STRN 322 Construction Planning & Scheduling

Lecture 9:
Project Control: Schedule and Cost Control

Hesham Osman Ph.D.,
Associate Professor
Construction Engineering & Management, Cairo University

Measuring work progress

- During the execution of a construction project, the individuals executing it must periodically report the progress of each activity.
- The nature of each activity varies and hence each type has a suitable method for measuring progress
- The most convenient methods is to report the %complete for each activity
- There are several available methods to calculate an activity's % completion…..

Activity Percent Complete

- **Units complete:** Applies to activities that involve repeated production of easily measured work (e.g. concrete poring, pile driving, etc…)

% Complete = Units Complete / Total Units

- **Cost Ratio:** Involves activities that are budgeted based on a bulk allocation of dollars and involve a long time or are continuous during the life of a project (e.g. project management, quality assurance)

% Complete =
Actual cost (or hours) of work to date / forecast at completion

Activity Percent Complete

- **Incremental Milestones:** Applies to activities that include subtasks that must be handled in sequence. Each milestone is assigned a percentage as a rule of credit

Equipment Installation:

Receive & Inspect	15%
Setting Complete	35%
Alignment Complete	50%
Internals Installed	75%
Testing Complete	90%
Accepted by Owner	100%

Activity Percent Complete

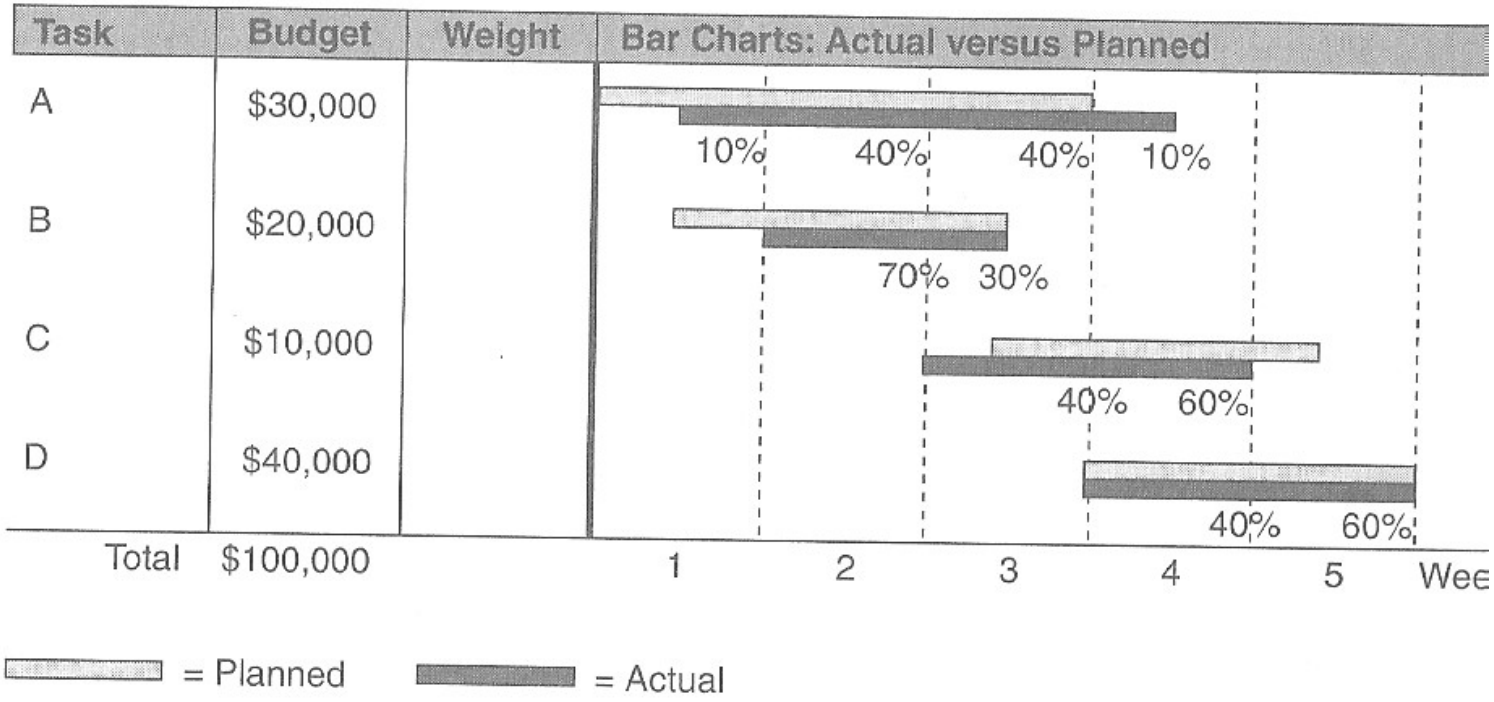
- **Supervisor Opinion:** Applies to activities that require the subjective judgment of foreman or supervisors (e.g. Dewatering, landscaping, temporary construction).

Project Percent Completion

- Company management and owners may be more interested in knowing the overall percent completion for the entire project.
- This percentage must be reported "bottom-up" by aggregating the individual activity % completion

Project % complete = Σ Activity % complete * Activity Weight

Project Percent Completion Example



Project Percent Completion Example

Task	Weight		1	2	3	4	5
A	30%	Plan	0.333	0.666	1.0	1.0	1.0
		Actual	0.1	0.5	0.9	1.0	1.0
B	20%	Plan	0.25	0.75	1.0	1.0	1.0
		Actual		0.7	1.0	1.0	1.0
C	10%	Plan			0.25	0.75	1.0
		Actual			0.4	1.0	1.0
D	40%	Plan				0.5	1.0
		Actual				0.4	1.0

Project Percent Completion

	1	2	3	4	5
Plan	0.15	0.35	0.525	0.775	1.0
Actual	0.03	0.29	0.51	0.76	1.0

Earned Value

- The budgeted value of work completed during a time period

Task	Budget	1	2	3	4	5
A	30,000	3,000	12,000	12,000	3,000	
B	20,000		14,000	6,000		
C	10,000			4,000	6,000	
D	40,000				16,000	24,000
Earned Value		3,000	26,000	22,000	25,000	24,000

Cost and Schedule Control

- After calculating the percent completion for a project how can we evaluate our project management performance….
  - Are we behind schedule?
  - Are we over budget
  - Are we behind schedule **and** over budget?
- We will present three methods of evaluation:
  - S-Curve Method
  - Double S-Curve Method
  - Earned Value Analysis (EVA)

S-Curve Method

Draw an envelope for early and late planned costs

Plot the actual costs on the same figure

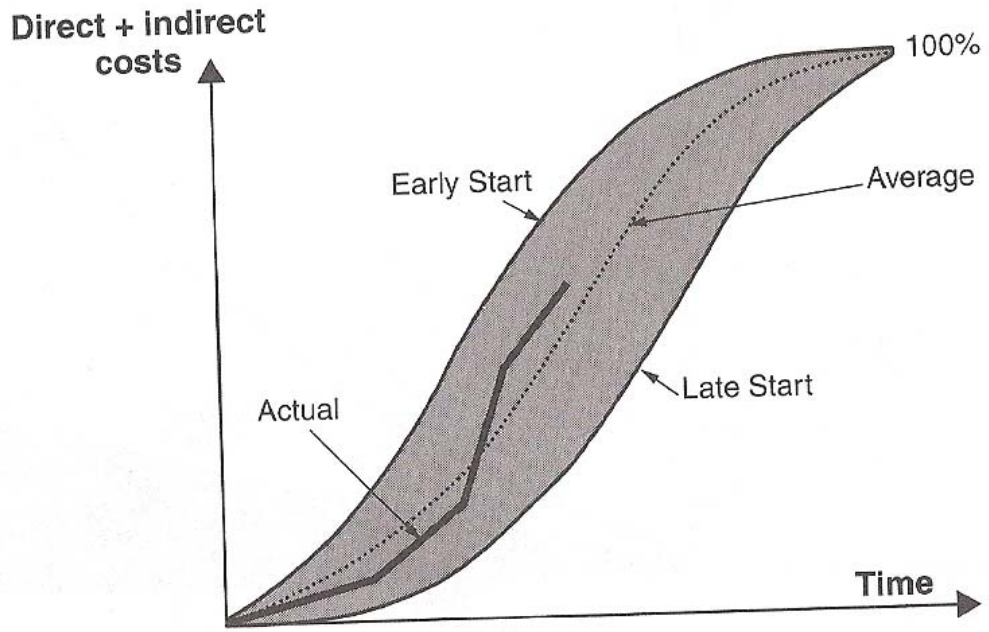
Disadvantage:

Not useful in analyzing project performance

If actual costs are more than planned costs what does this mean?

1- Are we spending more money than planned on activities?

2- Are we ahead of schedule?

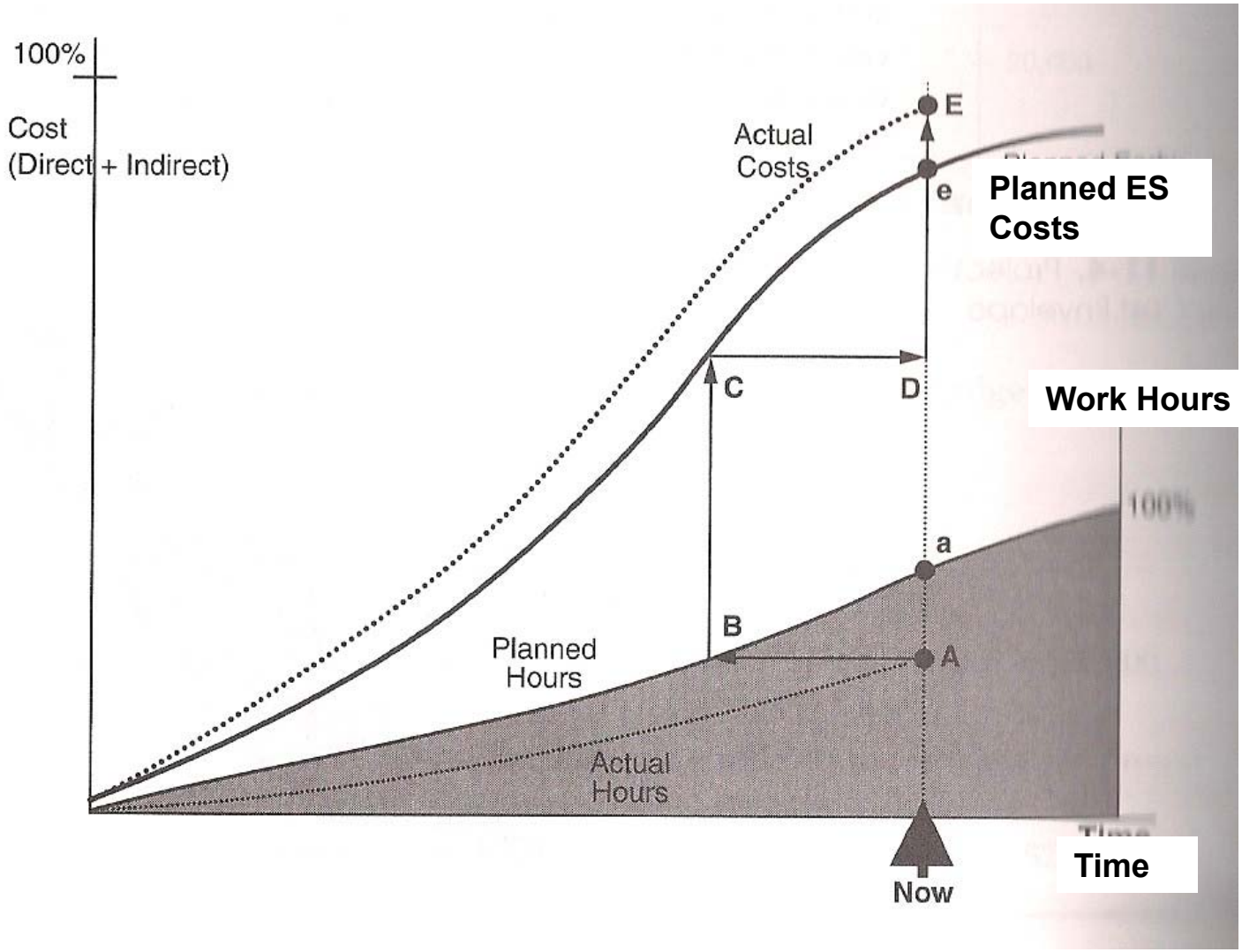


Double S-Curve Method

- In order to better identify cost and schedule overruns we can draw two S-Curves

  - **Cost S-Curve:** Planned versus actual
  - **Labor hours S-Curve:** Planned versus actual

Double S-Curve Method



Double S-Curve Method

- Disadvantage: Produces conflicting conclusions on project cost performance

What is the cost overrun?
1- Difference between points E and e
2- Difference between points E and D

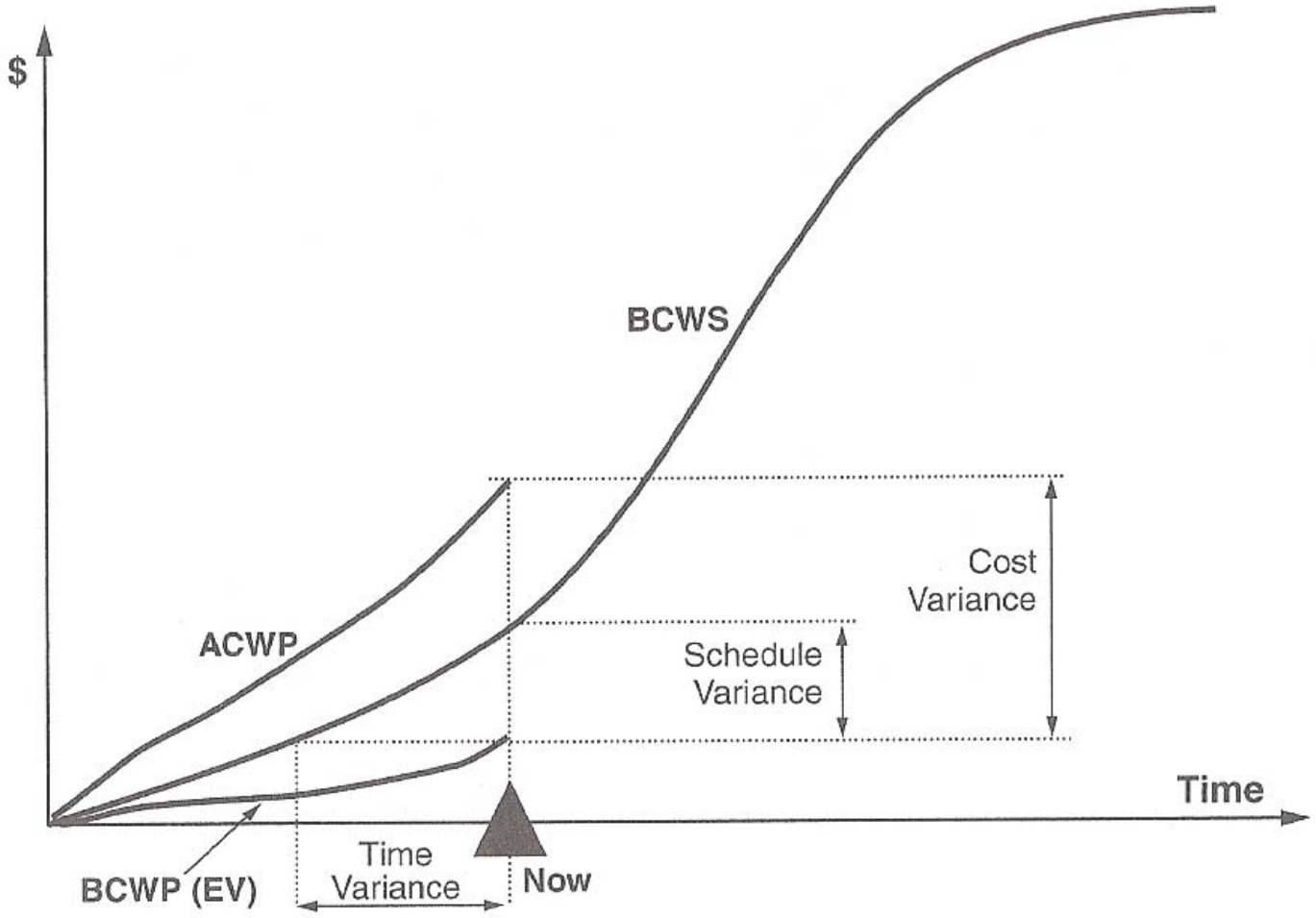
1- Point B represents the time at which we planned to have spent the number of hours A.
2- At time B we had planned to spend the amount C (or D)

Earned Value Analysis

In order to better identify variances in cost versus variances in schedule we define three key terms:

- Budget Cost of Work Scheduled (BCWS): The ***planned*** cost of work that was ***planned*** to be completed to date
- Budget Cost of Work Performed (BCWP): The ***planned*** cost of work that was ***actually*** completed to date
- Actual Cost of Work Performed (ACWP): The ***actual*** cost of work that was ***actually*** completed to date

Earned Value Analysis



Project experiencing a schedule delay and cost overrun

Project Performance Indicators

Using EVA we can develop project-specific performance indicators for cost and schedule

Schedule Performance Index (SPI) = $\frac{BCWP}{BCWS}$

SPI > 1 → Ahead of schedule
SPI < 1 → Behind Schedule

Cost Performance Index (CPI) = $\frac{BCWP}{ACWP}$

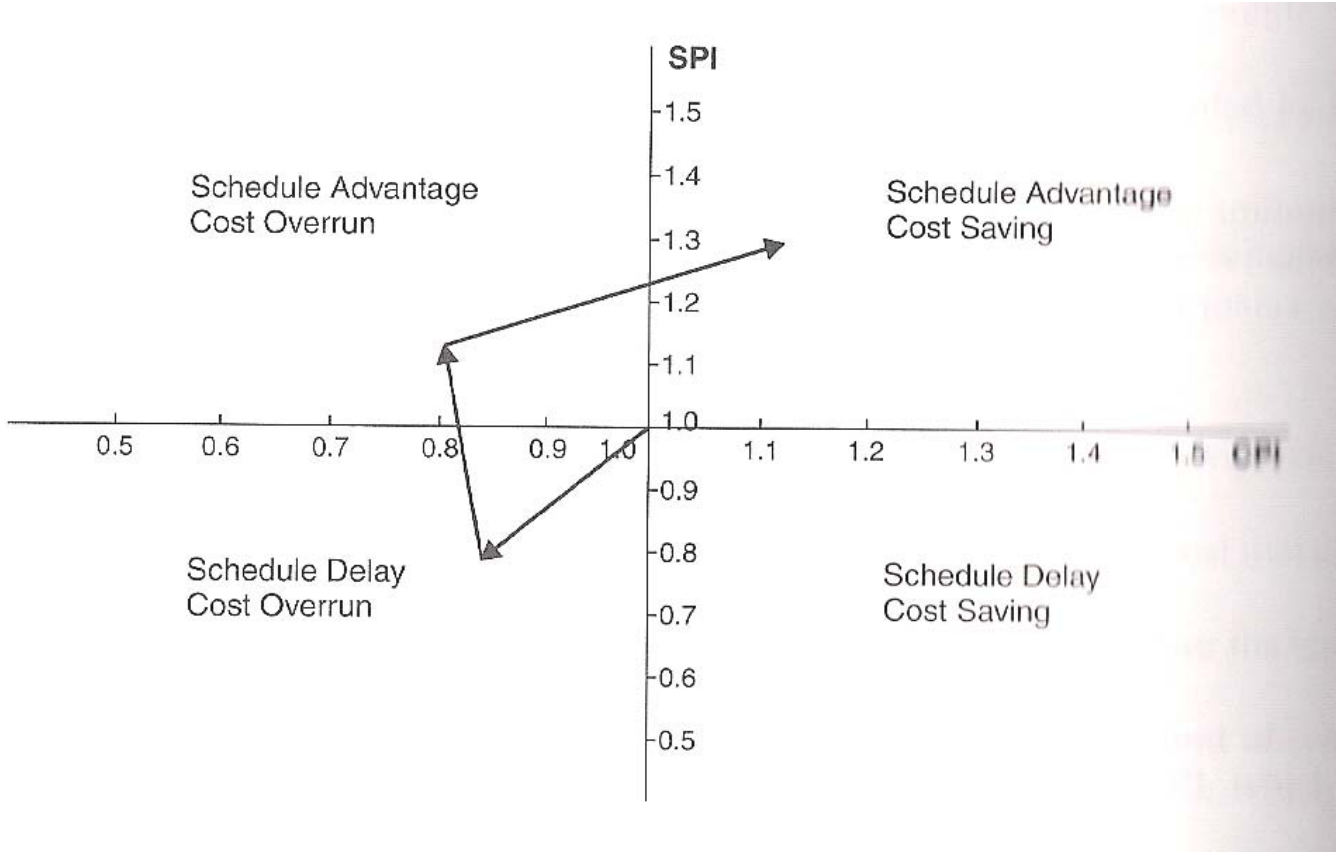
CPI > 1 → Cost saving
CPI < 1 → Cost overrun

Other indicators:

Schedule Variance (SV) = BCWP – BCWS (SV>0 indicates ahead of sched.)
Cost Variance (CV) = BCWP – ACWP (CV >0 indicates cost saving)

SPI/CPI Charts

By plotting the value of SPI and CPI on orthogonal axes we can visualize the progression of project performance



Forecasting Project Performance

- EVA gives us an instantaneous snapshot of project performance.
- In many cases we want to forecast future performance
- A commonly used indicator is the Estimate at Completion (EAC) that is used to forecast the expected cost at project completion
- There are 2 approaches to estimate EAC

Assuming future progress will be **as-planned**

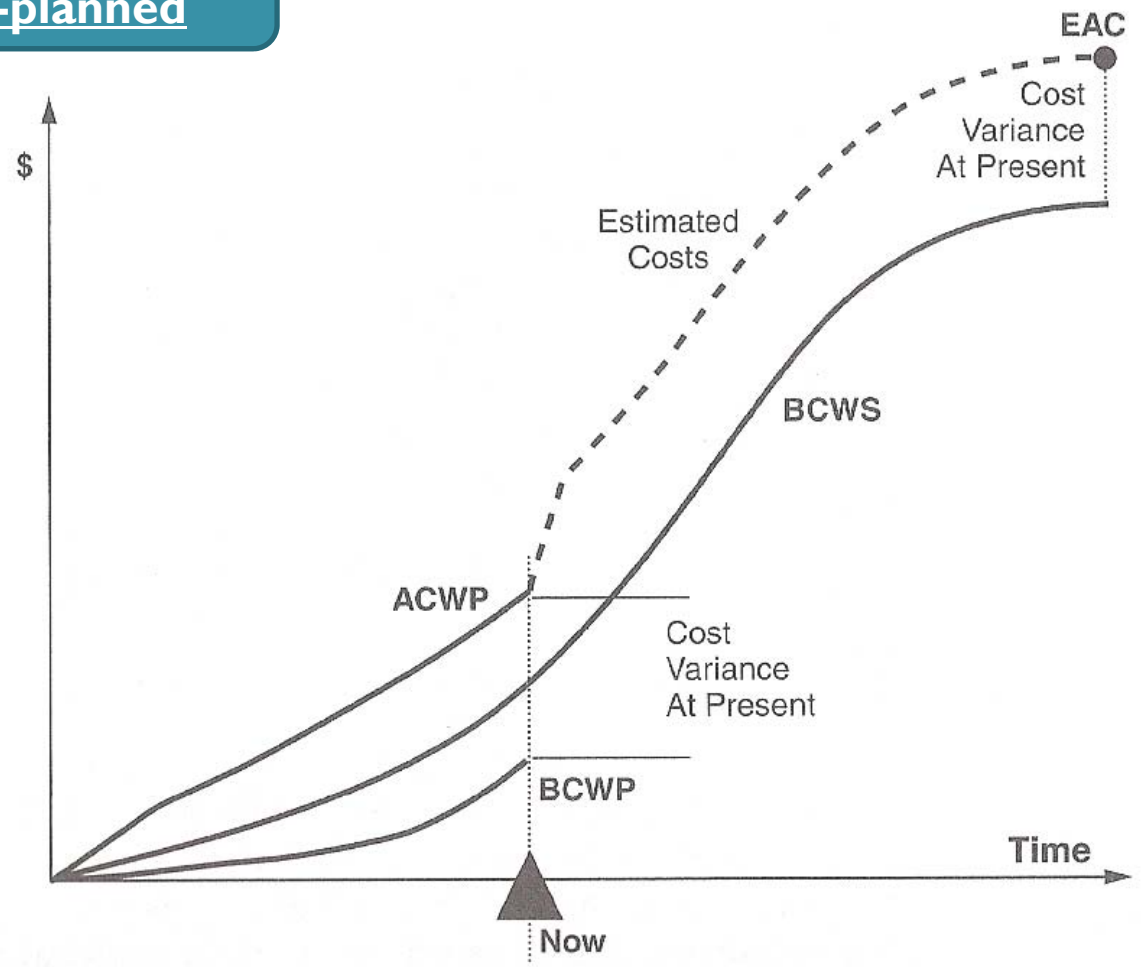
EAC = **Project Budget** - **CV** at present

Assuming future progress will be **as performed so far**

EAC = **Project Budget** / CPI

Forecasting Project Performance

Assuming future progress will be **as-planned**



Example

Act.	Budget		1	2	3	4	5	6	7	8
A	100,000	Planned								
		Actual Spent		20,000	30,000	25,000	25,000	25,000		
		% complete		20%	40%	60%	80%	100%		
B	360,000	Planned								
		Actual Spent				80,000	140,000	140,000		
		% complete				30%	70%	100%		
C	300,000	Planned								
		Actual Spent			100,000	100,000	100,000			
		% complete			40%	80%	100%			
D	140,000	Planned								
		Actual Spent					30,000	40,000		
		% complete					20%	25%		

Undertake earned value analysis on this project at the end of months 4 and 6. Calculate SPI, CPI, CV, SV and EAC.

What can you conclude about the project progress?