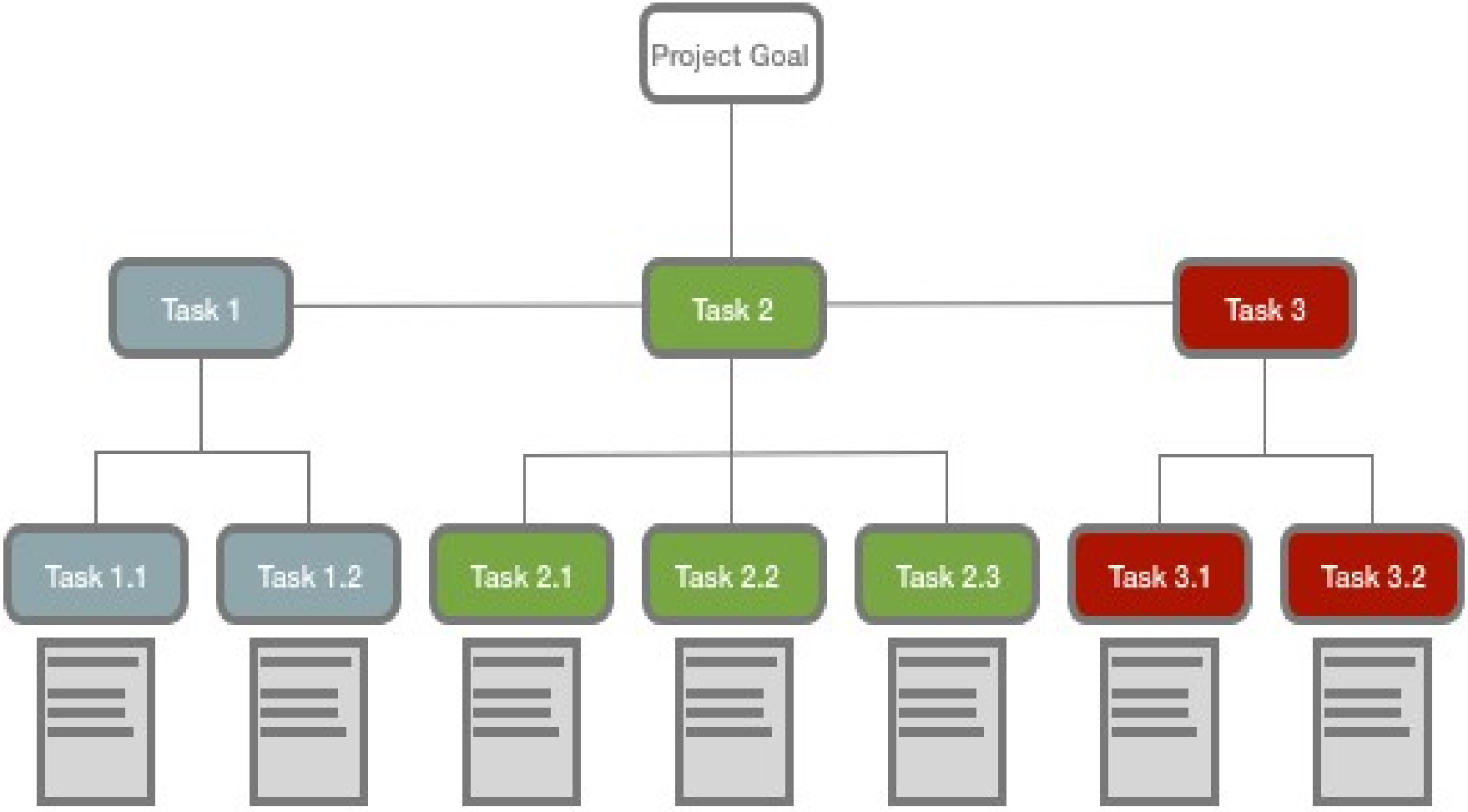
- The scope and requirements documents are unclear or insufficiently detailed.
- The users expect something different from what you plan to provide.
- Project stakeholders are uninvolved until the end of a project.

Schedule

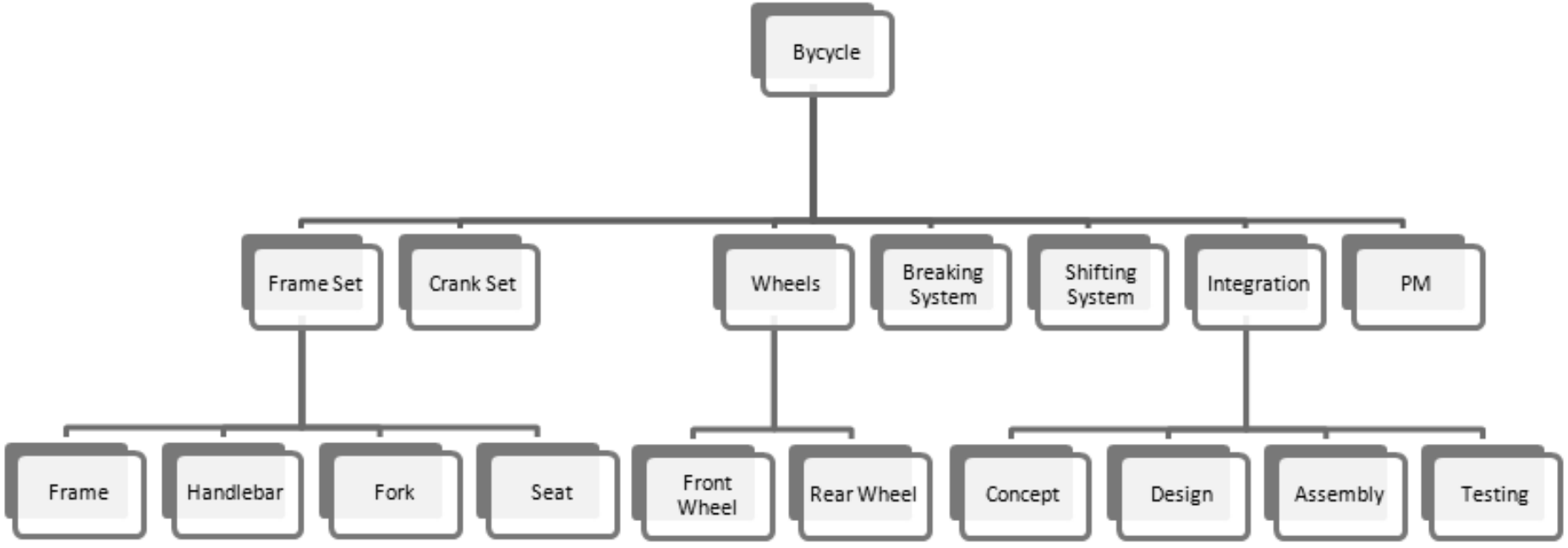
A work breakdown structure

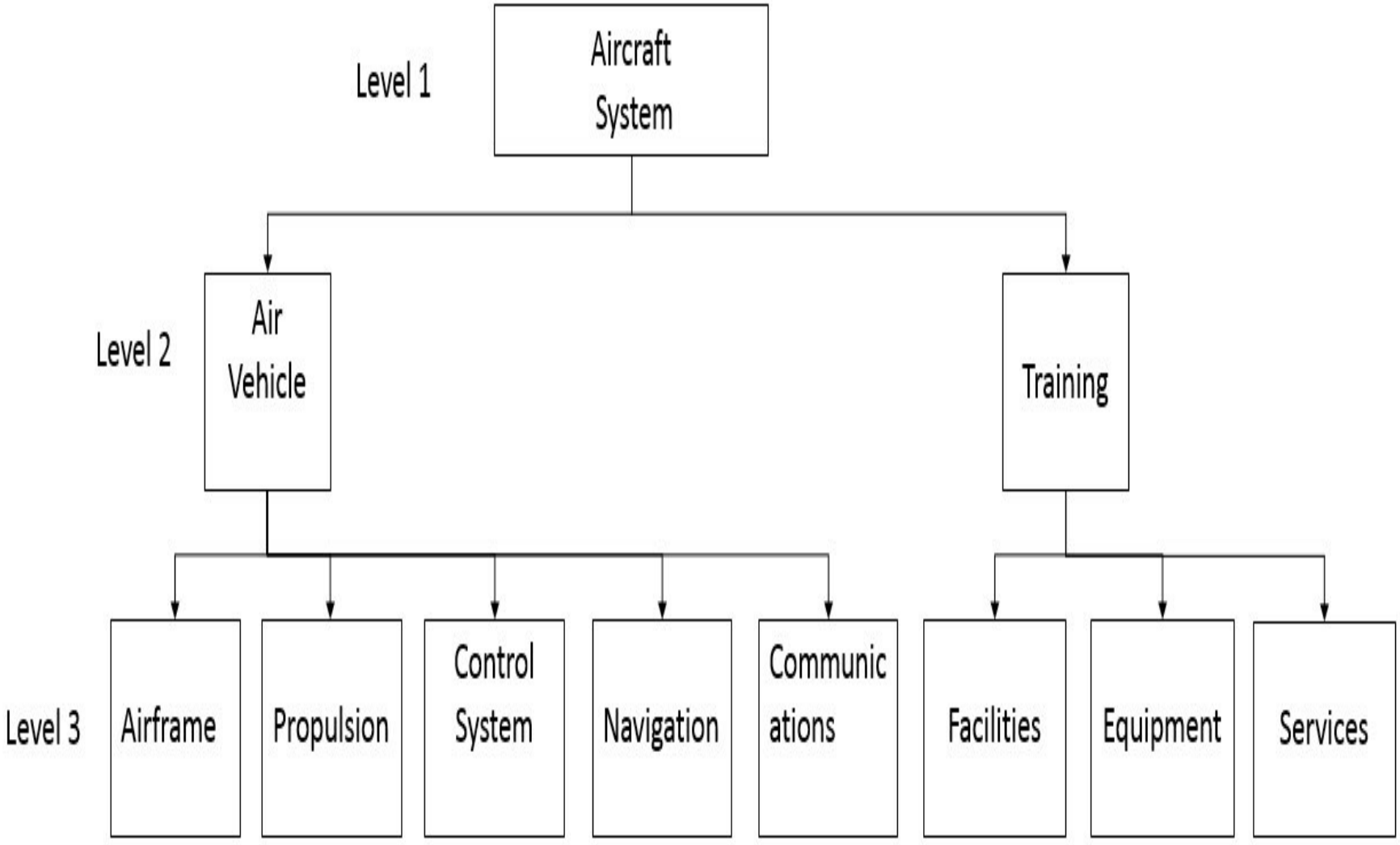
- In project management and systems engineering, is a deliverable oriented decomposition of a project into smaller components.
- A work breakdown structure element may be a **product**, **data**, a **service**, or any combination. A WBS also provides the necessary framework for **detailed cost estimating** and control along with providing guidance for schedule development and control

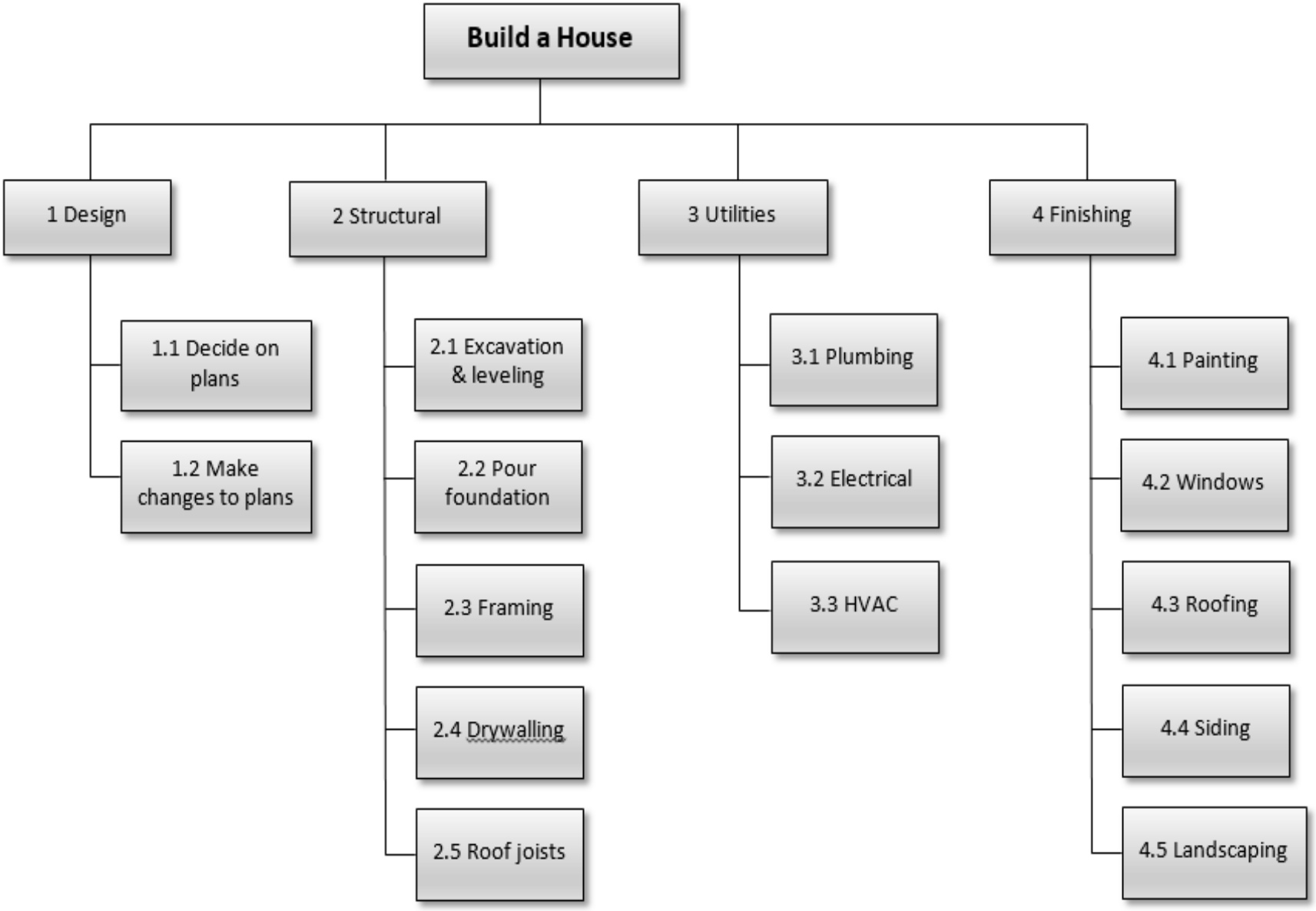

Project
Task 1
Task 2
Task 3
Sub Task 1.1
Sub Task 1.2
Sub Task 1.3
Work Package 1.1.1
Work Package 1.1.2
Work Package 1.1.3

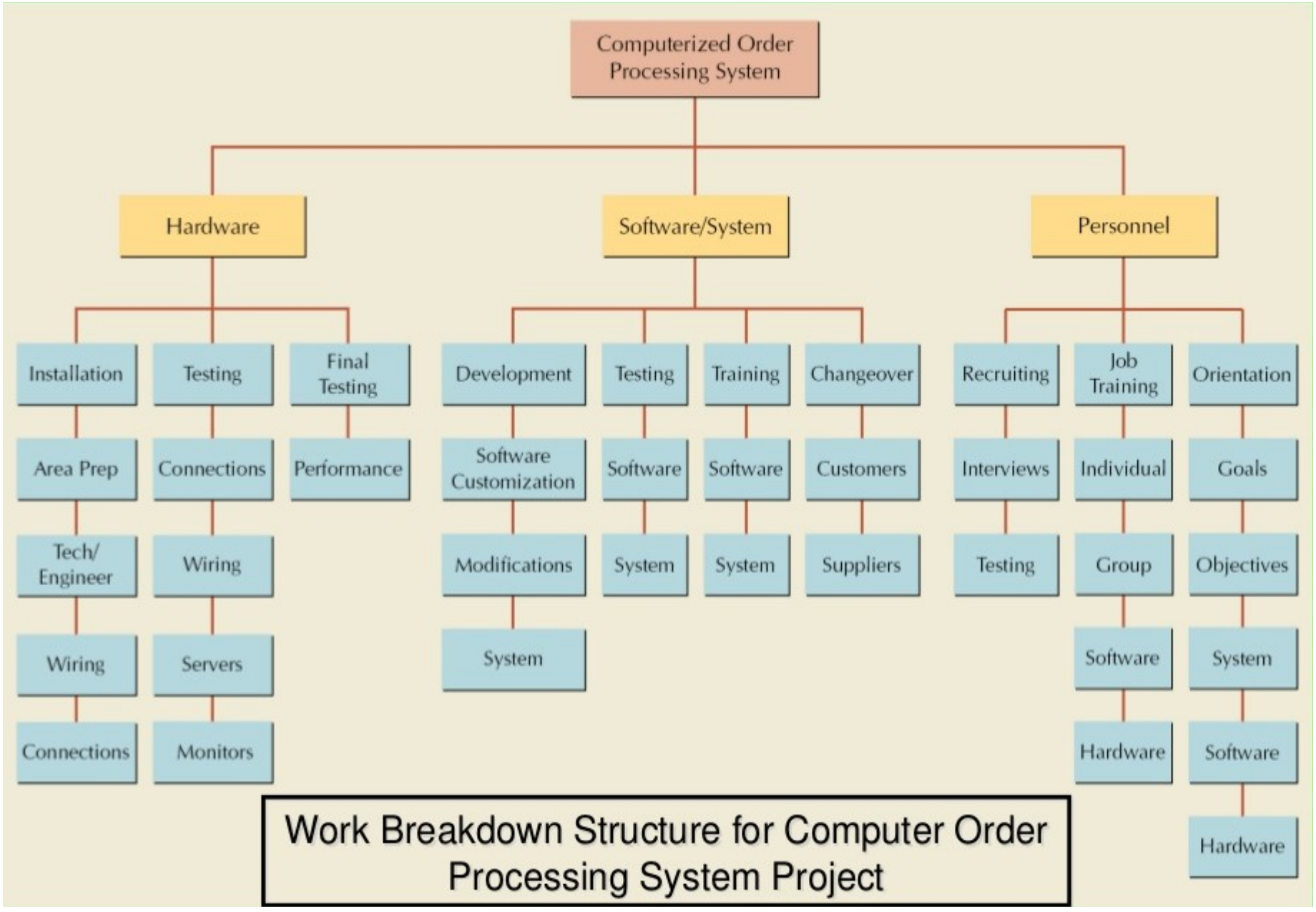

Project Goal
Task 1
Task 2
Task 3
Task 1.1
Task 1.2
Task 2.1
Task 2.2
Task 2.3
Task 3.1
Task 3.2

Sample WBS for Building a Custom Bicycle




Level 1
Aircraft System
Level 2
Air Vehicle
Training
Level 3
Airframe
Propulsion
Control System
Navigation
Communications
Facilities
Equipment
Services


Build a House
1 Design
2 Structural
3 Utilities
4 Finishing
1.1 Decide on plans
1.2 Make changes to plans
2.1 Excavation & leveling
2.2 Pour foundation
2.3 Framing
2.4 Drywalling
2.5 Roof joists
3.1 Plumbing
3.2 Electrical
3.3 HVAC
4.1 Painting
4.2 Windows
4.3 Roofing
4.4 Siding
4.5 Landscaping


Computerized Order Processing System
Hardware
Software/System
Personnel
Installation
Testing
Final Testing
Development
Testing
Training
Changeover
Recruiting
Job Training
Orientation
Area Prep
Connections
Performance
Software Customization
Software
Software
Customers
Interviews
Individual
Goals
Tech/ Engineer
Wiring
Modifications
System
System
Suppliers
Testing
Group
Objectives
Wiring
Servers
System
Software
System
Connections
Monitors
Hardware
Software
Hardware
Work Breakdown Structure for Computer Order Processing System Project

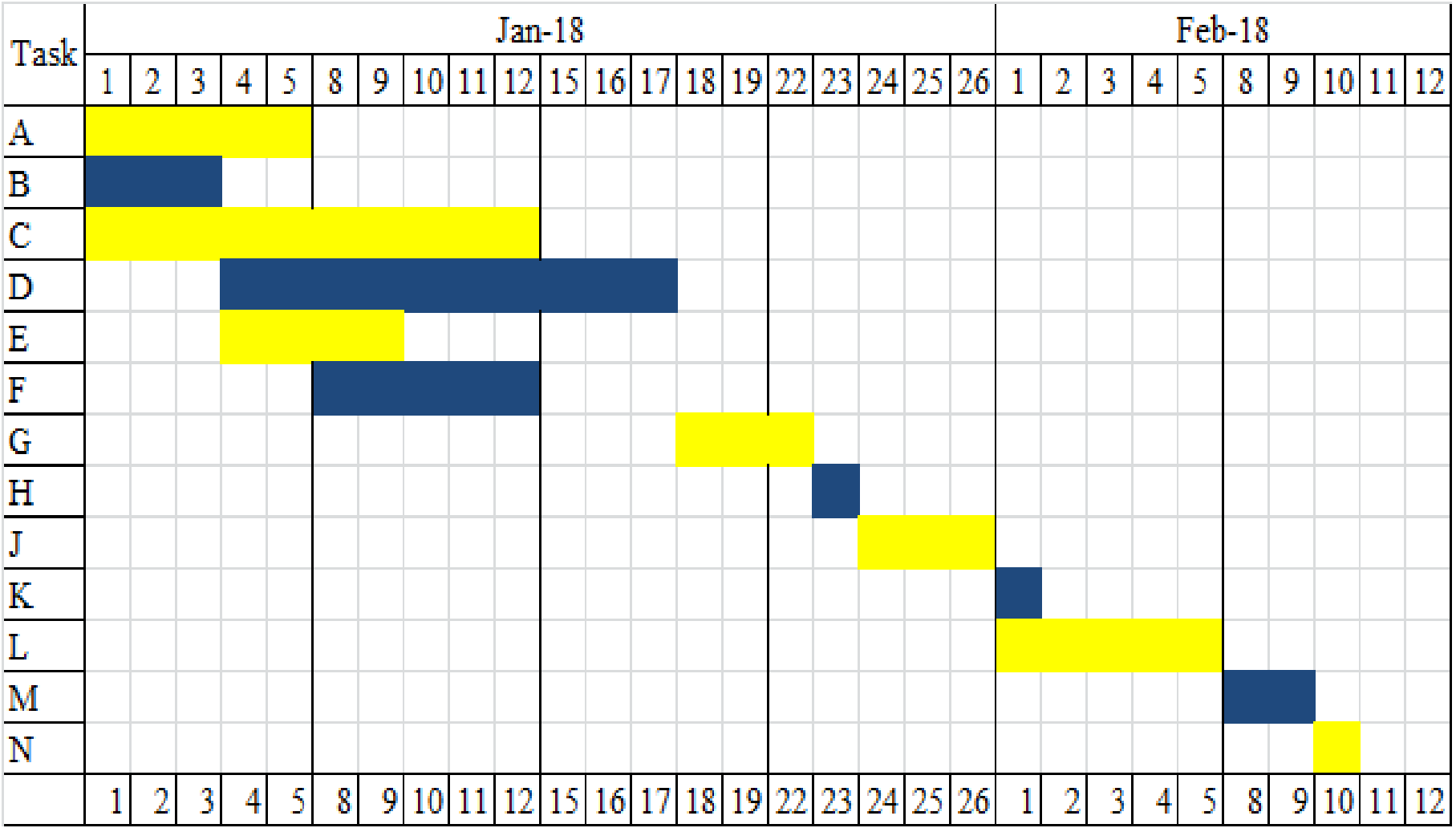
Planning House Project

Task	Follows Task(s)	Weeks Duration	Task Description
A	Start	1.0	Clear site
B	Start	0.6	Obtain Lumber and other materials
C	Start	2.0	Obtain other materials and components
D	B	2.0	Prefabricate wall panels
E	B	0.8	Prefabricate roof trusses
F	A,B	1.0	Form and pour footings and floor slab
G	D,F	0.6	Erect wall panels
H	E,G	0.2	Erect roof trusse
J	C,H	0.6	Complete roof
K	J	2.0	Finish interior
L	J	1.0	Finish exterior
M	L	0.4	Clean up site
N	K,M	0.2	Final inspection and approval

Consider a 5 day week.

8-hour day is 0.2 week

Gantt Chart



Gantt Charts are easy to understand and use, and they provide a good tool for managing small projects without an excessive number of tasks.

Network-Based Project Scheduling - CPM/PERT

CPM (Critical Path Method) determines the longest path and the critical activities along this path in a project network;

- the project completion time can't be shorter than the duration of this longest path unless such techniques as time crashing are used.

Critical Path: longest duration path through a network diagram and determines the shortest time to complete project.

- Easiest way for finding critical path is to identify all paths through the network and add the activity durations for each. Longest duration = critical path

PERT (Program Evaluation and Review Technique) incorporates probabilistic elements into the computation of activity durations and hence the project completion time;

- PERT uses optimistic (o), most probable (m), and pessimistic (p) activity times to estimate the expected activity times.

An Example Network Diagram – House Construction Project

Table 8.1: Sequence of Activities for House Construction Project

Name of the activity	Starting and finishing event	Description of activity	Predecessor	Time duration (days)
A	(1,2)	Prepare the house plan	--	4
B	(2,3)	Construct the house	A	58
C	(3,4)	Fix the door / windows	B	2
D	(3,5)	Wiring the house	B	2
E	(4,6)	Paint the house	C	1
F	(5,6)	Polish the doors / windows	D	1

Solution:

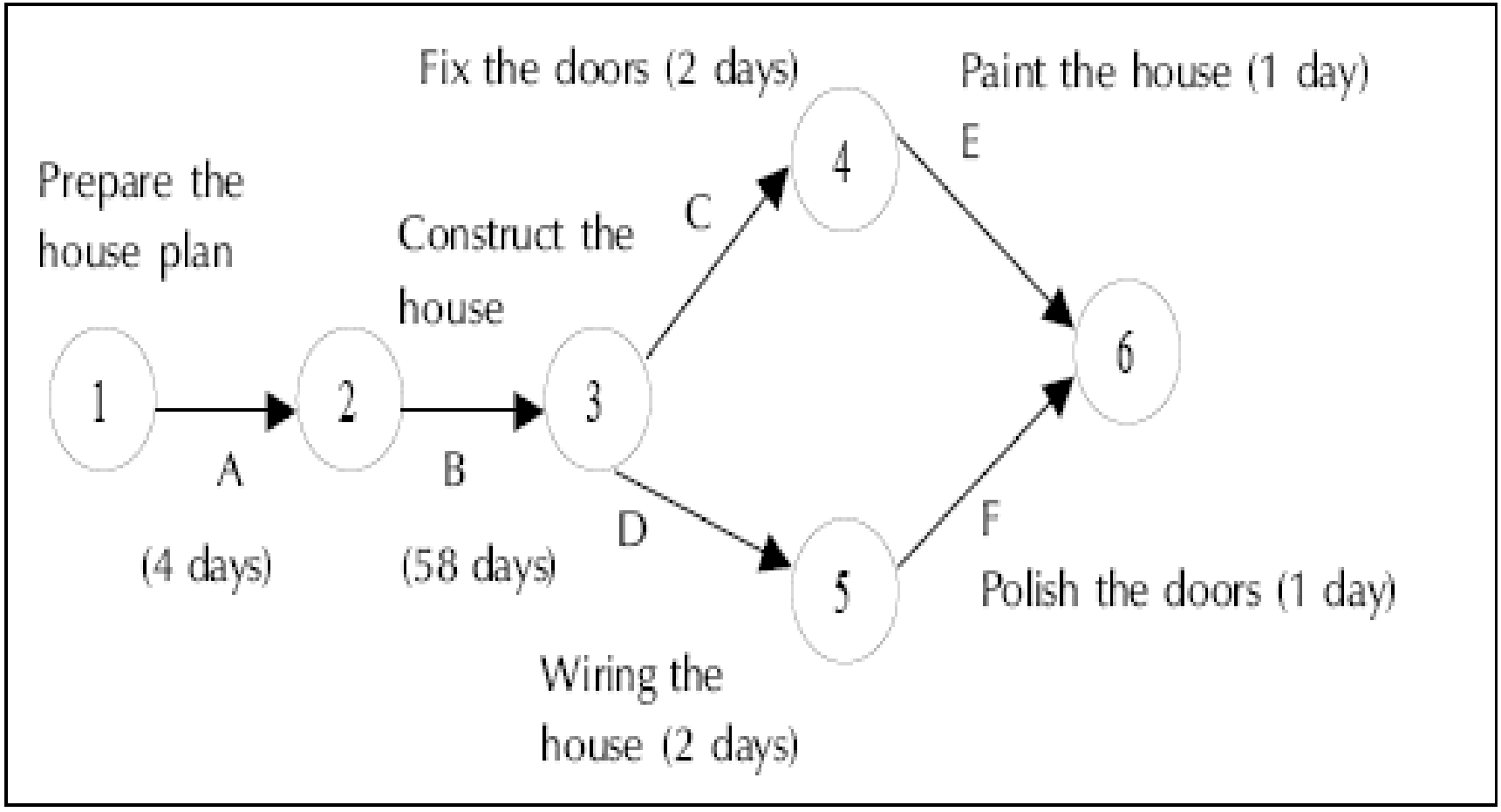
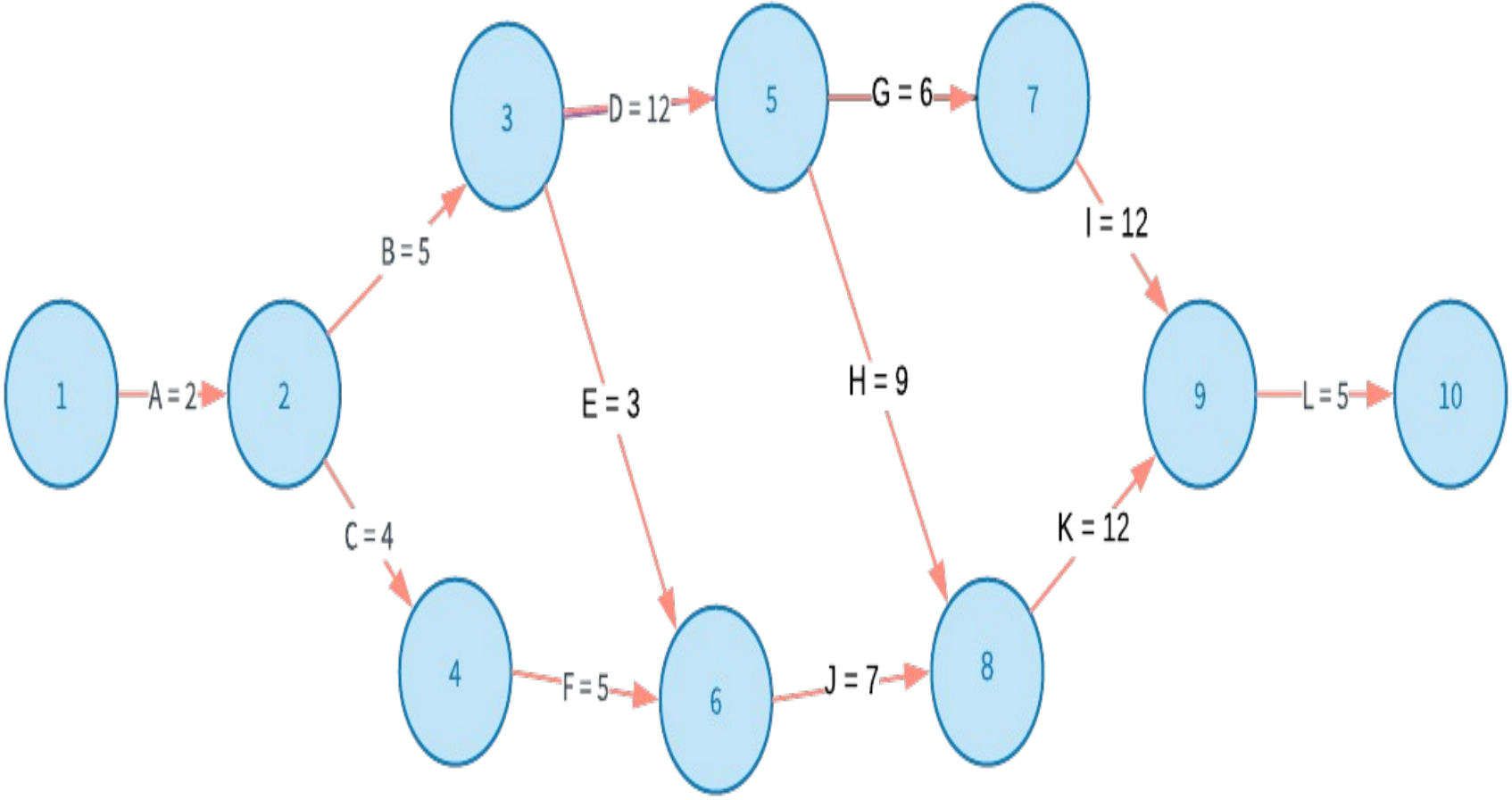
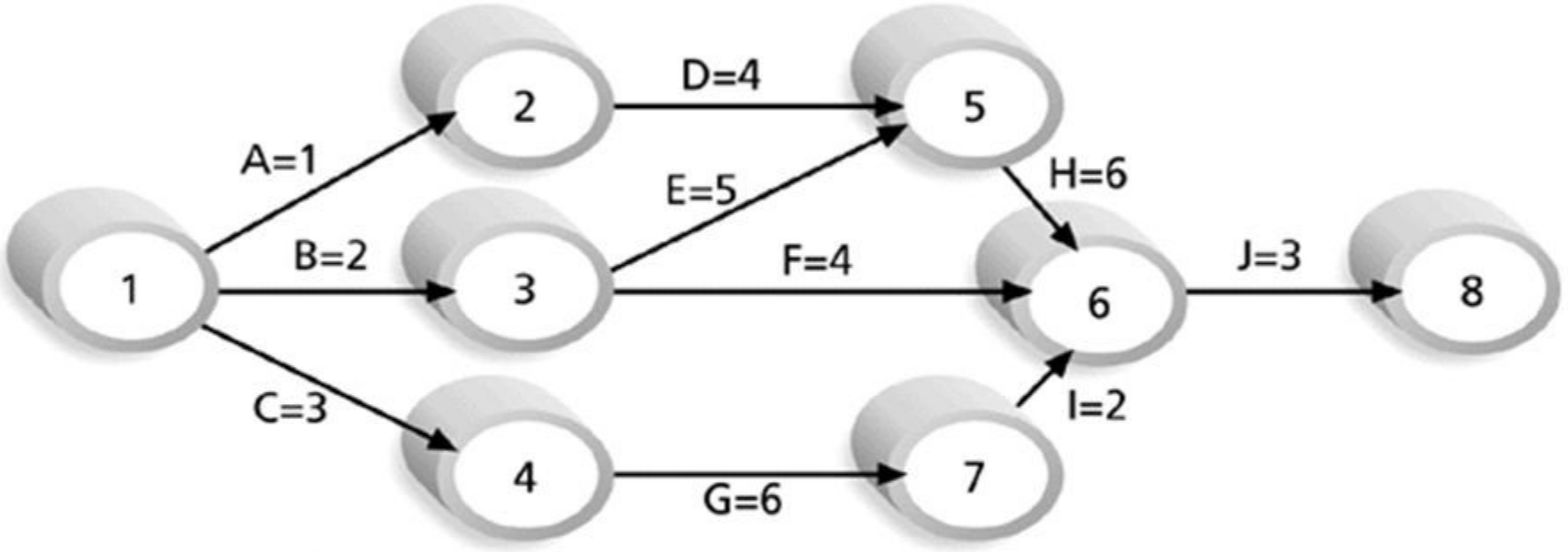


Figure 8.11: Network diagram representing house construction project.

Activity	Dependency	Duration in Weeks
A	-	2
B	A	5
C	A	4
D	B	12
E	B	3
F	C	5
G	D	6
H	D	9
I	G	12
J	E,F	7
K	H, J	12
L	I, K	5


1
A = 2
2
B = 5
3
D = 12
5
G = 6
7
I = 12
9
L = 5
10
C = 4
4
F = 5
6
J = 7
8
K = 12
E = 3
H = 9

Critical Path Method (CPM)



Note: Assume all durations are in days.

Path 1:	A-D-H-J	Length = 1+4+6+3 = 14 days
Path 2:	**B-E-H-J**	**Length = 2+5+6+3 = 16 days**
Path 3:	B-F-J	Length = 2+4+3 = 9 days
Path 4:	C-G-I-J	Length = 3+6+2+3 = 14 days

Since the critical path is the longest path through the network diagram, Path 2, B-E-H-J, is the critical path for Project X.

Activity	Description	Immediate Predecessor	Duration (Hours)
A	Receive raw materials	-	0.5
B	Bolt cutting	A	1.0
C	Transfer Machine (series of drilling and cutting operations)	B	1.5
D	Transfer Machine (barrels)	B	1.4
E	Barrel pinning	D	1.2
F	Shackle groove cutting	B	0.8
G	Shackle Bending	F	1.0
H	Insert shackle into body	C,E,G	0.4
I	Insert barrel into body and test key set	H	1.4
J	Packaging of padlock	I	0.5

Activity	Description	Predecessor	Duration (weeks)
A	Redesign Product	-	6
B	Redesign Packaging	-	2
C	Order / Receive components for redesigned product	A	3
D	Order / Receive components for redesigned packaging	B	2
E	Assemble products	C	4
F	Make up packaging	D	1
G	Package the product	E,F	1
H	Test market the packaged product	G	6
I	Revise redesigned product	H	3
J	Revise redesigned packaging	H	1
K	Prepare report	I,J	1

Construct a network for a project whose activities and their predecessor relationship are given below:

Table 8.3: Activity Sequence for a Project

Activity	A	B	C	D	E	F	G	H	I	J	K
Predecessor	-	-	-	A	B	B	C	D	E	H, I	F, G

Solution:

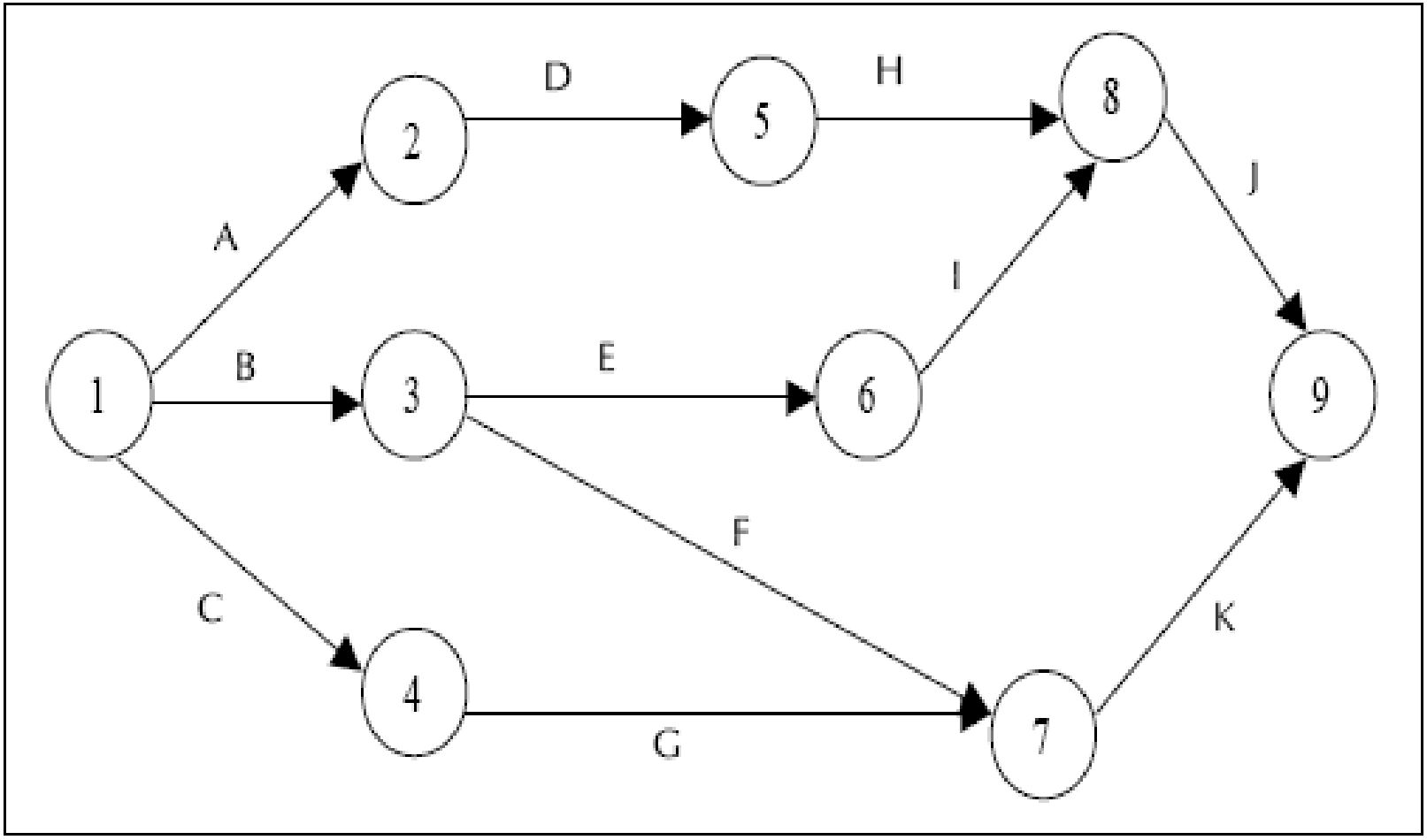


Figure 8.14: Network Diagram

Controlling Cost and Schedule

Reducing Project Duration

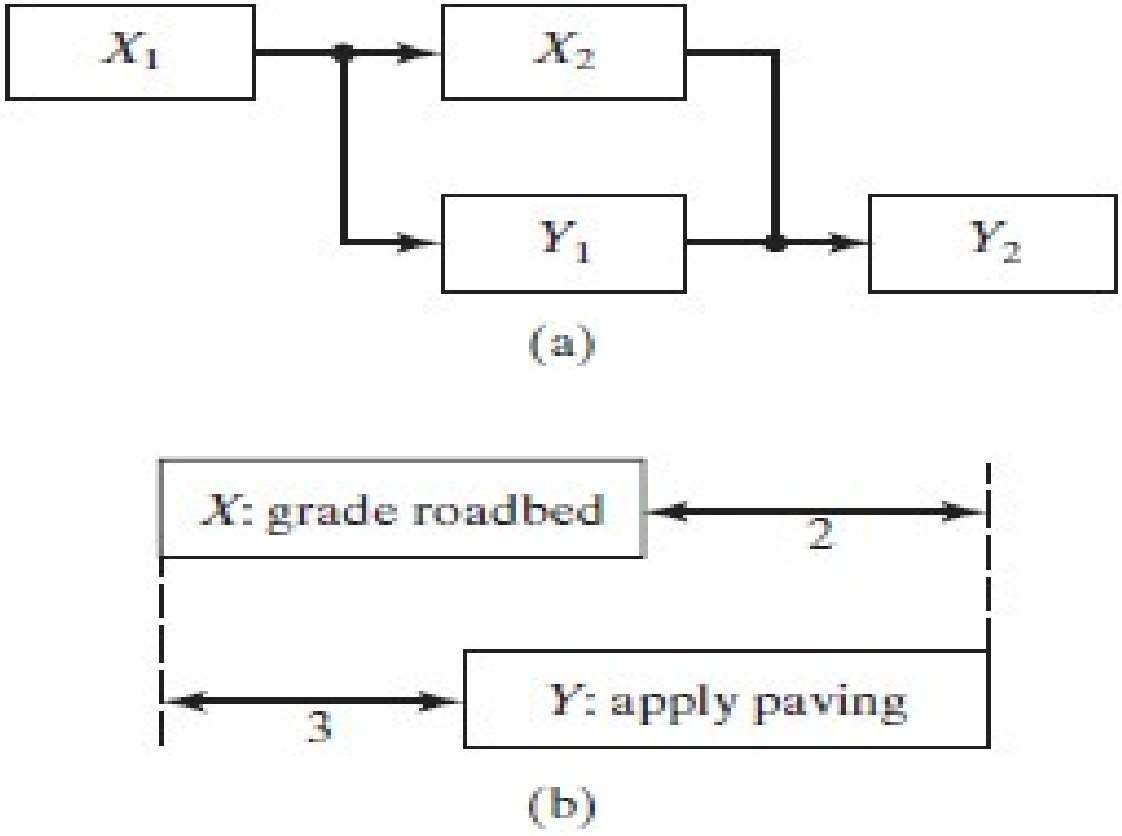
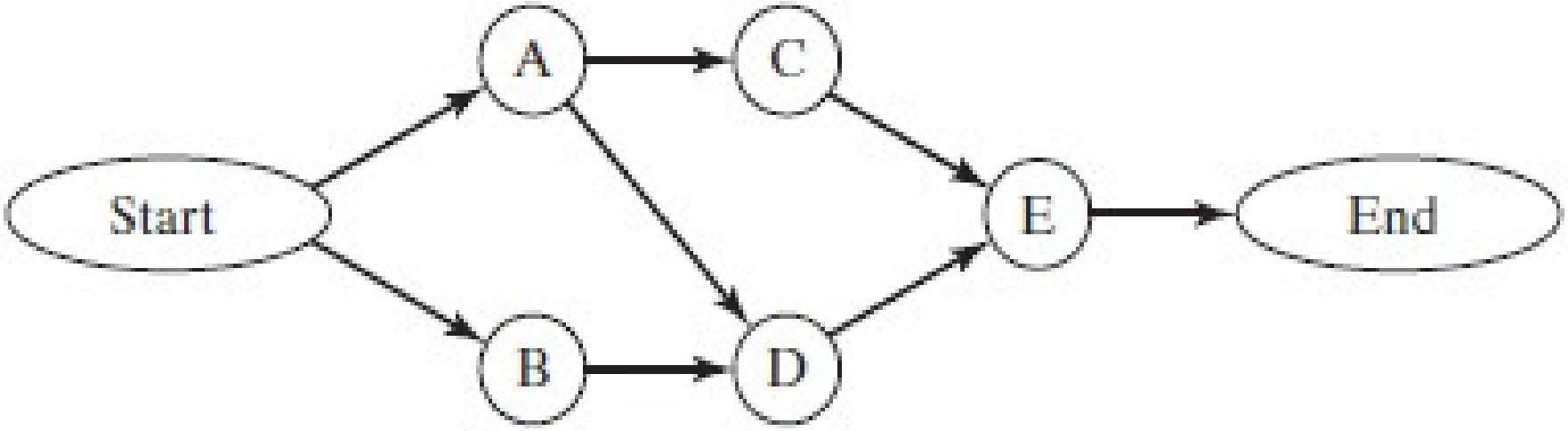


Figure 14-13 (a) Modified Gantt and (b) precedence diagrams.

Crashing the Project

Crashing is the technique to use when fast tracking has not saved enough time on the schedule. It is a technique in which resources are added to the *project* for the least cost possible. Cost and schedule tradeoffs are analyzed to determine how to obtain the greatest amount of compression for the least incremental cost.

In crashing you add extra resources to the project to compress the schedule. You review the critical path and see which activities can be completed by adding extra resources. You try to find the activities that can be reduced the most by adding the least amount of cost. Once you find those activities, you will apply the crashing technique.



Activity	Time (weeks)		Cost (dollars)		Slope (dollars/week)
	Normal	Crash	Normal	Crash	
A	5	4	4,000	6,000	2,000
B	4	2	3,000	4,000	500
C	6	5	2,200	3,000	800
D	7	4	5,000	8,000	1,000
E	7	5	3,000	6,000	1,500

Figure 14-14 Network and data for "crashing" example.

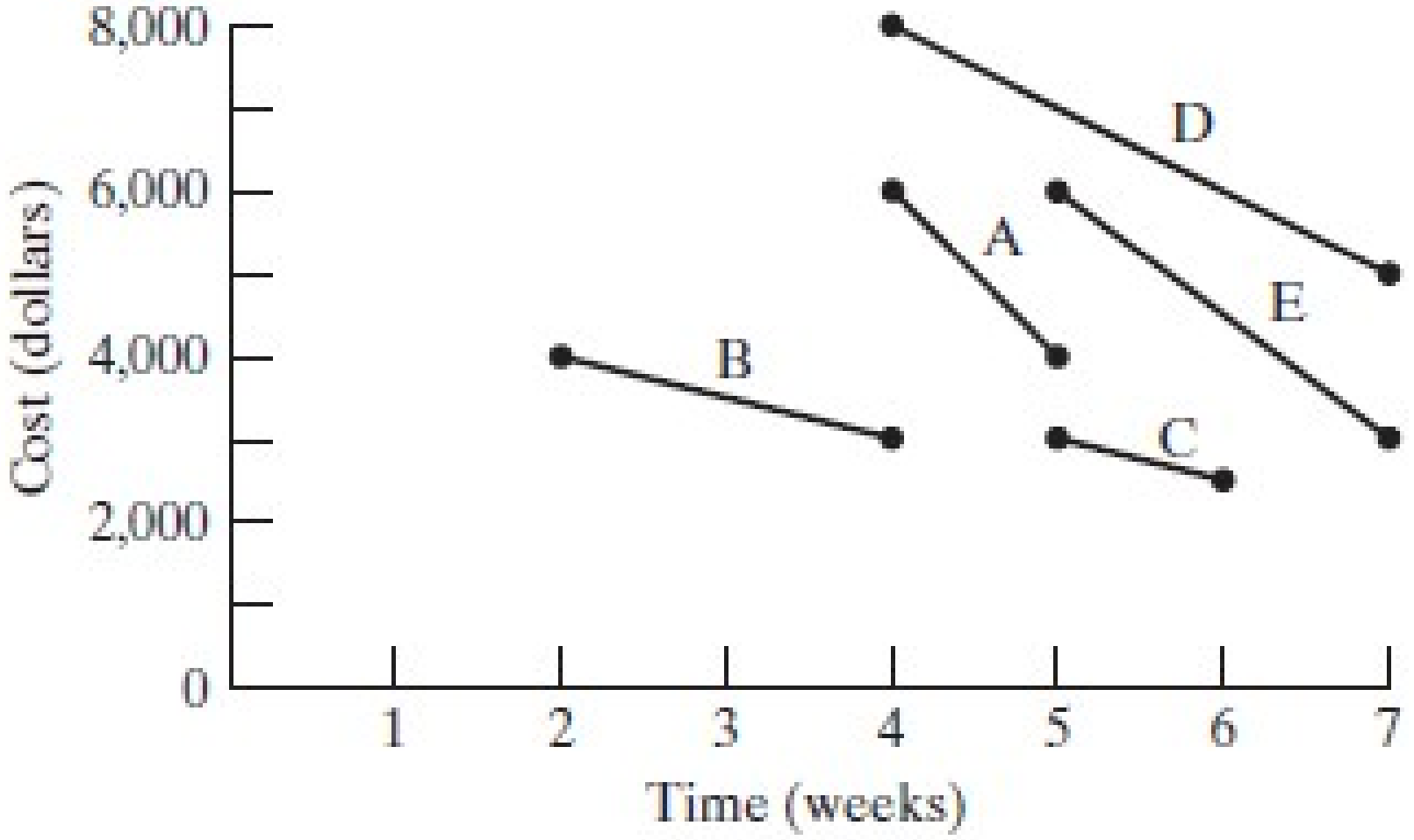
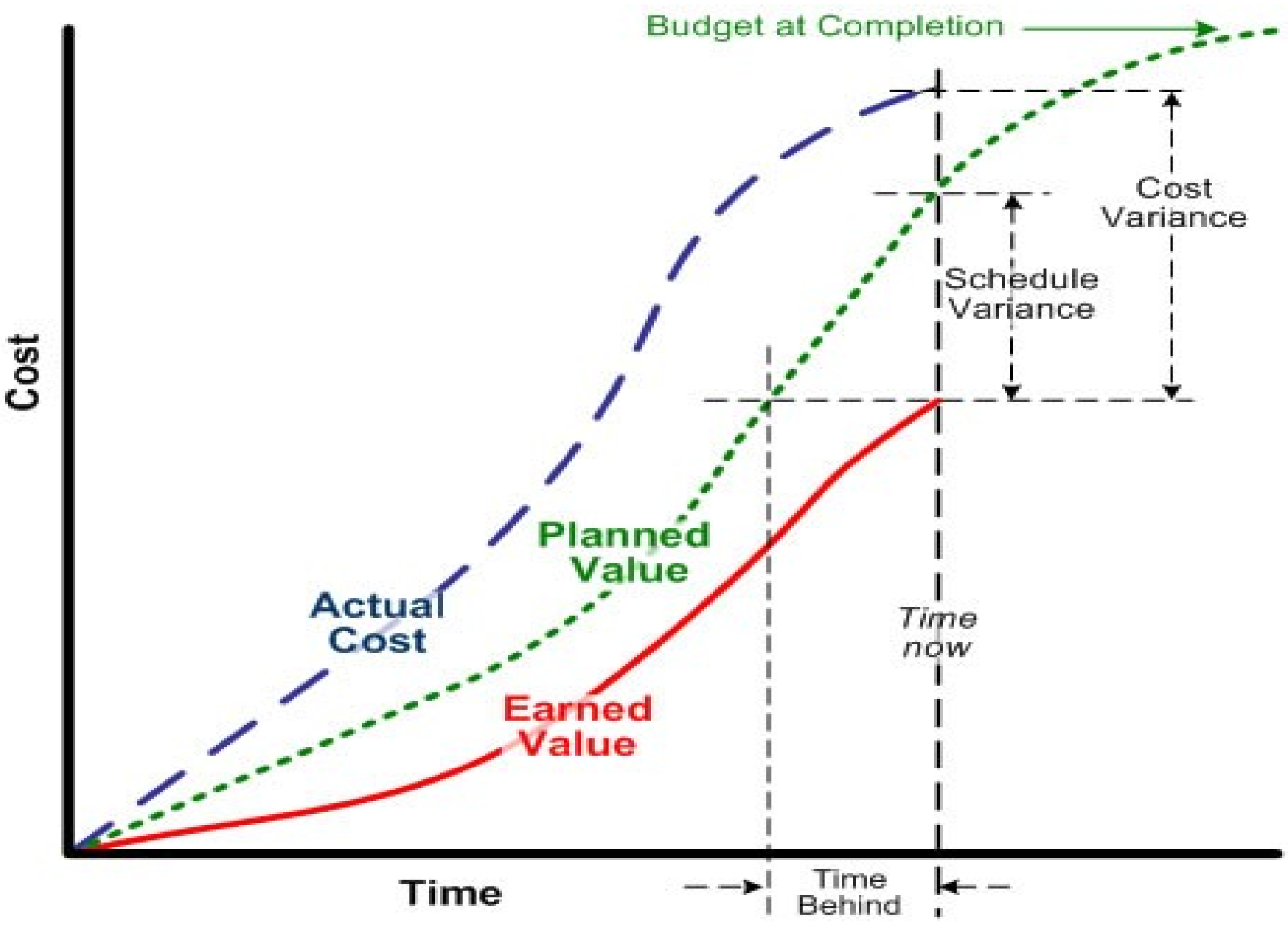


Figure 14-15 Illustration of slopes in crashing example.

Earned Value System

In a nutshell, *Earned Value* is an approach where you monitor the project plan, actual work, and work completed *value* to see if a project is on track.

Earned Value Management System (EVMS) — the process, procedures, tools, and templates used by an organization to do earned value management.


Budget at Completion
Cost Variance
Schedule Variance
Cost
Planned Value
Actual Cost
Time now
Earned Value
Time
Time Behind

Components of Earned Value

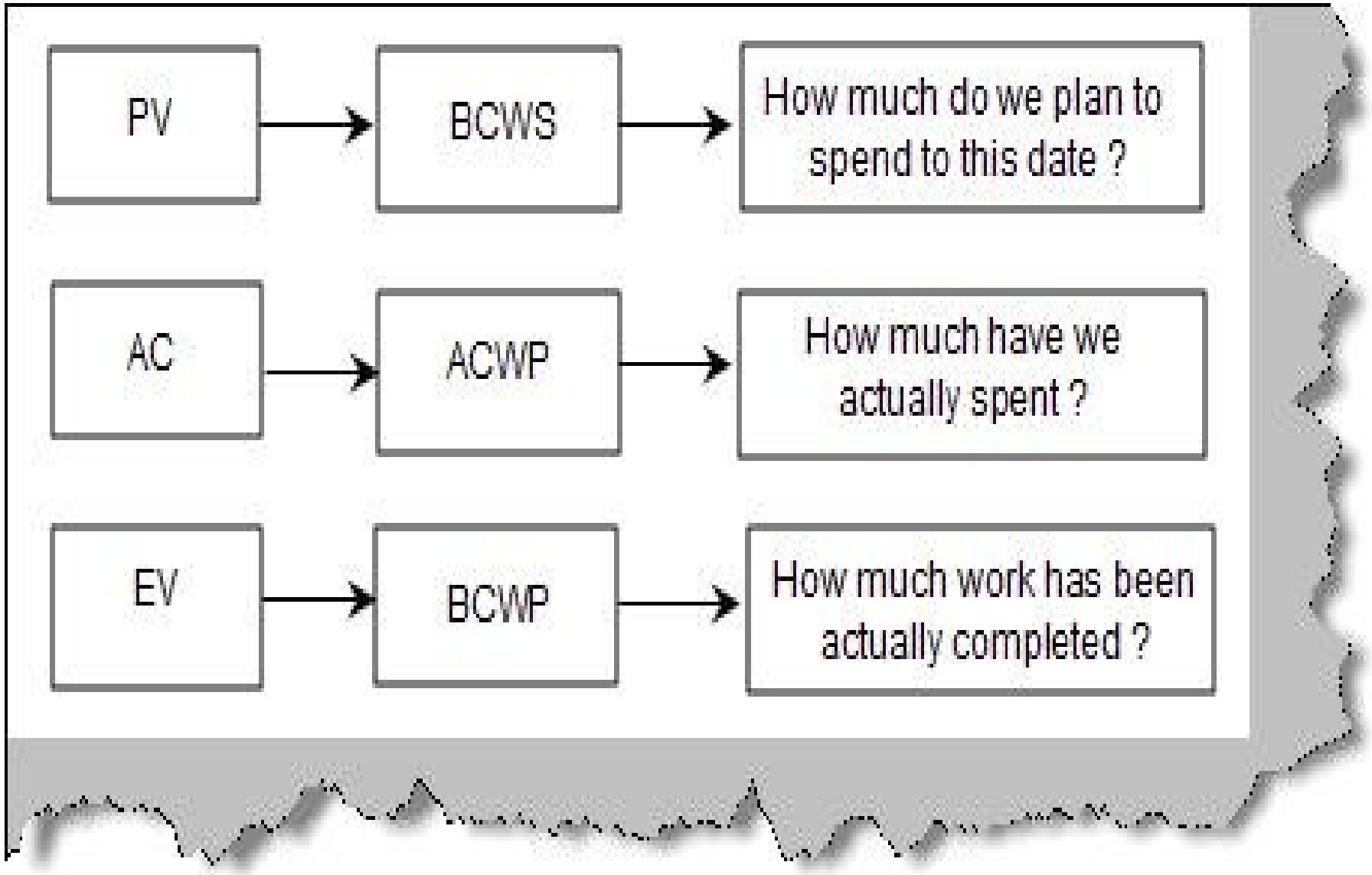
- Budgeted Cost for Work Scheduled (BCWS)
  - The planned cost in hours and / or dollars.
- Budget Cost of Work Performed (BCWP)
  - The planned value of the work delivered.
  - When BCWS = BCWP we're staying with the Peloton.
  - This is the "Earned Value" over the period of performance.
- Actual Cost of Work Performed (ACWP)
  - The cost in dollars or hours to "earn" the Earned Value (BCWP).

Budgeted cost of work scheduled (BCWS), also called the **budget**, is that portion of the approved total cost estimate planned to be spent on an activity during a given period.

Actual cost of work performed (ACWP), also called actual cost, are the total direct and indirect costs incurred in accomplishing work on an activity during a given period.

Budgeted cost of work performed (BCWP), also called **earned value**, is the percentage of work actually completed multiplied by the planned cost (or BCWS).

- Planned Value (PV)
  - The work scheduled and the authorized budget to accomplish that work
  - Also known as Budget Cost of Work Schedule (**BCWS**)
- Earned Value (EV)
  - The physical work completed to date and the authorized budget for that work
  - Also known as Budgeted Cost of Work Performed (**BCWP**)
- Actual Cost (AC)
  - The actual amount of monies the project has required to date
  - Also known as Actual Cost of Work Performed (**ACWP**)

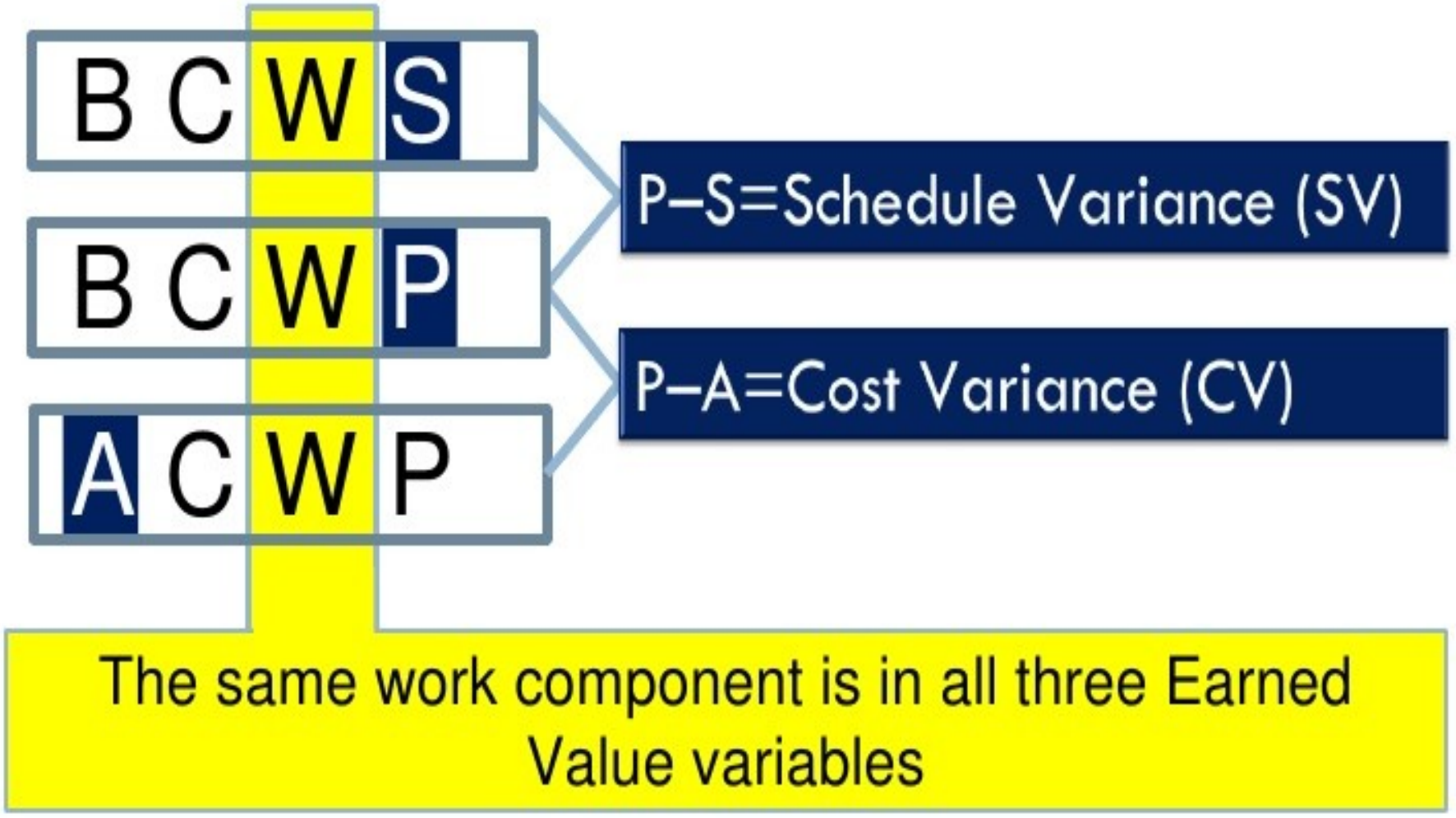

PV
BCWS
How much do we plan to spend to this date ?
AC
ACWP
How much have we actually spent ?
EV
BCWP
How much work has been actually completed ?

Earned Value Formulas

Table 7-8: Earned Value Formulas

TERM	FORMULA
Earned value	EV = PV to date X percent complete
Cost variance	CV = EV – AC
Schedule variance	SV = EV – PV
Cost performance index	CPI = EV/AC
Schedule performance index	SPI = EV/PV
Estimate at completion (EAC)	EAC = BAC/CPI
Estimated time to complete	Original time estimate/SPI

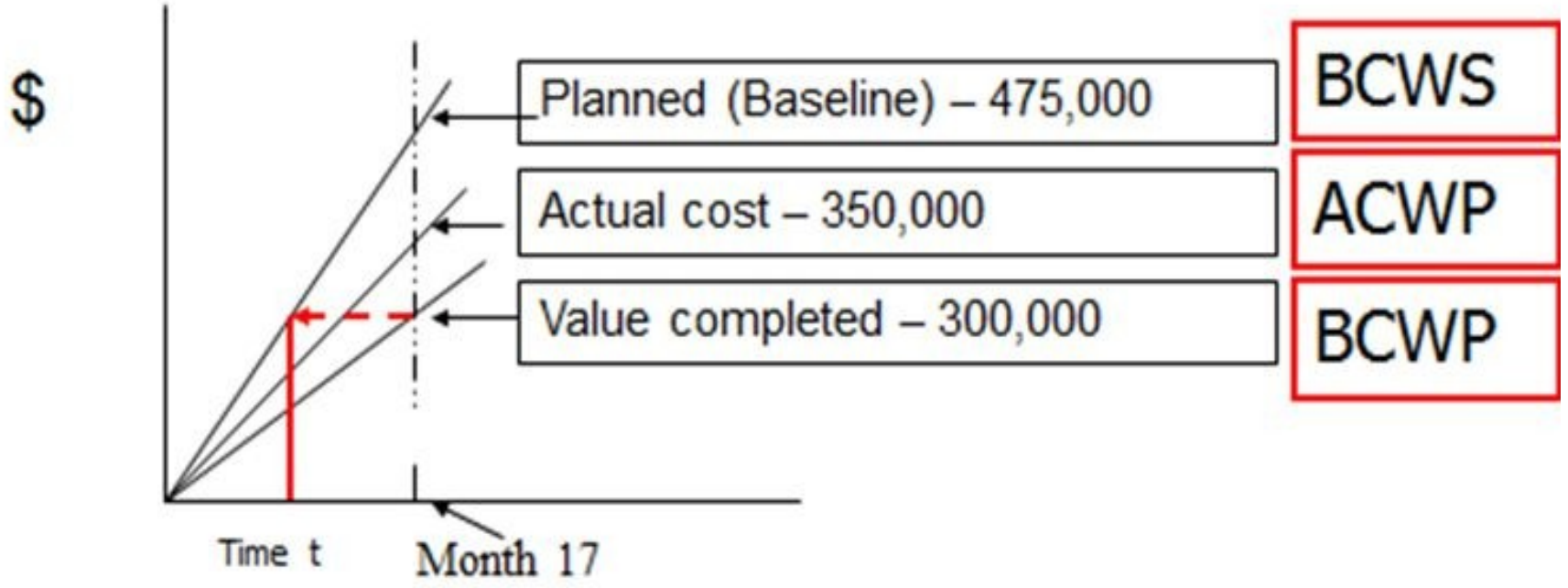
Earned Value = BCWP = Budgeted Cost Work Performed
Actual Cost = ACWP = Actual Cost Work Performed
BCWS = Budgeted Cost Work Scheduled



† CPM–300: Principles of Earned Value Implementation, Lesson E: Developing the Performance Measurement Baseline, Dennis W. White, IPMC 2002 Fall Conference, Professional Education Program.

Name	Formula	What it says	Why you use it
BAC—Budget at Completion	No formula – it's the project budget	How much money you'll spend on the project	To tell the sponsor the total amount of value that he's getting for the project
PV—Planned Value	$PV = BAC \times \text{Planned \% Complete}$	What your schedule says you should have spent	To figure out what value your plan says you should have delivered so far
EV—Earned Value	$EV = BAC \times \text{Actual \% Complete}$	How much of the project's value you've really earned	EV lets you translate how much work the team's finished into a dollar value
AC—Actual Cost	What you've actually spent on the project	How much you've actually spent so far	The amount of money you spend doesn't always match the value you get!
SPI—Schedule Performance Index	$SPI = \frac{EV}{PV}$	Whether you're behind or ahead of schedule	To figure out whether you've delivered the value your schedule said you would
SV—Schedule Variance	$SV = EV - PV$	How much ahead or behind schedule you are	This puts a dollar value on exactly how far ahead or behind schedule you are
CPI—Cost Performance Index	$CPI = \frac{EV}{AC}$	Whether you're within your budget or not	Your sponsor is always most interested in the bottom line!
TCPI—To-Complete Performance Index	$TCPI = \frac{BAC-EV}{BAC-AC}$	How well your project must perform to stay on budget.	This will let you forecast whether or not you can stick to your budget.
CV—Cost Variance	$CV = EV - AC$	How much above or below your budget you are	Your sponsor needs to know how much it costs to get him the value you deliver

Example



BCWS = 475,000
BCWP = 300,000
ACWP = 350,000

CV = BCWP – ACWP = -50,000
SV = BCWP – BCWS = -175,000
CPI = BCWP/ACWP = 0.86
SPI = BCWP/BCWS = 0.63