Unit-1 & 5
Project Schedule

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Outline

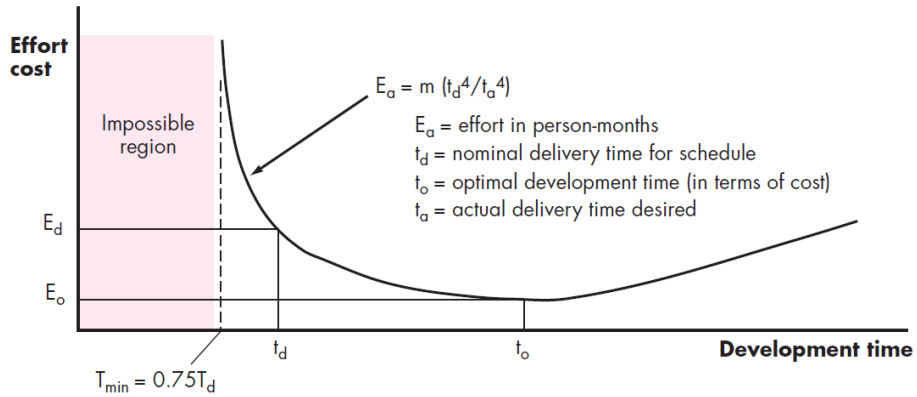
- Relationship between People and Effort
- Task Set
- Task Network
- Project Scheduling
- Earned Value Analysis

Relationship between People and Effort

Project Size

- Small size projects – a single person can analyze requirements, perform design, generate code, and conduct tests.
- Large size projects – more people must become involved.

- "If we fall behind schedule, we can always add more programmers and catch up later in the project."
- More people increase the number of communication paths and the complexity of communication throughout a project.
- project schedules are elastic - compress, extend
- Putnam-Norden-Rayleigh (PNR) Curve



Relationship between People and Effort(contd..)

PNR curve

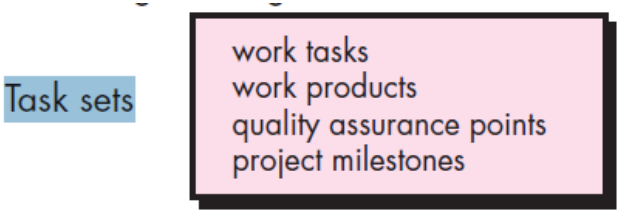
- Estimated effort E_d require a nominal delivery time t_d
- In PNR curve, project delivery time cannot be compressed much beyond $0.75t_d$
- PNR curve indicates that the lowest cost delivery option,$t_o = 2t_d$.
- The number of delivered lines of code (source statements), L, is related to effort and development time by the equation: $L = P * E^{1/3}t^{4/3}$

Task Set

- Tasks are called the project work breakdown structure (WBS)
- Each software engineering action is defined by a task set that identifies the work tasks that are to be completed, the work products that will be produced, the quality assurance points that will be required, and the milestones that will be used to indicate progress.
- A task set is a collection of software engineering work tasks, milestones, work products, and quality assurance filters that must be accomplished to complete a particular project.
- A task set must be distributed on the project time line.
- Eg. Task set for project planning, Elicitation.

Sample Elication task set

- Make contact with stakeholder via telephone.
- Discuss requirements and take notes.
- Organize notes into a brief written statement of requirements.
- E-mail to stakeholder for review and approval.



Task Set(contd..)

Task set for different project type

- Concept development projects - new business concept or application of some new technology.
- New application development projects for specific customer request
- Application enhancement projects - existing software undergoes major modifications
- Application maintenance projects - correct, adapt, or extend existing software
- Reengineering projects - rebuilding an existing (legacy) system

Factors that influence the task set

- Size of the project, number of potential users, mission criticality, application longevity, stability of requirements, ease of customer/developer communication, maturity of applicable technology, performance constraints, embedded and nonembedded characteristics, project staff, and reengineering factors.

Task Set(contd..)

Actions for Concept development projects

- Concept scoping, Preliminary concept planning, Technology risk assessment, Proof of concept, Concept implementation, Customer reaction

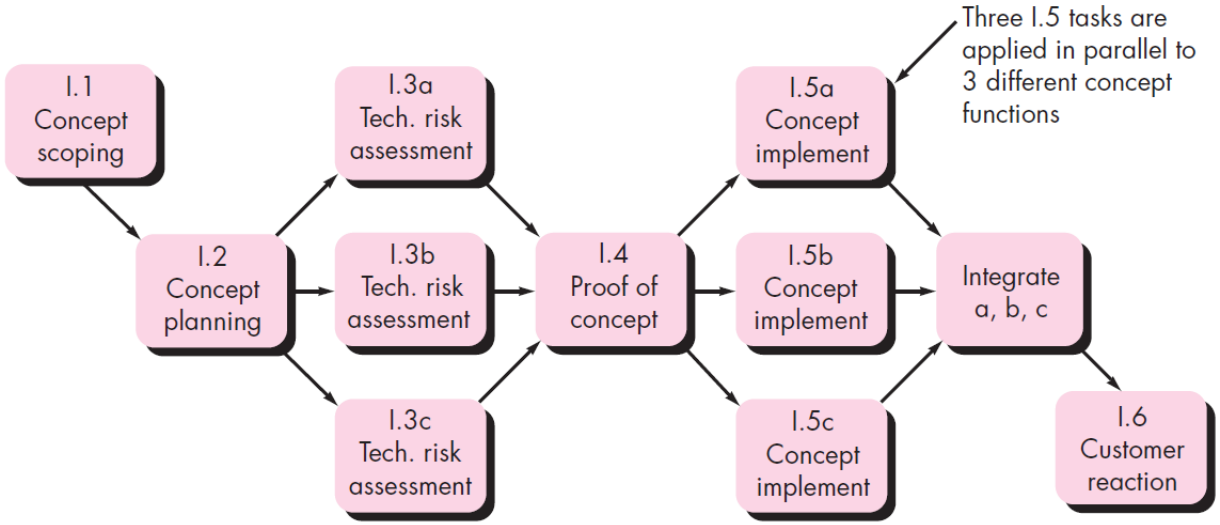
Task set for the Action - Concept scoping

1. Identify need, benefits and potential customers
2. Define desired output/control and input events that drive the application
3. Define the functionality/behavior for each major function
4. Isolate those elements of the technology to be implemented in software
5. Research availability of existing software
6. Define technical feasibility
7. Make quick estimate of size
8. Create a scope definition

Task network

- Task network or activity network, is created to enable the software team to meet the scheduled delivery deadline.
- A graphic representation of the task flow for a project.
- This network depicts major software engineering actions.
- Task network diagram identifies the critical path and the duration of the project.

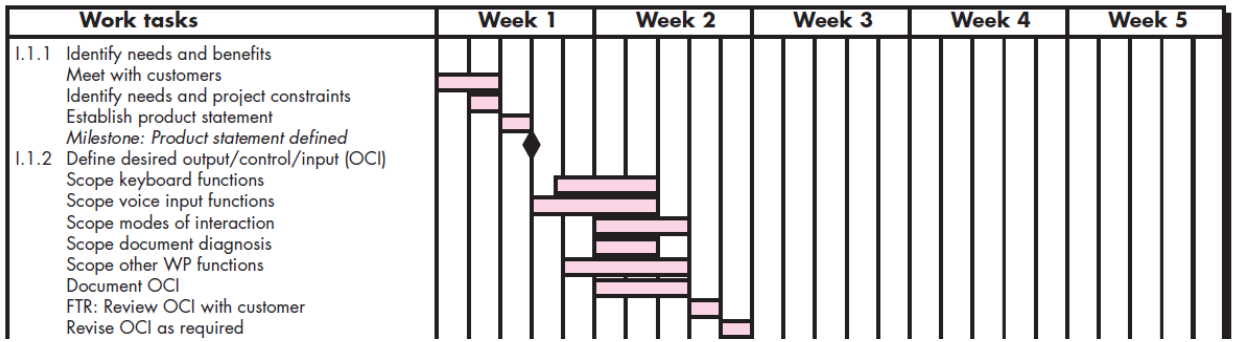
Figure: A task network diagram for "Concept development project"



Project Scheduling

- Software project scheduling distributes estimated effort across the planned project duration by allocating the effort to specific tasks
- During early stages of project planning, a macroscopic schedule is developed identifying all major process framework activities and the product functions to which they apply.
- A time-line chart, also called a Gantt chart

Figure: Time-line chart



Scheduling(Contd..)

Software Tools

- Program evaluation and review technique (PERT) and the critical path method (CPM) are two project scheduling methods that can be applied to software development. Tools produce project tables.
- Majority of software project scheduling tools produce project tables a tabular listing of all project tasks, their planned and actual start and end dates, and a variety of related information

Figure: Project table

Work tasks	Planned start	Actual start	Planned complete	Actual complete	Assigned person	Effort allocated	Notes
I.1.1 Identify needs and benefits							Scoping will
Meet with customers	wk1, d1	wk1, d1	wk1, d2	wk1, d2	BLS	2 p-d	require more
Identify needs and project constraints	wk1, d2	wk1, d2	wk1, d2	wk1, d2	JPP	1 p-d	effort/time
Establish product statement	wk1, d3	wk1, d3	wk1, d3	wk1, d3	BLS/JPP	1 p-d	
Milestone: Product statement defined	wk1, d3	wk1, d3	wk1, d3	wk1, d3			
I.1.2 Define desired output/control/input (OCI)							
Scope keyboard functions	wk1, d4	wk1, d4	wk2, d2		BLS	1.5 p-d	
Scope voice input functions	wk1, d3	wk1, d3	wk2, d2		JPP	2 p-d	

Basic principles of Software project scheduling:

- Compartmentalization, Interdependency, Time allocation, Effort validation, Defined responsibilities, Defined outcomes, Defined milestones

Scheduling(Contd..)

Case Study-Data provided in AGMS project

- CPM Estimation for the various activity & Flow of the activity in project

List of Activities for the Airport Gate Management System (AGMS) Acquisition Project

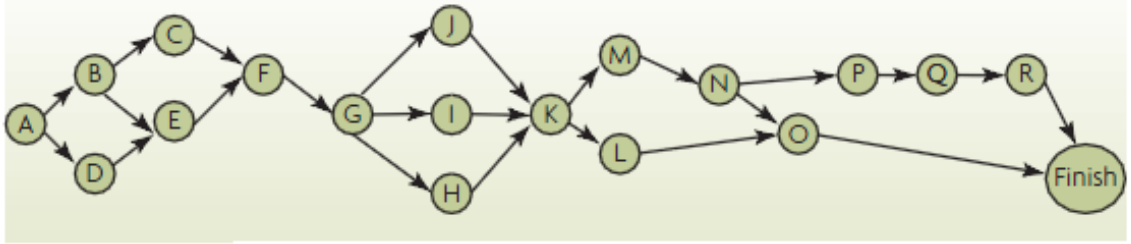
Activity	Description	Immediate Predecessors	Estimated Time (weeks)
A	Set up the project acquisition team	—	2
B	Write down the software requirements	A	2
C	Develop a contractor evaluation grid that will be used to evalute proposals	B	1
D	Identify and select potential contractors	A	1
E	Develop and send out a request for proposal to potential contractors	B, D	4
F	Audit candidate contractors, select one contractor, negotiate and sign an agreement contract with the selected contractor	C, E	2
G	Prepare the definition of functional specifications	F	5
H	Develop a software testing plan	G	2
I	Software customization phase I	G	12
J	Purchase and install the hardware	G	2
K	Test the first release	H, I, J	1
L	Develop a training plan for key users	K	1
O	Train key users	L, N	2
M	Software customization phase II	K	6
N	Test the second release	M	1
P	Software customization phase III	N	3
Q	Test the final release	P	2
R	Software deployment and project sign-off	Q	4

Scheduling(Contd..)

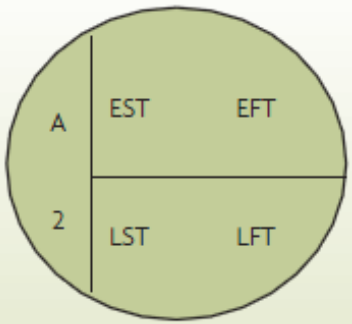
Case Study-Data provided in AGMS project

- CPM or Network diagram, total time to complete the project
- Early Start Time(EST) and Early Finish Time(EFT)
- Latest Start Time(LST) and Latest Finish Time (LFT)

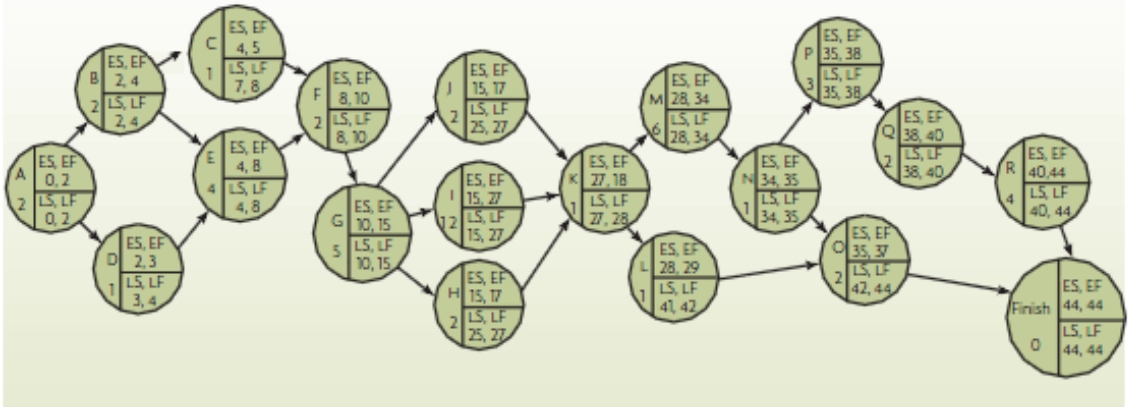
Network Representation for the AGMS Acquisition Project



Nodes Notation



LST and LFT Computation for the AGMS Acquisition Project



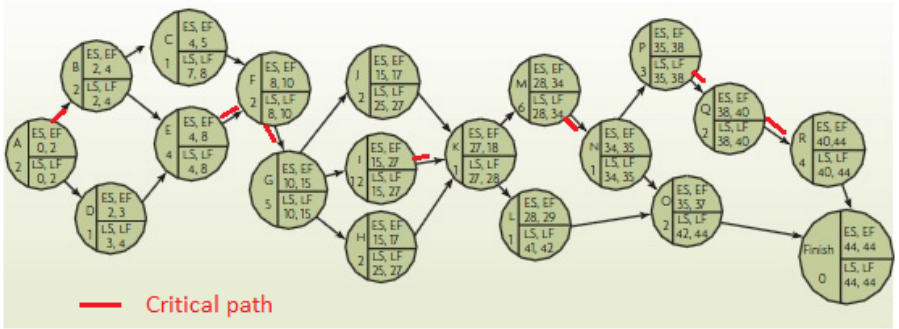
Scheduling(Contd..)

Case Study-Data provided in AGMS project

- Identification of Critical activity-CPM

Summary of Activities' Start, Finish, and Slack Times

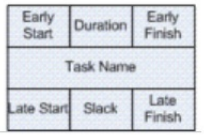
Activity	EST	EFT	LST	LFT	Slack	Critical Activity
A	0	2	0	2	0	Yes
B	2	4	2	4	0	Yes
C	4	5	7	8	3	
D	2	3	3	4	1	
E	4	8	4	8	0	Yes
F	8	10	8	10	0	Yes
G	10	15	10	15	0	Yes
H	15	17	25	27	10	
I	15	27	15	27	0	Yes
J	15	17	25	27	10	
K	27	28	27	28	0	Yes
L	28	29	41	42	13	
M	28	34	28	34	0	Yes
N	34	35	34	35	0	Yes
O	35	37	42	44	7	
P	35	38	35	38	0	Yes
Q	38	40	38	40	0	Yes
R	40	44	40	44	0	Yes
Finish	44	44	44	44	0	Yes



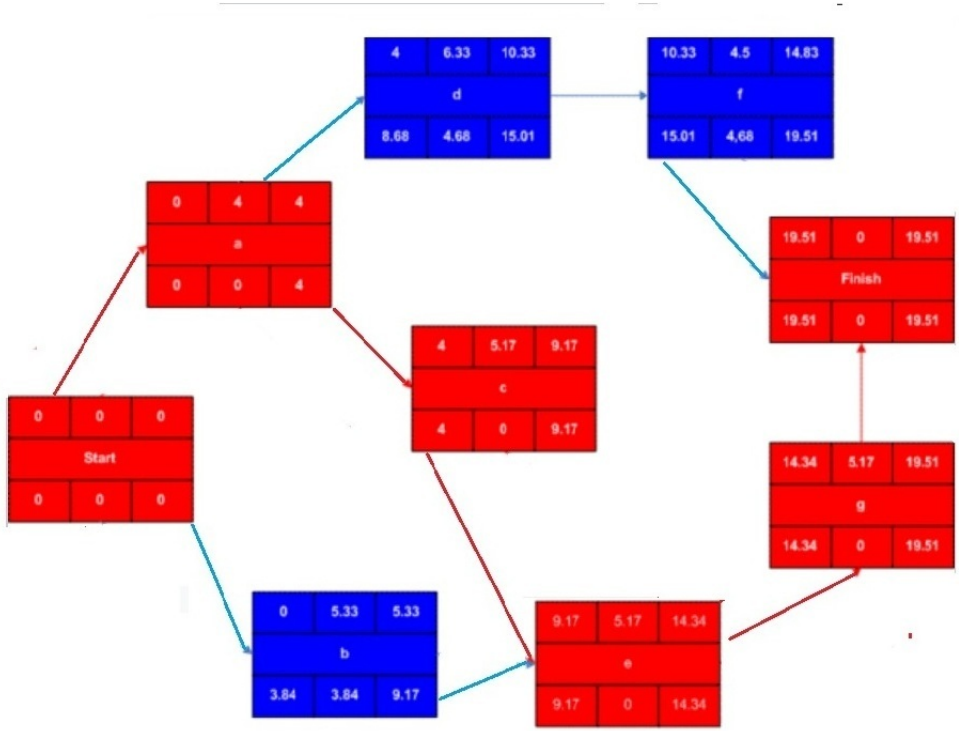
PERT

- PERT method

Activity	Predecessor	Time estimates			Expected time
		Opt. (*o*)	Normal (*m*)	Pess. (*p*)	
A	—	2	4	6	4.00
B	—	3	5	9	5.33
C	*A*	4	5	7	5.17
D	*A*	4	6	10	6.33
E	*B*, *C*	4	5	7	5.17
F	*D*	3	4	8	4.50
G	*E*	3	5	8	5.17



Expected time=0+4m+p



Note the critical path is in red.

Scheduling(Contd..)

CPM and PERT - Differences

CPM

- Critical Path Method (CPM) is a project management tool which is suitable for projects that have predictable activities.
- CPM uses a single estimate for the time that a project can be completed .
- CPM is a deterministic project management tool
- CPM allows project management planners to determine which aspect of the project to sacrifice when a trade-off is needed in order to complete the project.

PERT

- The Program Evaluation and Review Technique (PERT) is a project management technique or tool which is suitable for projects that have unpredictable activities.
- PERT uses three estimates(optimistic,normal, pessimistic) for the time that it can be completed.
- PERT is a probabilistic project management tool.
- PERT does not allows project management planners to determine which aspect of the project to sacrifice when a trade-off is needed in order to complete the project.

Software Project Tracking

Qualitative approaches

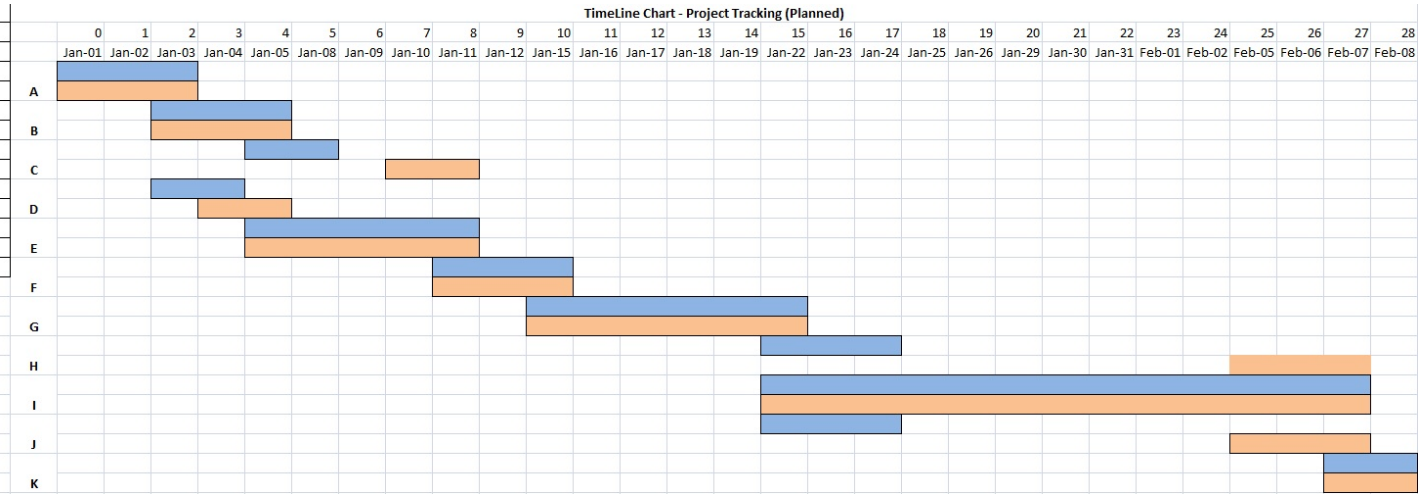
- Conduct periodic project status meetings in which each team member reports progress and problems
- Evaluate the results of all reviews conducted throughout the software engineering process
- Determine whether formal project milestones (i.e., diamonds) have been accomplished by the scheduled date
- Compare actual start date to planned start date for each project task listed in the timeline chart
- Meet informally with the software engineering team to obtain their subjective assessment of progress to date and problems on the horizon

Quantitative approach

- Use earned value analysis to assess progress quantitatively

Software Project Tracking(Contd..)

Data				
	Project Schedule			
Task	Plan (days)		Actual(days)	
A	0	2	0	2
B	2	4	2	4
C	4	5	7	8
D	2	3	3	4
E	4	8	4	8
F	8	10	8	10
G	10	15	10	15
H	15	17	25	27
I	15	27	15	27
J	15	17	25	27
K	27	28	27	28



Earned value analysis

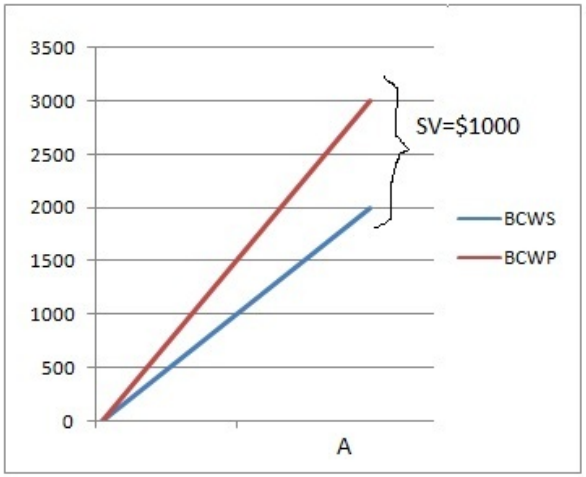
- An industry standard method of measuring a project's progress at any given point in time, and analyzing variances in the schedule and cost as the project proceeds.
- It enables you to assess the percent of completeness of a project using quantitative analysis.
- Compute the following to determine the earned value.
  1. Budgeted Cost of Work Scheduled (BCWS)
  2. Budgeted Cost of Work Performed (BCWP)
  3. Actual Cost of Work Performed (ACWP).
- BCWS represents the budget of the activities that were planned to be completed
- BCWP represents the budget of the activities that actually were completed.
- ACWP is the sum of the effort actually expended on work tasks that have been completed by a point in time on the project schedule.

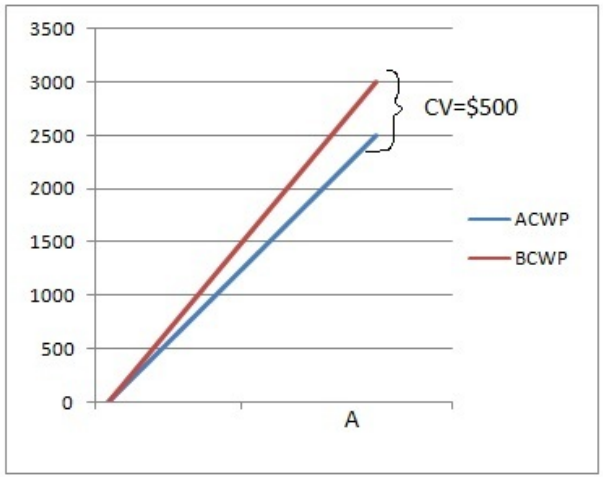
Earned value analysis

Table: Earn value analysis-calculation of schedule variance and cost variance

Task	Budget	WS	BCWS	WP	BCWP	ACWP	SV	CV
A	$4000	50%	$2000	75%	$3000	$2500	$1000	$500
B	$3000	23%	$690	10%	$300	$400	-$390	-$100

- For **Task A**
  - BCWS=WS x budget cost=50%x$4000=$2000
  - BCWP=WP x budget cost=75%x$3000=$1000
  - SV=BCWP-BCWS=$2000-$1000=$1000
  - CV=BCWP-ACWP=$3000-$2500=$500





Earned value analysis(contd..)

- Schedule Performance Index, SPI value close to 1.0 indicates efficient execution of the project schedule.
  1. SPI= $\frac{BCWP}{BCWS}$, Schedule variance
- Cost performance index, CPI value close to 1.0 indicates that the project is within its defined budget.
  1. CPI= $\frac{BCWP}{ACWP}$

Summary

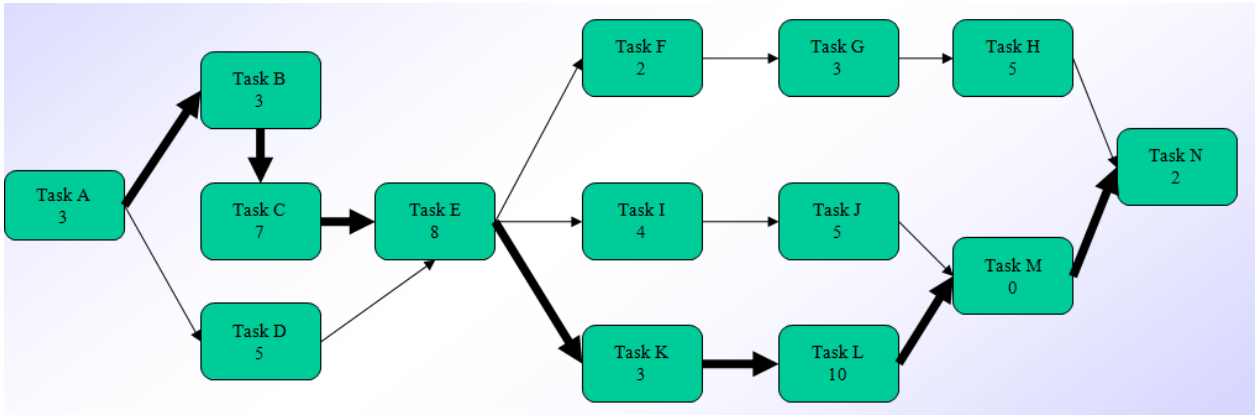
- Why people are important in software project ?
- Impossible region in project schedule.
- To draw time line chart and task network diagram.
- Identify critical activity in schedule.
- Assess the progress of schedule using EVM.

Assessment-I

Questions

- What is the duration for this project completion ?
- What is the critical path ?
- Draw the time line chart.
- Tabulate the project data with the available information.

Figure: Sample project task network



Assessment-II

Questions

- What is the duration for this project completion ?
- What is the critical path ?
- How to calculate execution time in PERT estimation?
- Difference between PERT and CPM.
- Draw the time line chart.
- Complete the project table with the available information.

Figure: Sample project data

Task #	Task Name	Duration	Start	Finish	Pred.	4/1	4/8	4/15	4/22	4/29	5/6	5/13	5/20	5/27	6/3
A	Establish increments	3	4/1		None										
B	Analyze Inc One	3			A										
C	Design Inc One	8			B										
D	Code Inc One	7			C										
E	Test Inc One	10			D										
F	Install Inc One	5			E										
G	Analyze Inc Two	7			A, B										
H	Design Inc Two	5			G										
I	Code Inc Two	4			H										
J	Test Inc Two	6			E, I										

Assessment-III

- During project scheduling, resource allocation to different activities is done using which of the following representations?

  1. PERT chart
  2. activity network representation
  3. work breakdown structure
  4. Gantt chart

References I