Slide Sequence for PM 201 – The Technical Side of PM

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Agenda of Topics

- Work Breakdown Structures (WBS)
- Network Diagramming
- Activity Duration Estimation
- Developing the Critical Path
- Crashing Projects
- Monitoring Project Performance

WBS

- Defined as: “A hierarchical decomposition of the work to be executed”

<u>STEPS</u>

- Define project objective
- Determine the work elements
  - Break project into manageable pieces
  - Work package is the lowest element

Organization

- Levels of WBS
  - Project
  - Deliverable
  - Sub-deliverable
  - Work Package

Work Packages

- Clearly defined ownership
- Clearly defined start and end dates that are representative of physical accomplishments
- Results that can be compared with expectations
- A specific budget in terms of dollars, hours to completion, or other measurable units

WBS sample

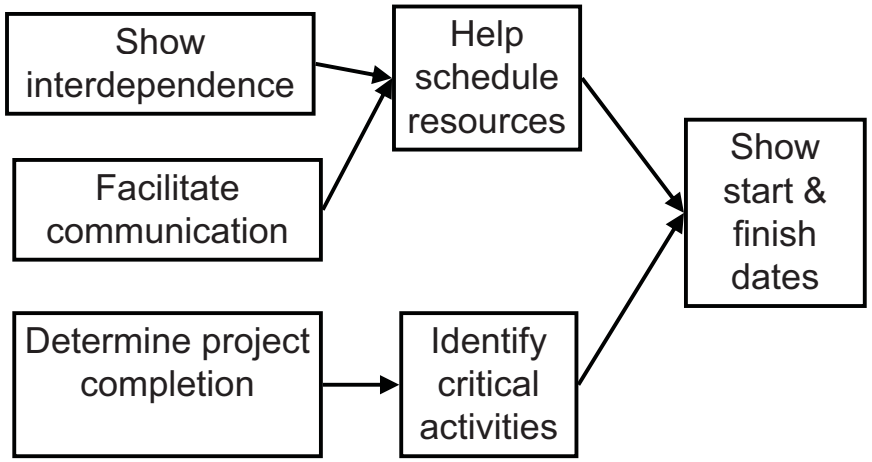
- 1. Wedding project
  - 1.1 Decide on date
  - 1.2 Marriage license
  - 1.3 Bridal arrangements
    - 1.3.1 Select attendants
    - 1.3.2 Order dresses
    - 1.3.3 Fit dresses
  - 1.4 Ceremony
    - 1.4.1 Rent church
    - 1.4.2 Florist
    - 1.4.3 Create/print programs
    - 1.4.4 Hire photographer
    - 1.4.5 Wedding ceremony

WBS sample

- 1.5 Guests
  - 1.5.1 Develop guest list
  - 1.5.2 Order invitations
  - 1.5.3 Address and mail invitations
  - 1.5.4 Track RSVPs
- 1.6 Reception
  - 1.6.1 Reserve reception hall
  - 1.6.2 Food and beverage
    - 1.6.2.1 Choose caterer
      - » 1.6.2.2 Decide on menu
      - » 1.6.2.3 Make final order
    - 1.6.3 Hire band
    - 1.6.4 Decorate reception hall
    - 1.6.5 Wedding reception

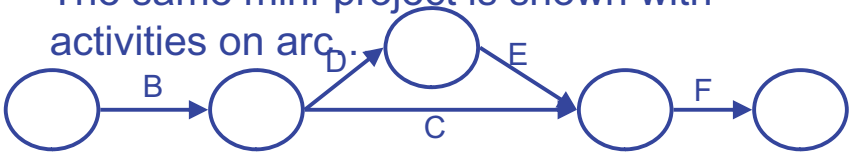
Developing Activity Networks

Network Diagrams

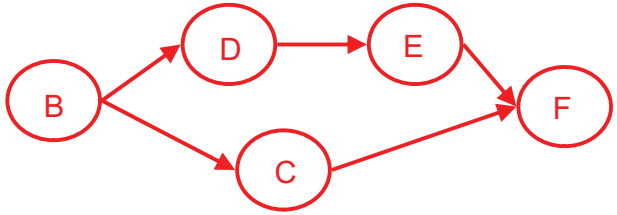


AOA Vs. AON

The same mini-project is shown with activities on arc…



…and activities on node.



Node Labels

Early Start	ID Number	Early Finish
Activity Float	Activity Descriptor	
Late Start	Activity Duration	Late Finish

Rules for Developing Activity Networks

- **Some determination of activity precedence ordering must be done prior to creating the network.**
- **Network diagrams usually flow from left to right.**
- **An activity cannot begin until all preceding connected activities have been completed.**
- **Arrows on networks indicate precedence and logical flow. Arrows can cross over each other, although it is helpful for clarity's sake to limit this effect when possible.**

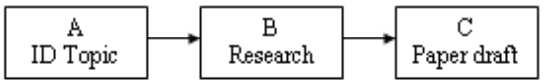
Rules for Networks, con'd:

- **Each activity should have a unique identifier associated with it (number, letter, code, etc).**
- **Looping, or recycling through activities, is not permitted.**
- **Although not required, it is common to start a project from a single beginning node. A single node point also is typically used as a project end indicator.**

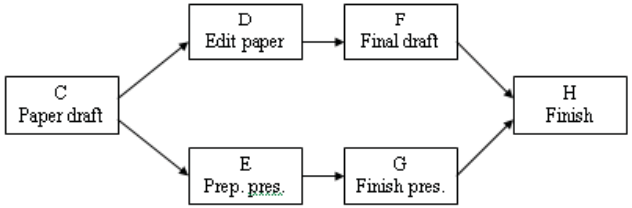
Important Terminology

- Serial Relationships
- Parallel Relationships
- Merge Activities
- Burst Activities

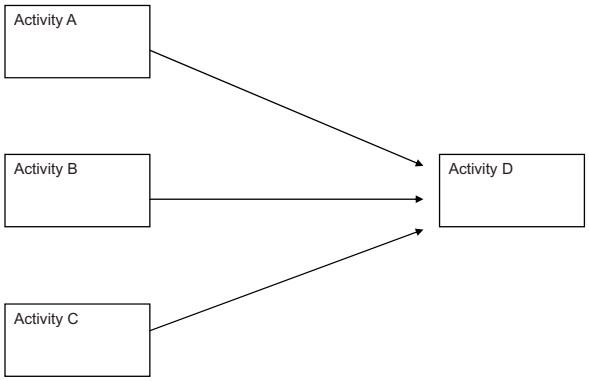
Activities Linked in Series



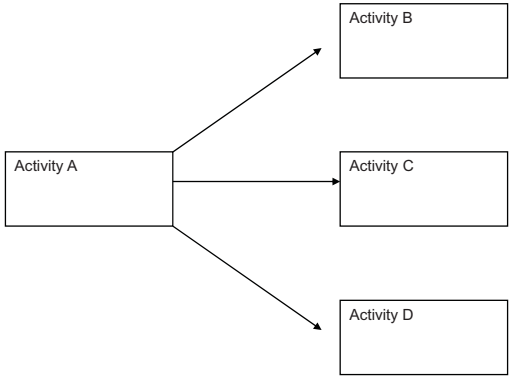
Activities Linked in Parallel



Merge Activities

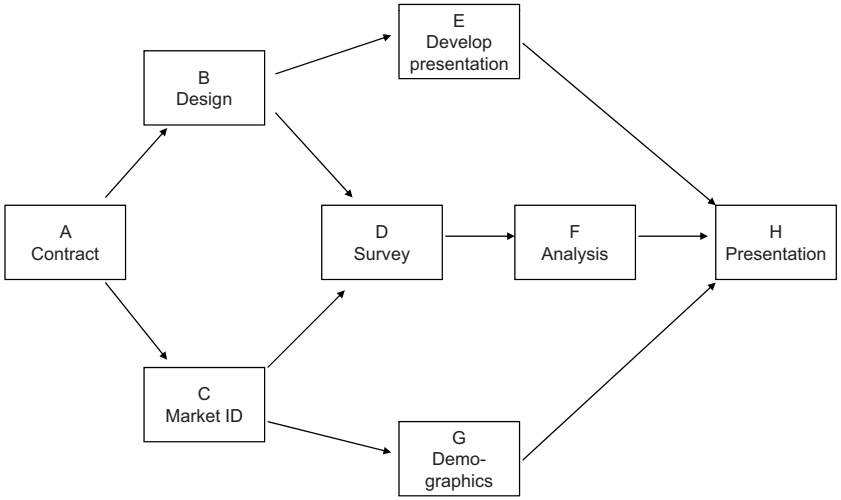


Burst Activities



Information for Network Construction

Activity	Description	Predecessors
A	Contract signing	None
B	Questionnaire design	A
C	Target Market ID	A
D	Survey Sample	B,C
E	Develop presentation	B
F	Analyze results	D
G	Demographic analysis	C
H	Presentation to client	E,F,G



Duration Estimation Methods

- Past experience
- Expert opinion
- Mathematical derivation – Beta distribution
  - Most likely (m)
  - Most pessimistic (b)
  - Most optimistic (a)

$$Activity\ Duration = \mathrm{TE} = \frac{a + 4m + b}{6}$$

Example

Determine the expected duration of each activity.

Task	Predecessor	a	b	c
Z	--	7	8	15
Y	Z	13	16	19
X	Z	14	18	22
W	Y, X	12	14	16
V	W	1	4	13
T	W	6	10	14
S	T, V	11	14	19

Solution

Task	Predecessor	a	b	c	Exp. Duration
Z	--	7	8	15	9
Y	Z	13	16	19	16
X	Z	14	18	22	18
W	Y, X	12	14	16	14
V	W	1	4	13	5
T	W	6	10	14	10
S	T, V	11	14	19	14.33

Constructing the Critical Path

- Forward pass – an ***additive move*** through the network from ***start to finish***
- Backward pass – a ***subtractive move*** through the network from ***finish to start***
- Critical path – the ***longest path*** from end to end which determines the ***shortest project length***

Rules for Forward/Backward Pass

Forward Pass Rules (ES & EF)

- ES + Duration = EF
- EF of predecessor = ES of successor
- Largest preceding EF at a merge point becomes EF for successor

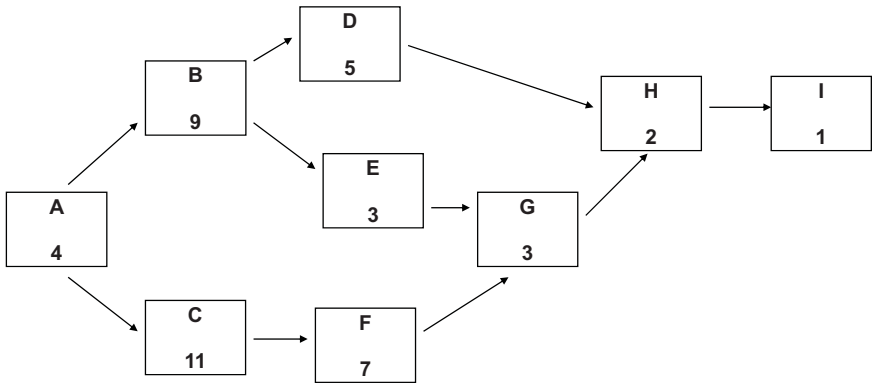
Backward Pass Rules (LS & LF)

- LF – Duration = LS
- LS of successor = LF of predecessor
- Smallest succeeding LS at a burst point becomes LF for predecessor

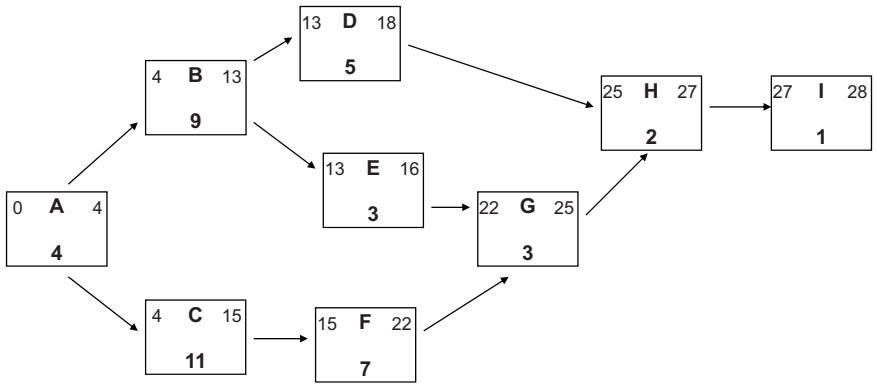
Task	Predecessor	Time
A	--	4
B	A	9
C	A	11
D	B	5
E	B	3
F	C	7
G	E, F	3
H	D, G	2
I	H	1

1. Sketch the network described in the table.
2. Determine the ES, LS, EF, LF, and slack of each activity

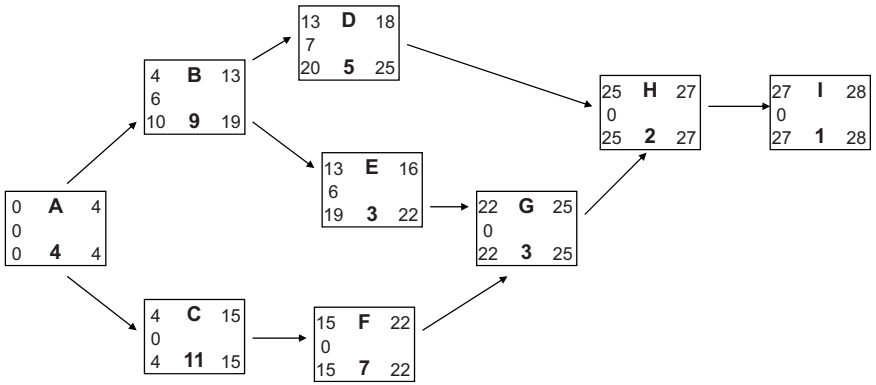
Solution: First, lay out the network



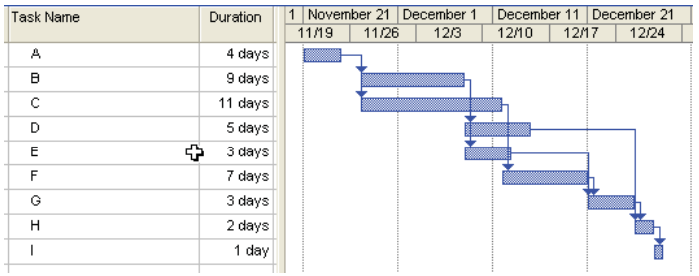
Next, add the Forward Pass



Finally, add the Backward Pass and Slack



Solution Using MS Project



Reducing the Critical Path

- Eliminate tasks on the CP
- Convert serial paths to parallel when possible
- Overlap sequential tasks
- Shorten the duration on critical path tasks
- Shorten
  - early tasks
  - longest tasks
  - easiest tasks
  - tasks that cost the least to speed up

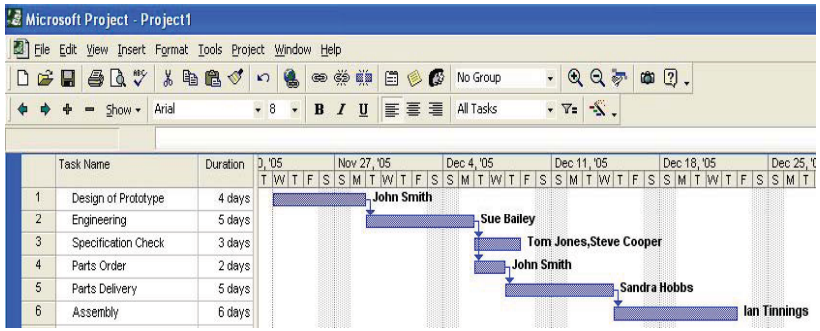
Gantt Charts

- ✓ Establish a time-phased network
- ✓ Can be used as a tracking tool

Benefits of Gantt charts

1. **Easy** to create and comprehend
2. Identify the schedule **baseline** network
3. Allow for **updating** and **control**
4. Identify **resource needs**

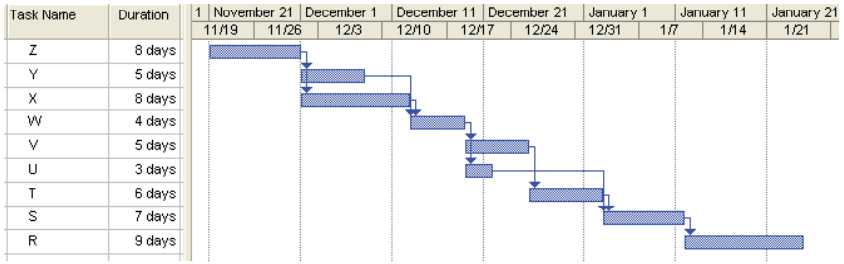
Gantt Chart With Resources in MS Project



Example: Create a Gantt chart based on the activities listed in the table.

Task	Time	Pred	Task	Time	Pred
Z	8	--	U	3	W
Y	5	Z	T	6	V
X	8	Z	S	7	U,T
W	4	Y,X	R	9	S
V	5	W			

Solution:



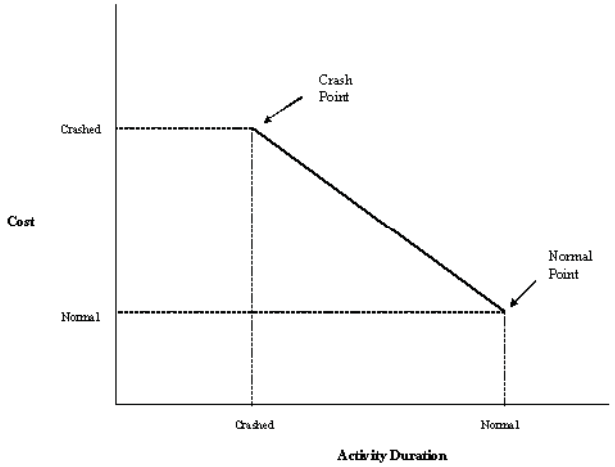
Crashing Projects

Accelerating a project by committing more resources than initially planned

Principal methods for crashing

- Improving existing resources' **productivity**
- Changing work **methods**
- Increasing the **quantity** of resources

Time/Cost Tradeoffs in Crashing



The Cost of Crashing

$$\text{Slope} = \frac{\text{Crash cost} - \text{Normal cost}}{\text{Normal time} - \text{Crash time}}$$

Suppose: Activity X takes 5 weeks at $12,000. By spending $32,000 We could save 2 weeks. What is the cost of crashing this activity?

$$\text{Crash cost} = \$\frac{32{,}000 - 12{,}000}{5 - 3}$$

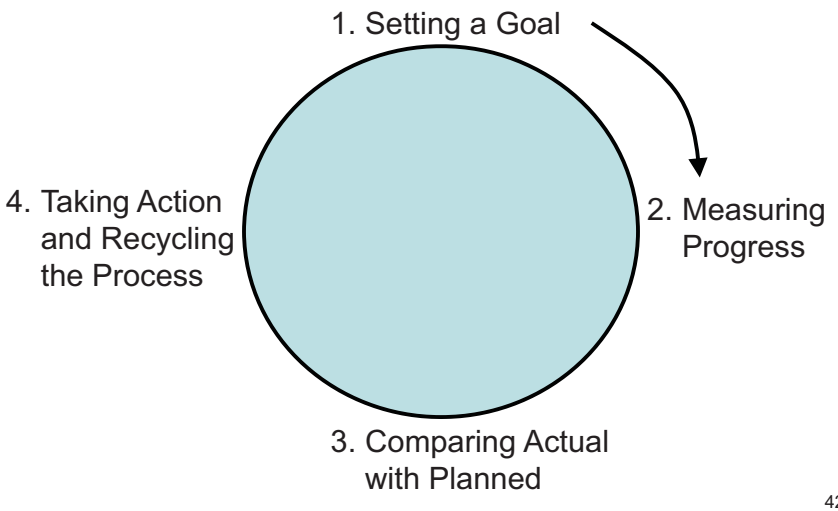
$$= \$10{,}000 \text{ per week}$$

Managerial Considerations

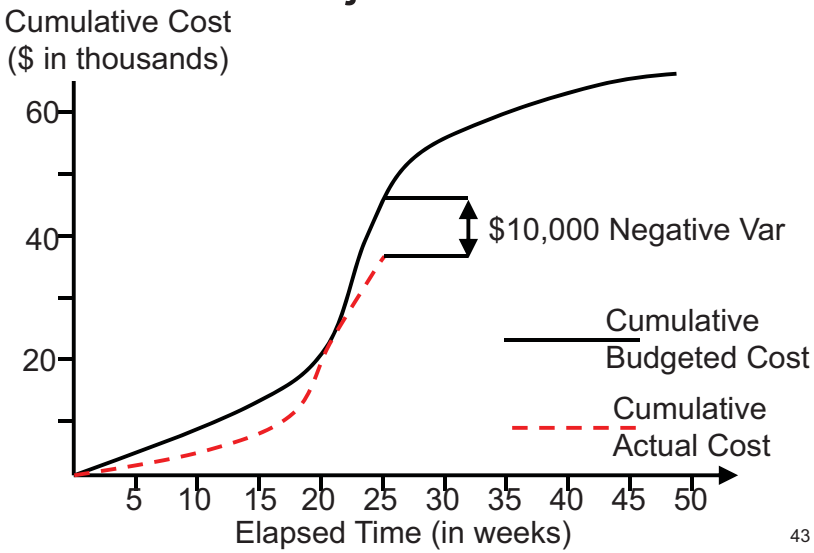
- Determine activity **costs**
- The **crash point** is the fully expedited activity
- Optimize **time-cost tradeoffs**
- Shorten activities on the **critical path**
- Cease crashing when
  - the **target completion time** is reached
  - the **crash cost exceeds the penalty cost**

Monitoring Project Performance

The Project Control Cycle



The Project S-Curve

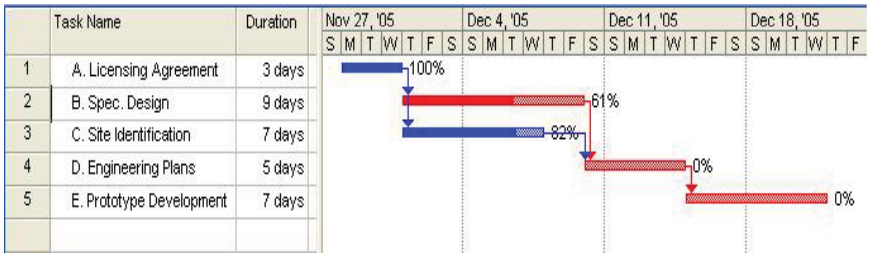


Milestone Analysis

Milestones are ***events or stages*** of the project that represent a ***significant accomplishment.***

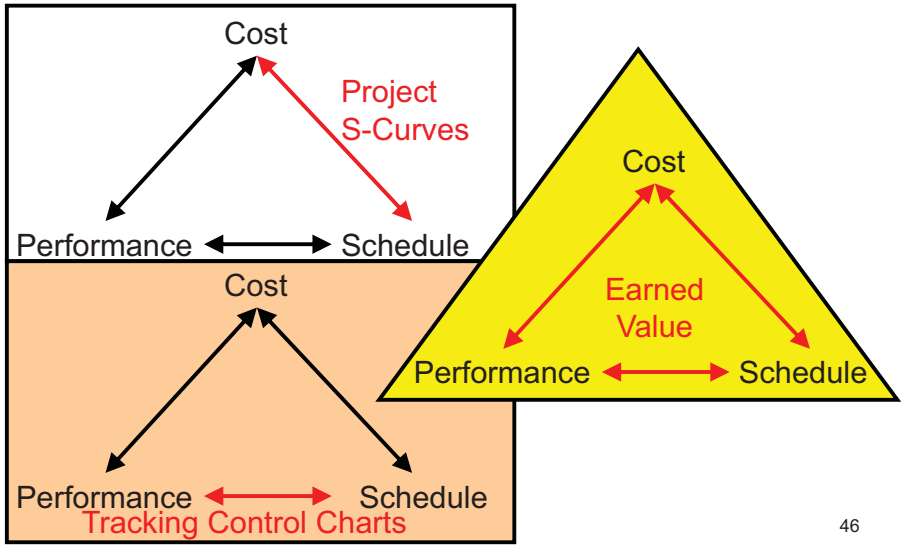
Milestones
…**signal** the team and suppliers
…can **motivate** the team
…offer **reevaluation** points
…help **coordinate** schedules
…**identify** key review gates
…**delineate** work packages

Tracking Gantt Chart



Project status is updated by linking task completion to the schedule baseline

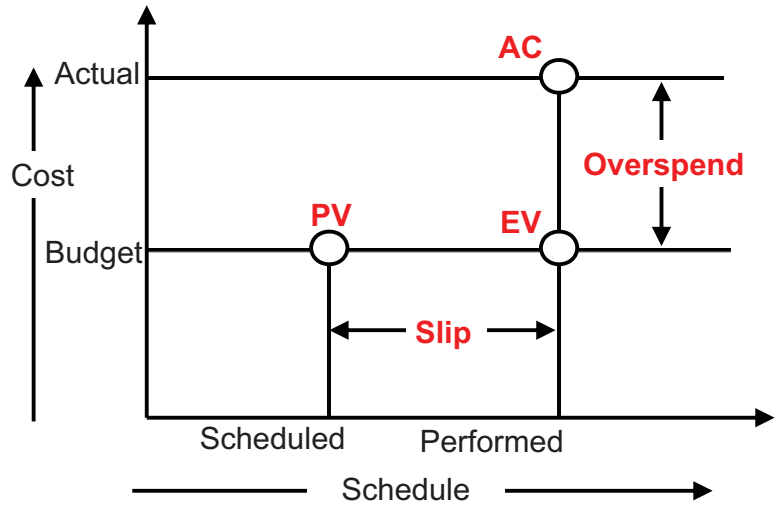
Earned Value Management



Earned Value Terms

- Planned value (PV)
- Earned value (EV)
- Actual cost of work performed (AC)
- Schedule performance index (SPI)
- Cost performance index (CPI)
- Budgeted cost at completion (BAC)

Earned Value Milestones



Steps in Earned Value Management

1. *Clearly define each activity* including its resource needs and budget
2. *Create usage schedules* for activities and resources
3. *Develop a time-phased budget* (PV)

Steps in Earned Value Management (con'd)

4. *Total the actual costs* of doing each task (AC)
5. *Calculate* both the budget variance (CV) and schedule variance (SV)

Earned Value Example

Activity	Jan	Feb	Mar	Apr	Plan	%C	Value
Staffing	8	7			15	100	
Blueprint			4	6	10	80	
Prototype			2	8	10	60	
Design				3	3	33	
Mon Plan	8	7	6	17	38		
Cmltv	8	15	21	38			
Mon Act	8	11	8	13			
Cmltv Act	8	19	27	40			

Earned Value Example

Activity	Jan	Feb	Mar	Apr	Plan	%C	Value
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Mon Act	8	11	8	13			
Cmltv Act	8	19	27	40			

Planned Value
38=15+10+10+3

Earned Value Example

Value
8=80%(10)

Activity	Jan	Feb	Mar	Apr	Plan	%C	Value
Staffing	8	7			15	100	15
Blueprint			4	6	10	80	8
Prototype			2	8	10	60	6
Design				3	3	33	1
Mon Plan	8	7	6	17	38		
Cmltv	8	15	21	38			
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Earned Value Example

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Design				3	3	33	1
Mon Plan	8	7	6	17	38	∑	**30**
Cmltv	8	15	21	38			
Mon Act	8	11	8	13			
Cmltv Act	8	19	27	40			

Earned Value
30=15+8+6+1

Earned Value Example

Value
8=80%(10)

Activity	Jan	Feb	Mar	Apr	Plan	%C	Value
Staffing	8	7			15	100	15
Blueprint			4	6	10	80	8
Prototype			2	8	10	60	6
Design				3	3	33	1
Mon Plan	8	7	6	17	**38**	∑	**30**
Cmltv	8	15	21	38			
Mon Act	8	11	8	13			
Cmltv Act	8	19	27	40			

Earned Value
30=15+8+6+1

Cumulative
40=8+11+8+13

Planned Value
38=15+10+10+3

Earned Value Example

<u>Schedule Variances</u>

Planned Value (PV) = 15+10+10+3 = 38

Earned Value (EV) = 15+8+6+1 = 30

Schedule Performance Index = EV/PV
= 30/38 = .79

Estimated Time to Completion = (1/.79)x4 = 5

Example (Con'd):

Cost Variances

Actual Cost of Work Performed (AC) =
8+11+8+13 = $40,000

Cost Performance Index = EV/AC =
30/40 = .75

Estimated Cost to Completion =
(1/.75)x38 = $50,700

Completion Values in EVM

Accurate and **up-to-date** information is **critical** in the use of **EVM**

- 0/100 Rule
- 50/50 Rule
- Percentage Complete Rule

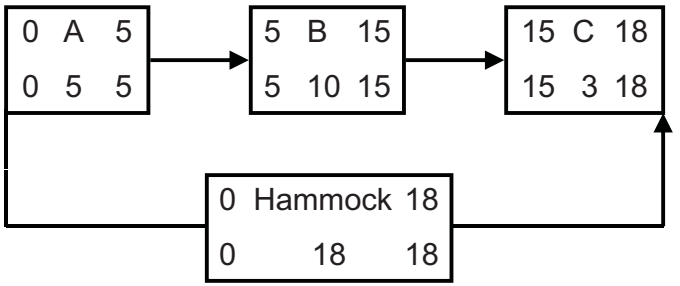
The Challenge

Successfully planning and controlling a project is one of the most critical skill sets a person can learn.

Doing it right requires an understanding of the principles, a commitment to applying them, and PRACTICE!!!

Hammock Activities

Used as summaries for subsets of activities



Useful with a complex project or one that has a shared budget