Project Cost Control

Objectives of Project Cost Control System

1. To identify those work types having excessive costs and to give an indication of how serious those overruns are.

2. To forecast the final total job cost.

3. To indicate the trend for each cost code, that is, whether the unit cost involved has been increasing or decreasing (evaluation of the effectiveness of cost reduction efforts).

4. To update the database of the company that will be used to estimate future works.

Project Cost Control System

- The ***cost estimate*** prepared for the project during the bidding process is the basis for cost control.
- Cost control for an engineering project is limited to the cost of ***labor, equipment, materials and site overheads.***
- Control of cost and time should be linked together.

Three Key Indicators in Performance

1. ***Budgeted Cost of Work Scheduled (BCWS)*** *is the budgeted amount of cost of the work scheduled to be accomplished in a given time period (including support and allocated overhead). (This is can be referred to as* ***"planned value of work to be accomplished [PV]"****.)*

2. ***Budgeted Cost of Work Performed*** **(BCWP)** *is the budgeted amount of cost for the work completed in a given time period, including support effort and allocated overhead. (This is can be referred to as* ***"earned value of work accomplished [EV]"****.)*

   How to calculate BCWP

   - ***Budgeted cost for work performed (BCWP) = Earned value of an activity = Percent completed for the activity * the activity budget***
   - ***Percent completed for an activity = [(Projected duration – Remaining duration) / Projected duration] * 100***

3. ***Actual Cost of Work Performed (ACWP) OR [AC]*** *is the amount reported as actually expended in completing the particular work accomplished within a given time period.*

Performance Equations

Symbol	Definition	التعريف
(BCWS) [PV]"	Budgeted Cost of Work Scheduled "planned value of work to be accomplished	تكلفة موازنة للأعمال المجدولة وفقا للخطة
(BCWP) [EV]	Budgeted Cost of Work Performed "earned value of work accomplished	تكلفة موازنة لما تم من أعمال
(ACWP) [AC]	Actual Cost of Work Performed	التكلفة الفعلية لما تم من أعمال وتم دفعها

Cost Performance

BCWP
ACWP

Cost Variance | **CV = BCWP-ACWP**

> 0	**Under budget** Work performed cost > Actual cost
= 0	**Within budget** Work performed cost = Actual cost
< 0	**Over budget** Work performed cost < Actual cost

Cost Performance

BCWP
ACWP

Cost Performance Index | **CPI = BCWP/ACWP**

> 1	**Under budget** Work performed cost > Actual cost
= 1	**Within budget** Work performed cost = Actual cost
< 1	**Over budget** Work performed cost < Actual cost

Cost Performance

BCWP
ACWP

% Cost Overrun/ Underrun | $\left(\frac{\text{ACWP} - \text{BCWP}}{\text{BCWP}}\right)$

> 0	**Under run** Performed cost > Earned
= 0	**on run** Performed cost = Earned
< 0	**Over run** Performed cost < Earned

The "Cost Overrun" *curve* is a plot of the calculated percent over- or Underrun at any given time.

Performance Equations

Symbol	Definition	التعريف
(BCWS) [PV]"	Budgeted Cost of Work Scheduled "planned value of work to be accomplished	تكلفة موازنة للأعمال المجدولة وفقا للخطة
(BCWP) [EV]	Budgeted Cost of Work Performed "earned value of work accomplished	تكلفة موازنة لما تم من أعمال
(ACWP) [AC]	Actual Cost of Work Performed	التكلفة الفعلية لما تم من أعمال وتم دفعها

Schedule (Time) Performance

BCWP
BCWS

Schedule/Performance Variance	SV = BCWP-BCWS

> 0	Ahead schedule Work performed > Work scheduled
= 0	On schedule Work performed = Work scheduled
< 0	Behind scheduke Work performed < Work scheduled

Schedule (Time) Performance

BCWP
BCWS

Schedule Performance Index	SPI = BCWP/BCWS

> 1	Ahead schedule Work performed > Work scheduled
= 0	On schedule Work performed = Work scheduled
< 1	Behind scheduke Work performed < Work scheduled

Cost Forecasting Equations

Symbol	Definition	التعريف
(BCWS) [PV]"	*Budgeted Cost of Work Scheduled "planned value of work to be accomplished*	تكلفة موازنة للأعمال المجدولة وفقا للخطة
(BCWP) *[EV]*	*Budgeted Cost of Work Performed "earned value of work accomplished*	تكلفة موازنة لما تم من أعمال
(ACWP) [AC]	*Actual Cost of Work Performed*	التكلفة الفعلية لما تم من أعمال وتم دفعها

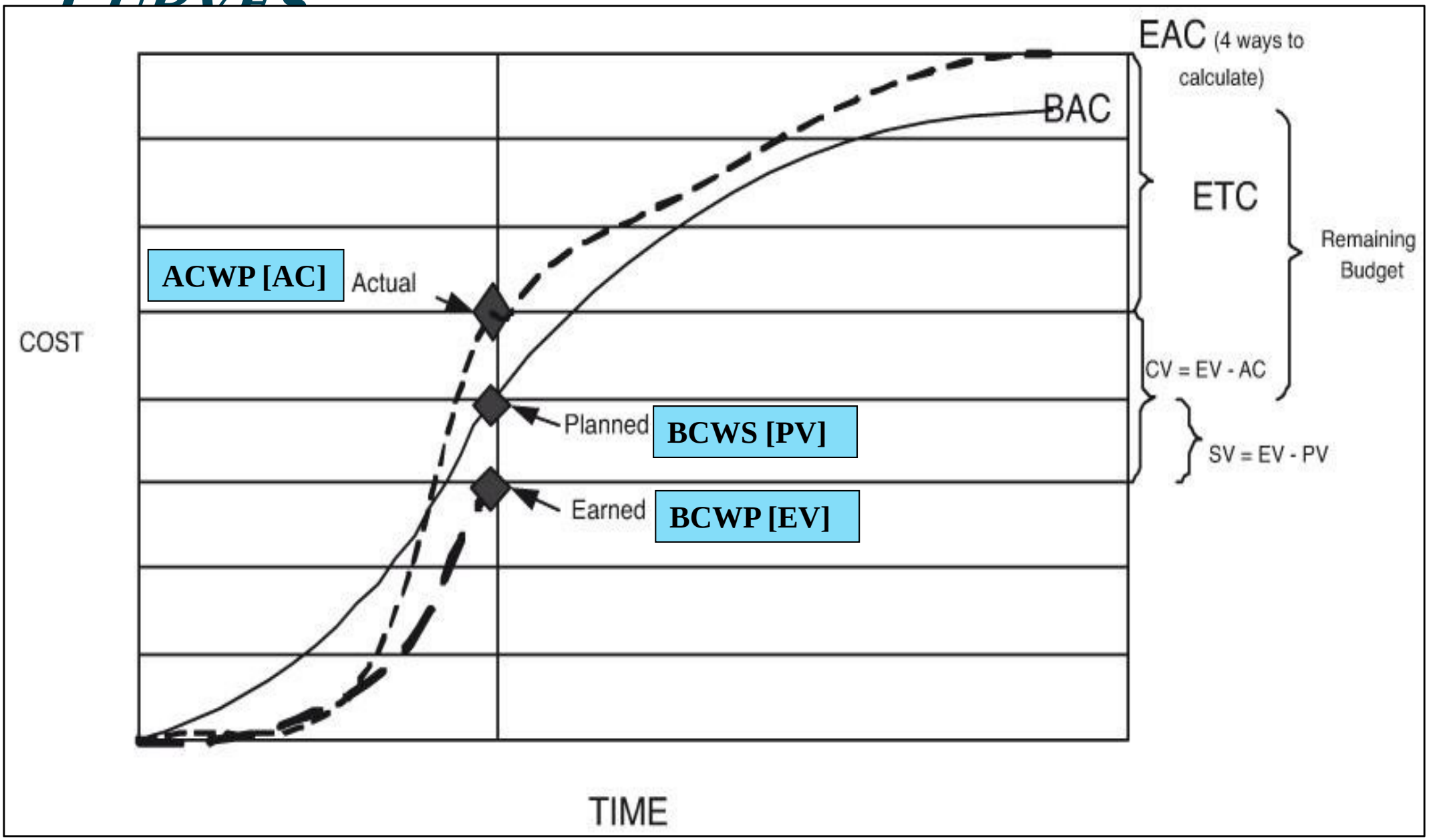
Budget Cost At Completion	$BAC = BCWS_{end}$

Estimated Cost At Completion	$EAC = \left(\frac{ACWP_{to\ data}}{BCWP_{to\ date}}\right) * BAC,$ *OR* $EAC = ACWP_{to\ date} + \frac{(BAC - BCWP_{to\ date})}{CPI_{this\ period}}$

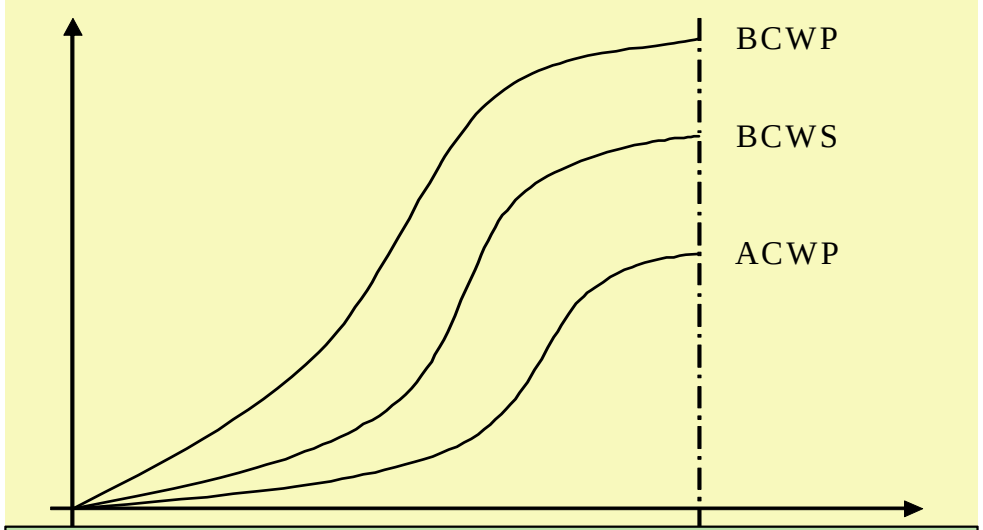
Estimate to Completion	ETC = EAC - ACWP

Variance from original budget	VB = EAC - BAC

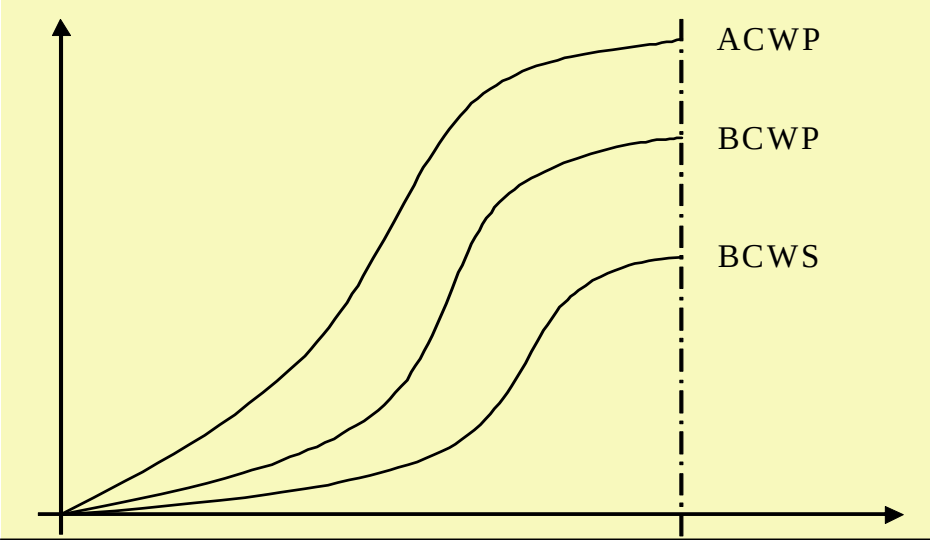
BCWS [PV], BCWP [EV], and ACWP[AC] – S-CURVES



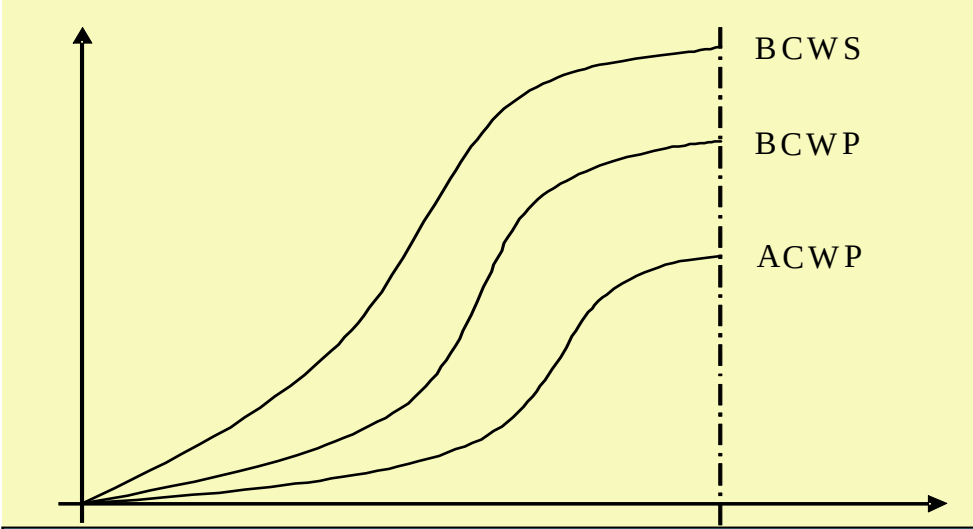
BCWS, BCWP, and ACWP



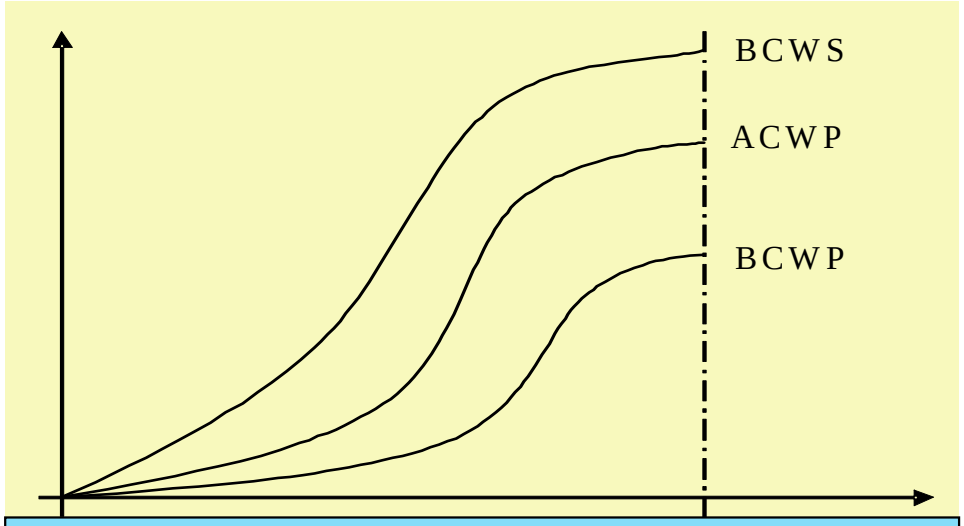
Under budget (costs below budget) & Ahead of schedule (fast)



Over budget (Over costs) & Ahead of schedule (fast)

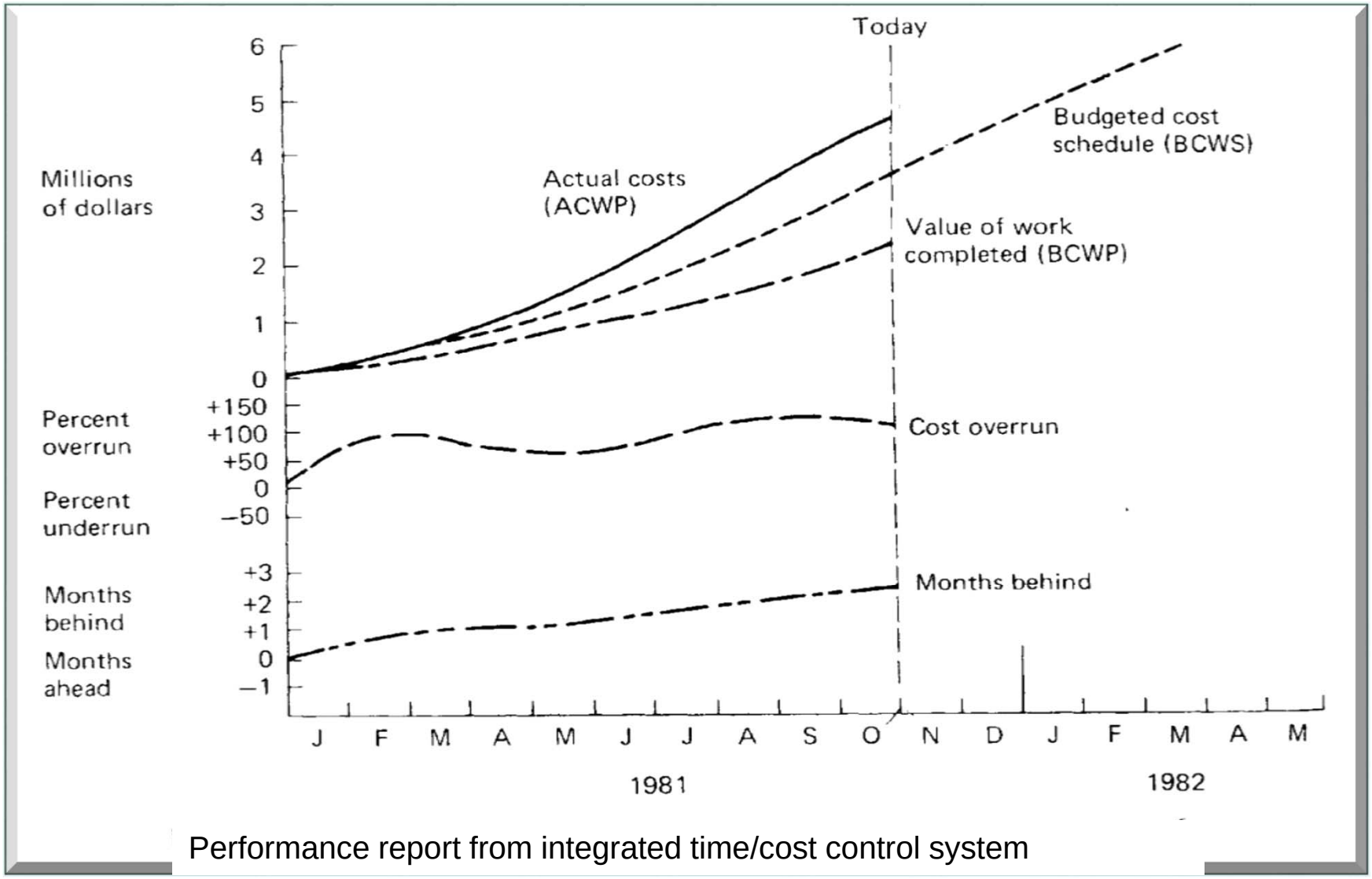


Under budget (costs below budget) & Behind schedule (Slow)



Over budget (*Over cost*) & Behind schedule (Slow)

BCWS, BCWP, and ACWP

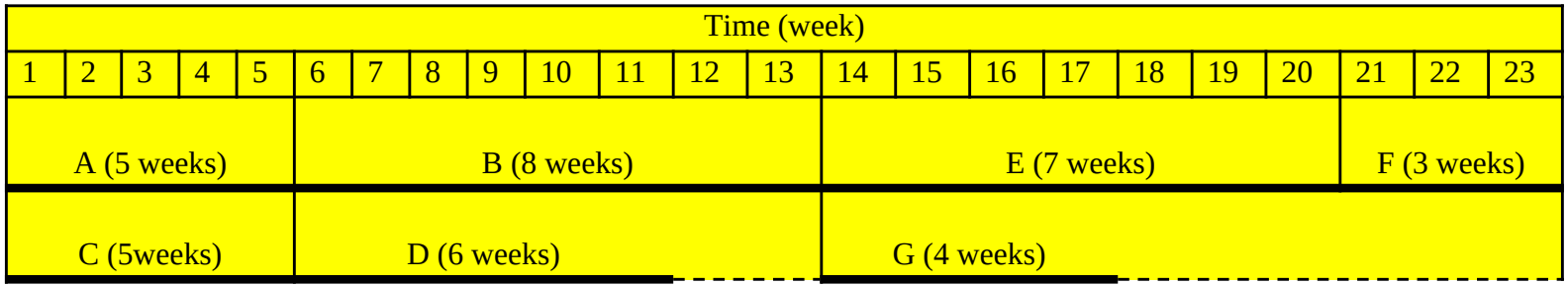


Performance report from integrated time/cost control system

Example

The following time-scale diagram represents a small engineering project. The budgeted cost of each activity is shown in the table below. ***At the end of the 10th week,*** the field progress report gives you the following information:

- Activity “A” was completed on schedule.
- Activity “B” started as planned but it is expected to take four weeks more.
- Activity “C” started as planned but finished one week later.
- % age of completion of activity “D” is 60%.
- ACWP at the end of week 10 = SR 90400



Activity	A	B	C	D	E	F	G
Budgeted cost (SR)	50000	12000	16000	24000	12000	21000	20000

Calculate the CV, SV, BAC, EAC, ETC, and comment on the progress of the work.

Example

- % age of completion of activity “A” = 100%
- Projected duration of activity “B” = 8 + 4 = 12 weeks
- % age of completion of activity “B” = 5/12 = ***41.666666***%
- % age of completion of activity “C” = 100%
- $BCWS_{10}$ = A + C + ***5/8****B + ***5/6****D = 50000 + 16000 + ***5/8****12000 + ***5/6****24000 = SR 93500 *[**remark:** 5/8 & 5/6 represent ratio off completion of activities B&D with respect to scheduled duration]*
- $BCWP_{10}$ = A + C ***+ 0.4167****12000 + ***0.60****24000 = SR 85400 *[**remark:** 0.4167 & 0.6 represent ratio of completion of activities B&D with respect to actual completion duration]*
- CV = BCWP – ACWP = 85400 – 90400 = SR -5000 (Over Budget)
- SV = BCWP – BCWS = 85400 – 93500 = SR -8100 (Behind Schedule)
- BAC = 50000 + 12000 + 16000 + 24000 + 12000 + 21000 + 20000 = SR 155000
- EAC = [ACWP/BCWP]*BAC = [90400/85400]*155000 = SR 164075

Project Example1

Figure (1) shows a planned schedule and cost of the main product design project activities. Figure (2) gives the planned scheduled for the engineering task activities which should be done within 7 month. A control report should be reported at 3rd month.

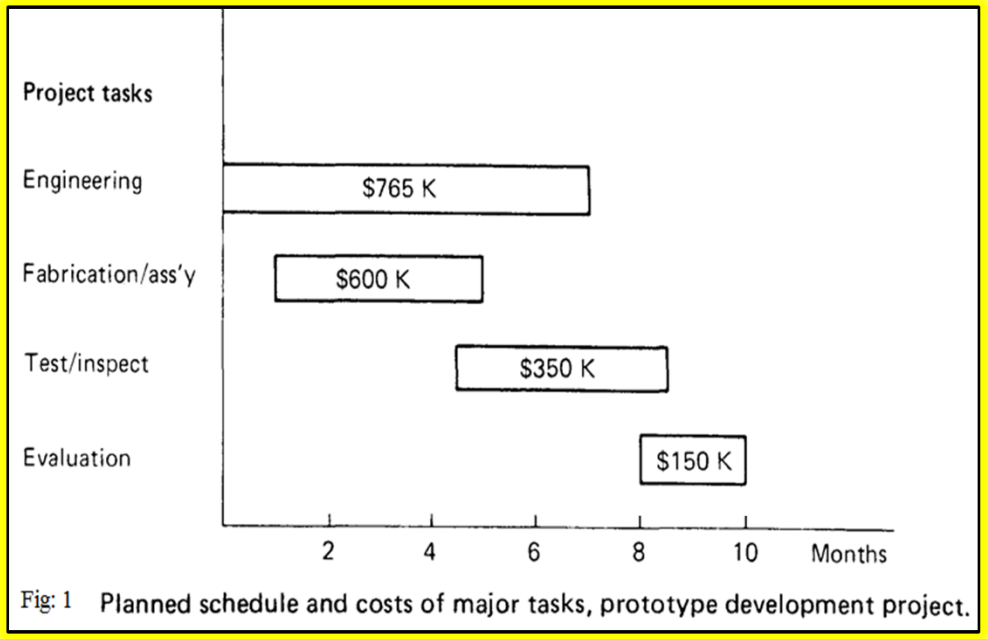


Fig: 1 Planned schedule and costs of major tasks, prototype development project.

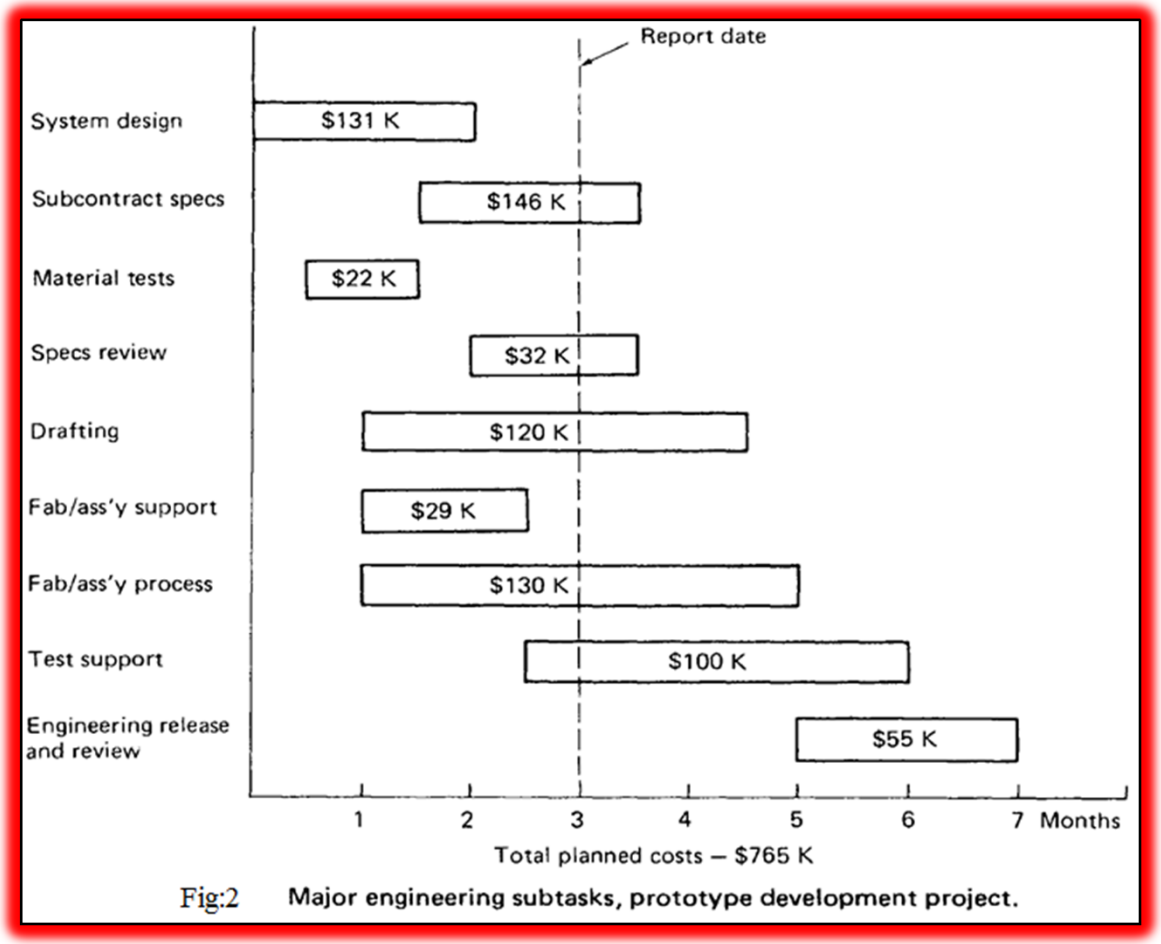


Fig:2 Major engineering subtasks, prototype development project.

Project Example1

Figure (2) shows that engineering task is done by 9 activities and the status of these activities at the end of 3rd month is reported as follows:

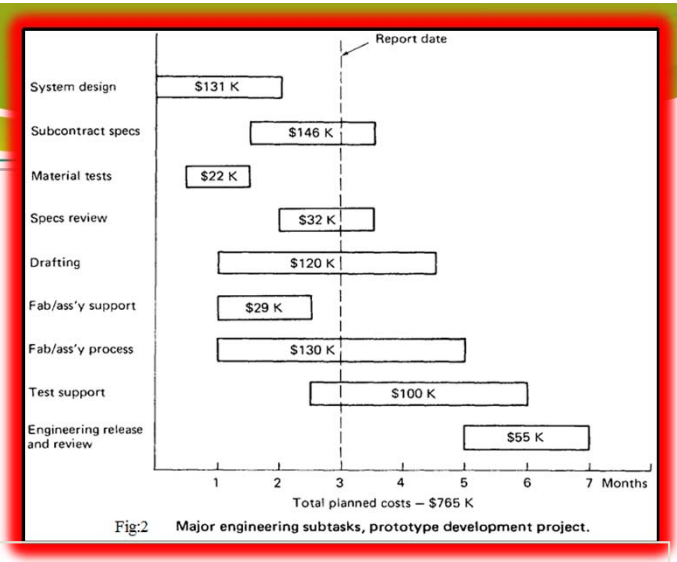


Fig:2 Major engineering subtasks, prototype development project.

Activity 1- system design: this activity is completed and it actual cost of work performed (ACWP) = $144

Activity 2- Subcontract specs: this activity is started and the scheduled completion is **90.4%** while actual completion is **62.1%** due delay with paid actual cost of work performed (ACWP) = $84

Activity 3- Material tests: this activity is completed and it actual cost of work performed (ACWP) = $22.5

Activity 4- Specs review: this activity is started and the scheduled completion is **68.75%** while actual completion is **46.875%** due delay with paid actual cost of work performed (ACWP) = $15.5

Activity 5- Drafting: this activity is started and the scheduled completion is **80.83%** while actual completion is **49.167%** due delay with paid actual cost of work performed (ACWP) = $59

Activity 6- Fabrication/assembly support: this activity is completed and it actual cost of work performed (ACWP) = $36

Activity 7- Fabrication/assembly process: this activity is started and the scheduled completion is **79.923%** while actual completion is **48.462%** due delay with paid actual cost of work performed (ACWP) = $67

Activity 8- Test support: this activity is started and the scheduled completion is **21%** while actual completion is **21%** due delay with paid actual cost of work performed (ACWP) = $21

Activity 9- Engineering release and review: this activity is not started yet

Project Example1

ENGINEERING SUBTASKS STATUS AT END OF MONTH 3

(thousands of dollars)

Example of calculation:

BCWS2 = 0.904*146 = 131

BCWP2 = 0.562*146 = 82

The status report is as shown in the table:

Task	*Status*	*BCWS*	*BCWP*	*ACWP*
System design	Completed	$131.0	$131.0	$144.0
Subcontract specs	Started	132.0	82.0	84.0
Material tests	Completed	22.0	22.0	22.5
Specs review	Started	22.0	15.0	15.5
Drafting	Started	97.0	59.0	59.0
Fabrication/assembly support	Completed	29.0	29.0	36.0
Fabrication/assembly process	Started	100.0	63.0	67.0
Test support	Started	21.0	21.0	21.0
Engineering release and review	Not Started			
Total		$554.0	$422.0	$449.0

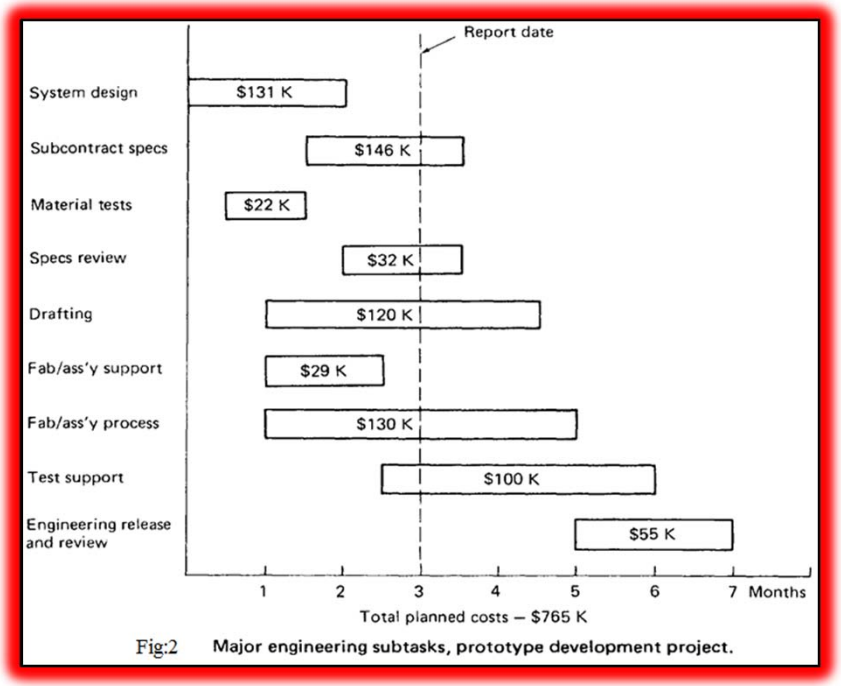


Fig:2 Major engineering subtasks, prototype development project.

Project Example1

Status summary of engineering subtasks in progress and estimate to complete.

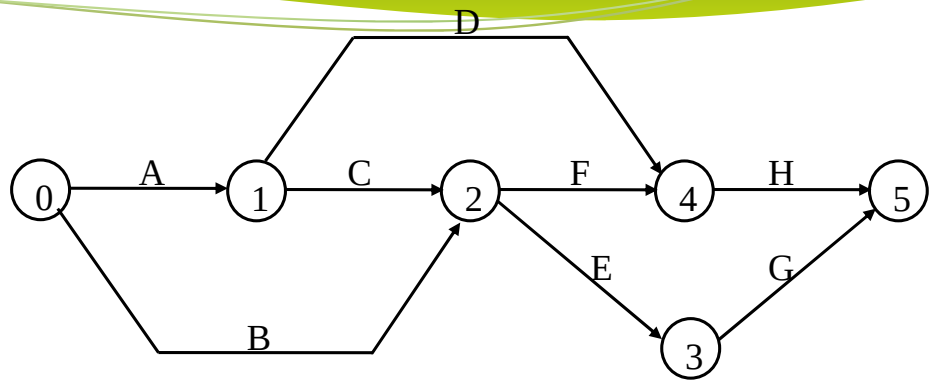
Task	*BCWS*	*BCWP*	*ACWP*	*Status*
Subcontract specs	$132	$82	$84	Behind schedule and over cost
Specs review	22	15	15.5	Behind schedule and over cost
Drafting	97	59	59	Behind schedule but within cost
Fabrication/assembly process	100	63	67	Behind schedule and over cost
Test support	21	21	21	On schedule and within cost

Estimated at completion: $\frac{ACWP}{PCWP} = \frac{449}{422} \times 765$ =$812 K

Summary: *Engineering work is behind schedule and a cost overrun is occurring*

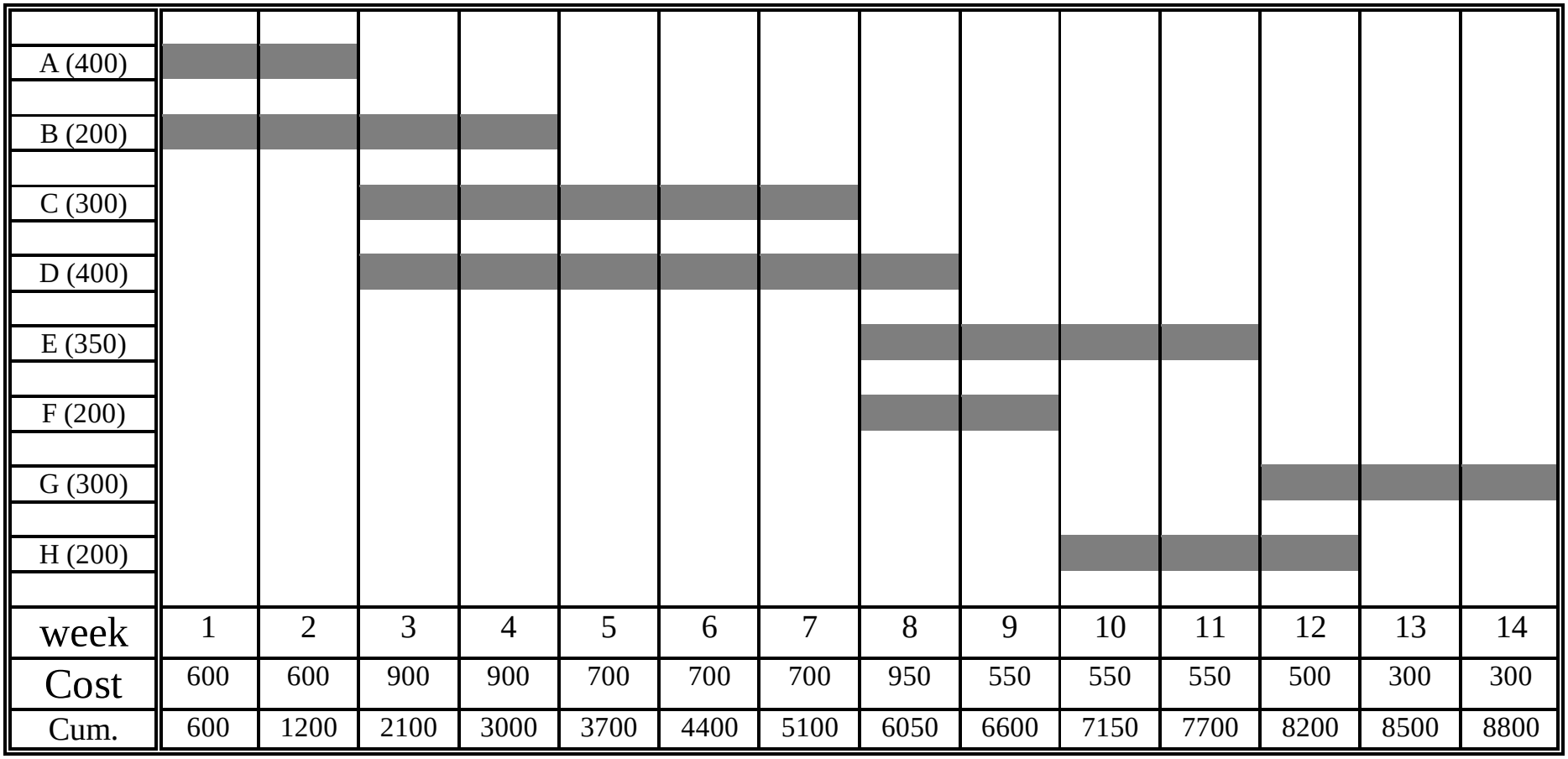
Project Example 2

For the following network, compute the early start cumulative costs for the project, and draw the result.



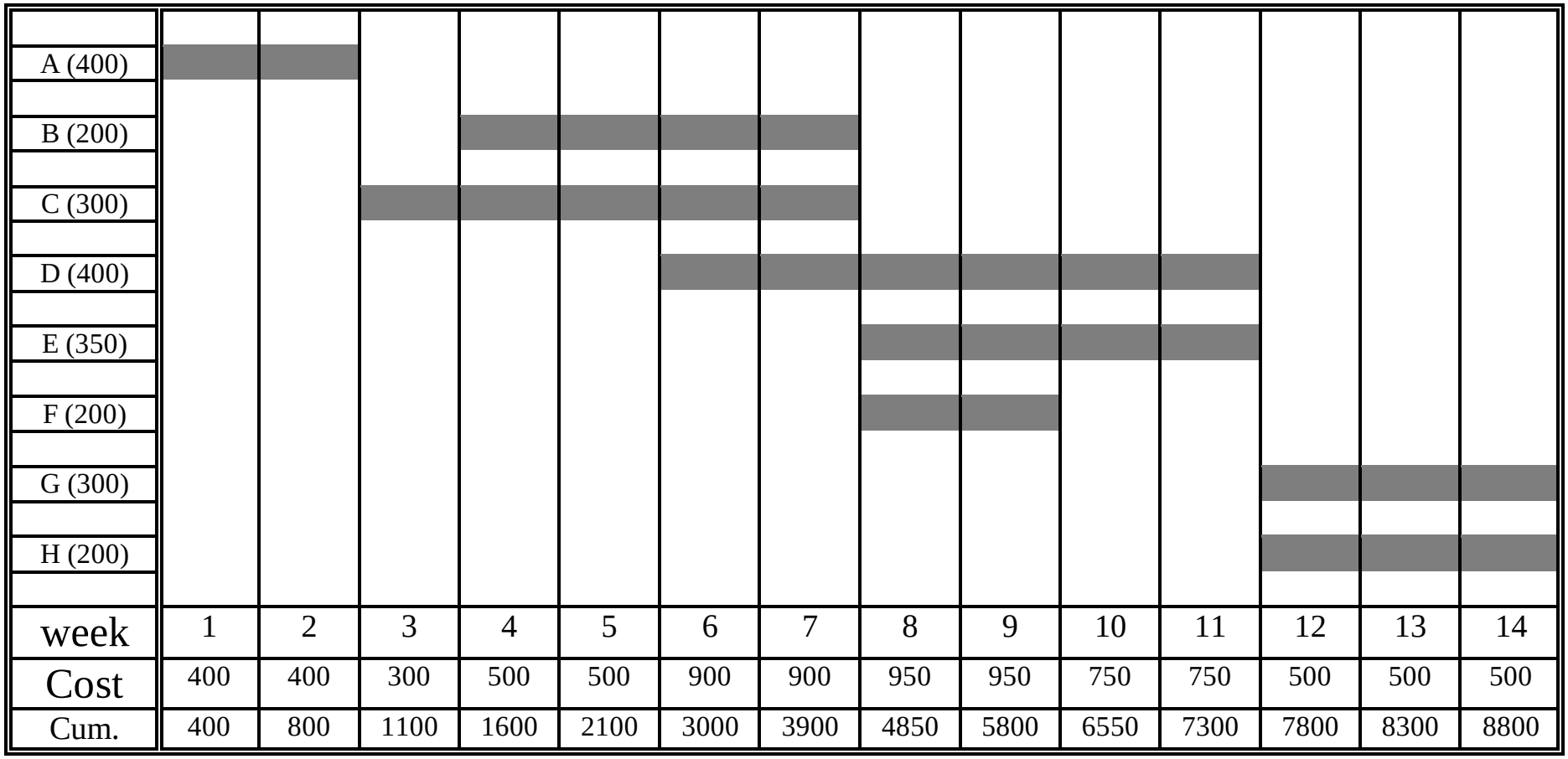
Activity	Depend on	Duration Week	ES Time	LS Time	Cost per week, SR
A	—	2	0	0	400
B	—	4	0	3	200
C	A	5	2	2	300
D	A	6	2	5	400
E	B, C	4	7	7	350
F	B, C	2	7	7	200
G	E	3	11	11	300
H	D, F	3	9	11	200

Cost based on Time Scaled Network (ES)



week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Cost	600	600	900	900	700	700	700	950	550	550	550	500	300	300
Cum.	600	1200	2100	3000	3700	4400	5100	6050	6600	7150	7700	8200	8500	8800

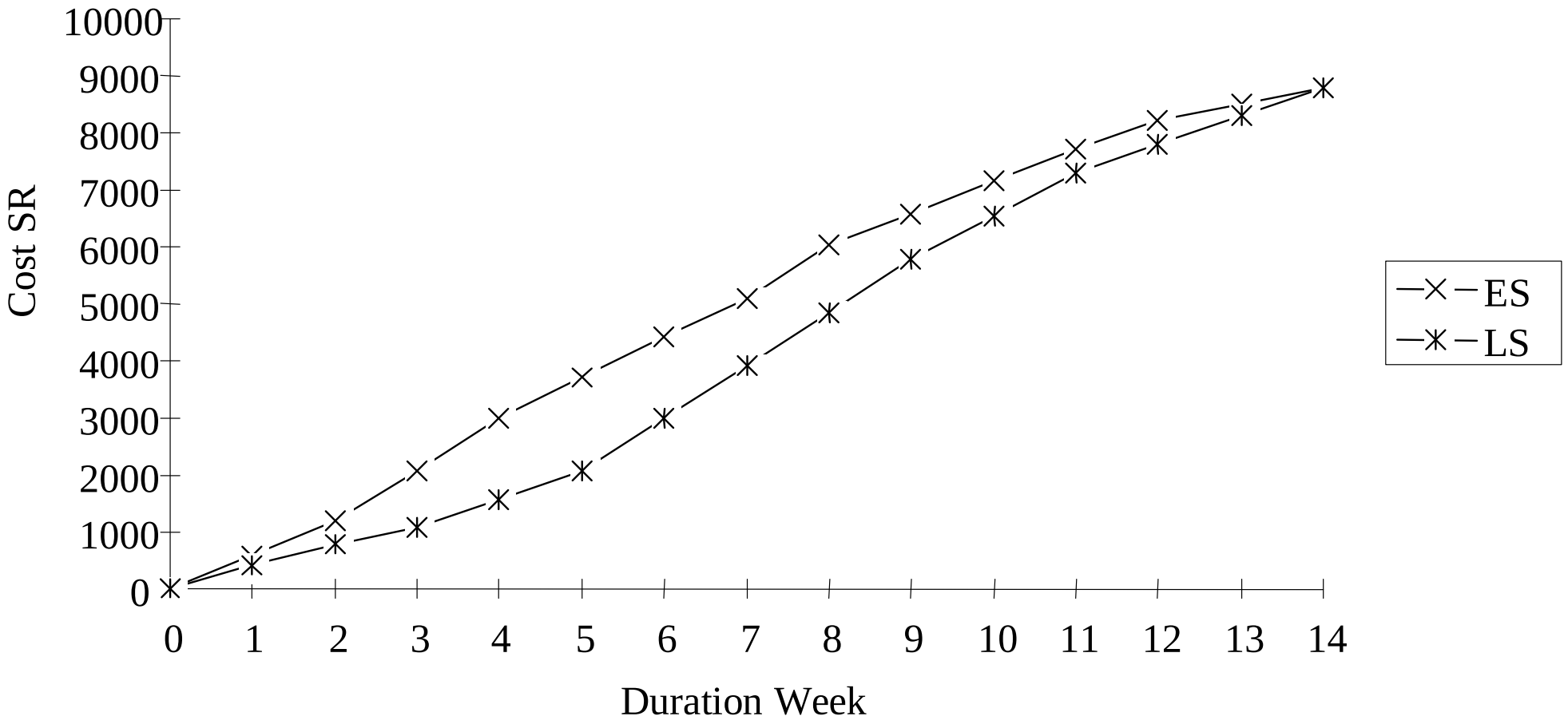
Cost based on Time Scaled Network (LS)



week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Cost	400	400	300	500	500	900	900	950	950	750	750	500	500	500
Cum.	400	800	1100	1600	2100	3000	3900	4850	5800	6550	7300	7800	8300	8800

Cumulative Project Cost

ES & LS Cumulative Cost for the Project.



Project Example 3 :

You are required to submit a progress report to your boss about the performance of an activity of a project. The activity's information as follow: number of units is (800); unit cost is SR 12 ; and planned productivity is 100 unit/day. Performances were measure at the end of day (3) and day (6) as follows:

Period	Cost at this period	Number of units finished
day 0 to day 3	SR 3,600	250
day 4 to day 6	SR 3,700	320

a) Calculate the following information for each of the two periods (i.e. day 0 to day 3 and day 4 to day 6) and to date (i.e. day 0 to day 3 and day 0 to day 6).
b) Draw a graphical report for ACWP, BCWP, and BCWS. Discuss the results.

1. This Period

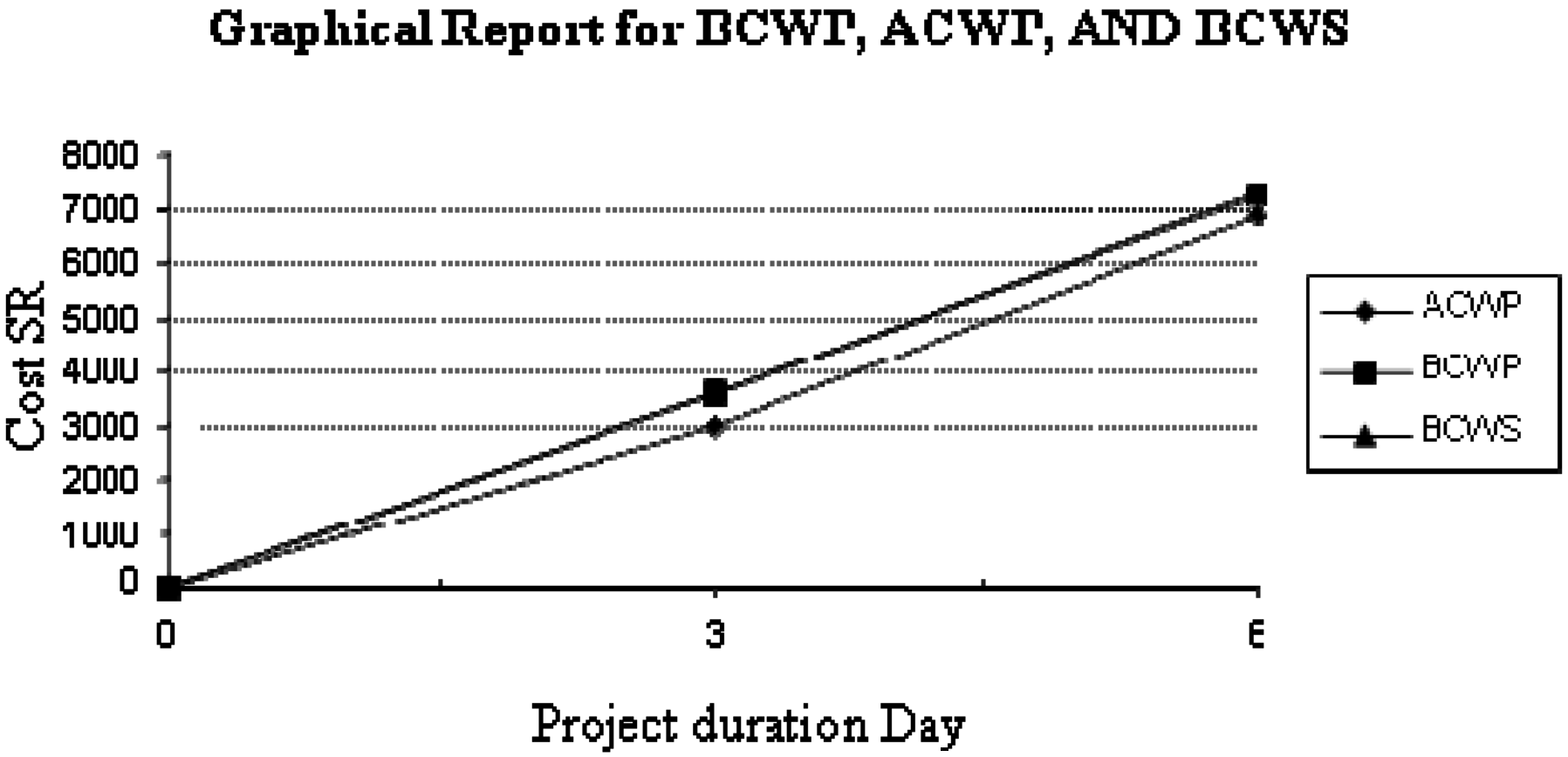
Period	BCWP	ACWP	BCWS	Variance		STATUS	
				Cost	Sch.	Schedule	Cost
0 - 3	SR 3000	SR 3600	SR 3600	-600	-600	Behind	Over Bud.
4 - 6	SR 3840	SR 3700	SR 3600	140	240	Ahead	under Bud.

2. To Date

Period	BCWP	ACWP	BCWS	Variance		STATUS		Estimate at completion	Day ahead or behind
				Cost	Sch.	Sch.	Cost		
0 - 3	SR 3000	SR 3600	SR 3600	-600	-600	Behind	Over Bud.	SR 11,520	0.5
0 - 6	SR 6840	SR 7300	SR 7200	-460	-360	Behind	Over Bud.	SR 10,446	0.3

Project Example 3 :

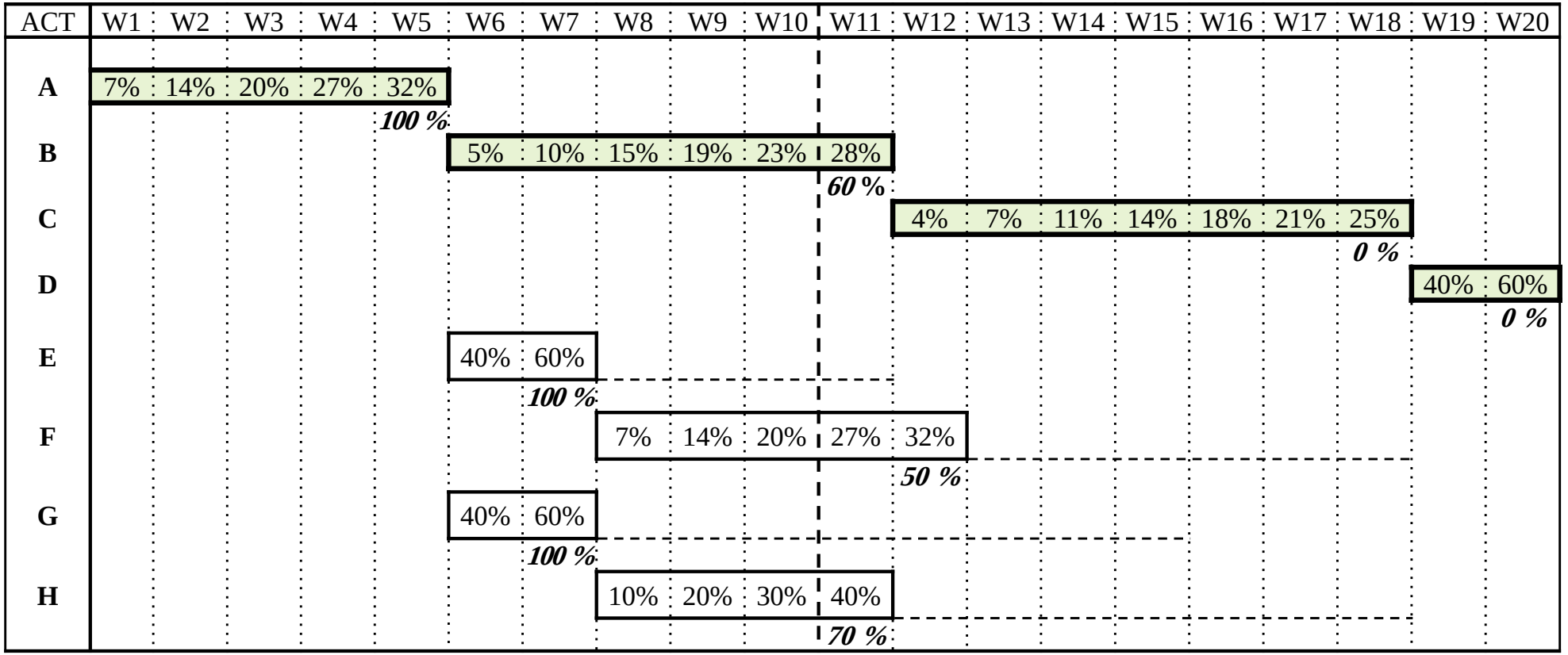
b) At this rate, the contractor needs actions to reduce the cost and accelerate the time.



Project Example 4 :

The following eight activities constitute an overall bar chart project that has twenty-week. Now 10 weeks finished on the project with and the project manager has the following Data:

- The weekly planned percentage of completion ***(inside each activity bar),***
- The actual percentage of completion up to week 10 ***(in below activity bar and table),***
- The Budget cost of each activity ***(in below table),***
- Actual Expenses up to week 10 of each activity ***(in below table),***
- The Critical Path is A-B-C-D (bolted bar), and Total Float of each activity (dash lines)



Project Example 4 :

For this point in time (10 weeks after the start date):

a) Calculate the values of the Budgeted Cost of Work Performed and Budgeted Cost of Work Scheduled for each activity? (8%)

b) For each activity in progress, calculate the Cost and Schedule Performed Indices and state its budget and schedule status. (3%)

c) Draw the weekly cumulative BCWS of activity B, determine its delay/Ahead week, and whether it will delay/accelerate the project or not and why. (5%)

d) Determine the project cost variance and state if the project is over or under budget. (2%)

e) Based on the performance of past 10 weeks, forecast the project completion cost at the end of the project, and its variance from original project budget. (2%)

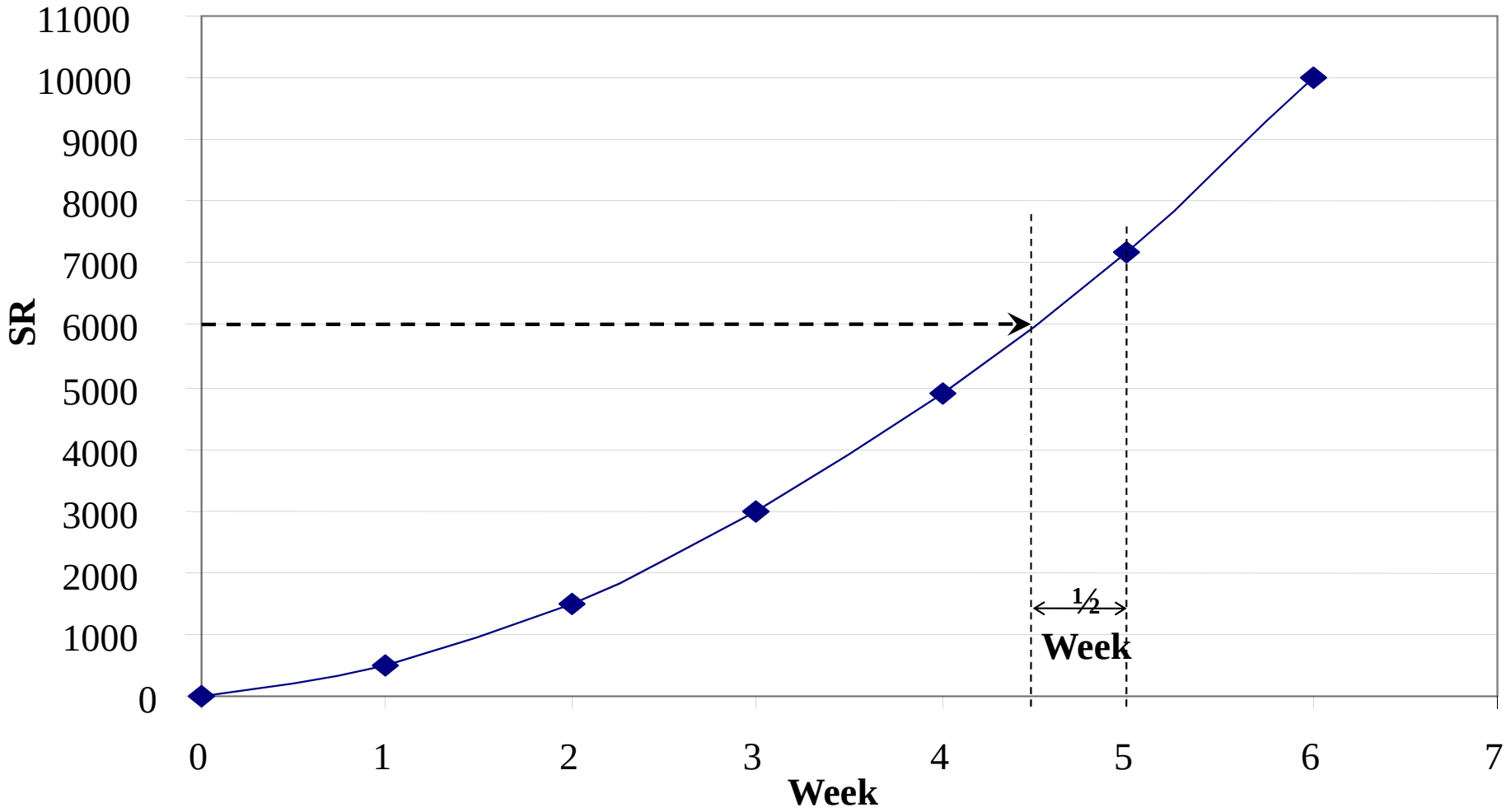
Project Example 4 : Solution

Parts a) and b),

Act.	% of Completion	Budget Cost (SR)	Actual Expenses (SR)	BCWS (SR)	BCWP (SR)	CPI	SPI	Cost Status	Schedule Status
A	100%	8000	9000	*8000*	*8000*	*1.13*	*1*	–	–
B	60%	10000	6000	*7200*	*6000*	*1*	*1.2*	*On Budget*	*Behind*
C	0%	11000	0	*0*	*0*	–	–	–	–
D	0%	3000	0	*0*	*0*	–	–	–	–
E	100%	4000	3500	*4000*	*4000*	*0.88*	*1*	–	–
F	50%	7000	4000	*2870*	*3500*	*1.143*	*0.82*	*Over Bud.*	*Ahead*
G	100%	5000	4000	*5000*	*5000*	*0.8*	*1*	–	–
H	70%	6000	3900	*3600*	*4200*	*0.93*	*0.86*	*Under Bud.*	*Ahead*
Total		***54,000***	***30,400***	***30,670***	***30,700***				

Project Example 4 : Solution

Parts c)



Project Example 4 : Solution

Parts d) and e),

This activity *will delay* the project because it is *critical activity*.

d) Project cost Variance = $BCWP_{project} - ACWP_{project}$ = 30,700 – 30,400

= *SR 300* (*Under Budget*)

e) Budgeted Cost At Completion (BAC) = ∑ Budget Cost = SR 54,000

Estimated Cost At Completion (EAC) = [ACWP/BCWP]*BAC = *SR 53,472.3*

OR

Estimated Cost At Completion (EAC) = ACWP + [(BAC – BCWP) / CPI] = *SR 53,472.3*

Variance from original project budget = EAC – BAC = *SR -527.7* (*Under Budget*)