Chapter 7

Part 2

Earned Value Analysis

Earned Value Analysis

- EV is defined as :an integrated cost-schedule approach used to monitor and analyze the progress of a project.
- Popescu and Charoennagam defined it as: “the performance measurement to report the status of the project in terms of both cost and time at a given data date.
- The concept of EV is simple; at any given point, take the following steps:

1. Determine how much work you have done and how much you planned to have done by this date.
2. Determine how much money you have earned and how much money you have spent.

Cont. of steps

3. Calculate the time (schedule) and money (budget) deviations (variances) so far.
4. Analyze the causes for the major deviations and determine possible remedies.
5. Extrapolate these deviations to the end of the entire project.

Basic Information

- Budgeted cost of work schedule (BCOS):

Represents baseline schedule and budget.

- Budgeted cost of work performed (BCWP):

Represents the earned value, it means the contract earning for performed work.

- Actual cost of work performed (ACWP):

Represents the actual budget spending.

- Variances:

Are absolute measures in units of dollars and days.

Types of variances are:

Basic Information

1. Cost variance (CV):

Difference between earned and actual costs for the completed work.

2. Schedule variance (SV):

Difference between the value of work that was planned for completion and the value of the work that was actually completed.

- Performance indexes:

Relative measures in percentages.

Types of performance indexes are:

Basic Information

1. Cost performance index (CPI or CI).
2. Schedule performance index (SPI or SI).

- Both variances and performance indexes are measures of deviation from the baseline.

Example

A contractor agreed to build 30 doghouses in 90 days at a price of $800 per unit. Twenty days later, the contractor has finished 8 doghouses with an actual total cost (that includes his overhead and profit) of $6,800. What is the status of the project?

- The solution is as follows:

Example

The following analysis applies only if work is sequential and not parallel (i.e., the contractor works on one unit till it is finished then starts the next unit and so on). Linearity of production and no learning curve effect are also assumed.

$$\text{Total planned budget (TB)} = 30 \text{ units} \cdot \$800 \text{ each} = \$24{,}000,$$

$$\text{Daily planned production} = 30 \text{ units}/90 \text{ days} = 0.3\overline{3} \text{ units/day (or 3 days per unit)},$$

$$\text{Daily planned budget} = \$24{,}000/90 \text{ days} = \$266.67$$

$$= 0.3\overline{3} \text{ units/day} \cdot \$800 \text{ each} = 266.67,$$

and

$$\text{Percent complete} = 8/30 = 26.7$$

Example

After 20 days, the contractor's plan calls for $0.3\overline{3}$ units/day · 20 days = $6.6\overline{6}$ units to be finished, with a total cost of $6.6\overline{6}$ · \$800 = \$5,333. We call this amount the **budgeted cost for work scheduled (BCWS).** In other words, if everything (schedule and budget) worked according to plan, in 20 days the contractor would have finished $6.6\overline{6}$ units and earned \$5,333.

The contract price was \$800 and the contractor actually finished 8 units, so he earned 8 · \$800 = \$6,400 from the owner (disregarding what it actually cost him). This is called the *earned value (EV),* or **budgeted cost for work performed (BCWP).**

However, the contractor's actual cost was \$6,800. This is called **actual cost for work performed (ACWP).**

Example

Cost Variance (CV) = BCWP − ACWP = 6,400 − 6,800 = −$400

Schedule variance (SV) = BCWP − BCWS = 6,400 − 5,333 = $1,067

Schedule variance in days (SV, days) = SV ($)/Daily planned budget
= $1,067/$266.67 = 4 days

Cost performance index (CPI) = BCWP/ACWP = 6,400/6,800 = 0.94

Schedule performance index (SPI) = BCWP/BCWS
= 6,400/5,333 = 1.20

Forecasted cost variance (FCV) = CV/% Complete −$400/26.7%
= −$1,500

Forecasted schedule variance (FSV) = SV/% Complete = 4/26.7%
= 15 days

Example (results in table)

ACTIVITY	Dog houses
TOTAL BUDGET ($)	24,000
% COMPLETE	26.7
ACWP ($)	6,800
BCWP ($)	6,400
BCWS ($)	5,333
CV ($)	−400
SV ($)	1,067
SV (DAYS)	4
CPI	0.94
SPI	1.20
FCV ($)	−1,500
FSV (DAYS)	15

Example

- From simple observation we can tell the following:

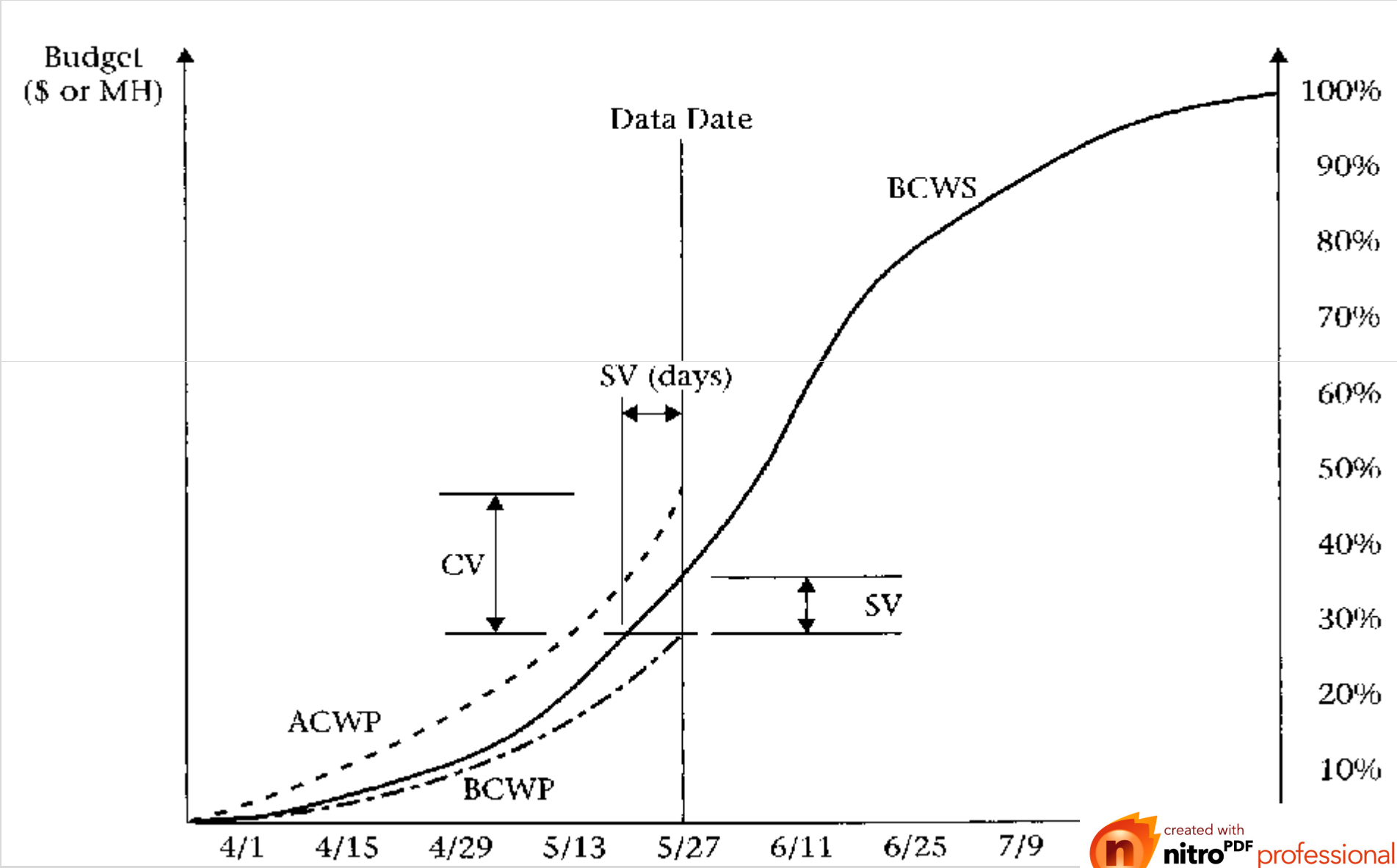
1. The project is 26.7% complete.
2. The project is ahead of scheduling by 4 days (planned to finish 6.66 units in 20 days but finished 8) .
3. The project is over budget by $400 (earned $6,400 but spent $6,800).
4. If the work continues at the same and pattern, the contractor will finish this project 15 days ahead of schedule but with a budget deficit of $1,500.

S - Curves

- Earned value (BCWP) and actual cost (ACWP) may be blotted against the baseline as shown in the figure bellow.

- Both curves, representing the ACWP and the BCWP, are usually extrapolated to forecast an estimated at completion (EAC) and the date of completion.

S-curve



Example

The total estimated duration of the mass excavation activities in an office building project is 40 days. After 15 days, the project manager receives the following information:

TYPE OF EXCAVATION	TASK NO.	TOTAL QUANTITY (CY)	UNIT PRICE ($)	TOTAL BUDGET ($)	ACTUAL CY	ACTUAL COST ($)
Mass Excavation	TOB11110	39,000	—	176,500	12,900	59,300
Common Earth	TOB11111	20,000	2.50	50,000	7,800	17,950
Clay	TOB11112	8,000	5.50	44,000	1,200	5,850
Rock	TOB11113	11,000	7.50	82,500	4,200	35,900

Perform an EV analysis.

Note that the "Mass Excavation" line is a summary of th

Example

ACTIVITY	TOB11110	TOB11111	TOB11112	TOB11113
TOTAL BUDGET ($)	176,500	50,000	44,000	82,500
% COMPLETE	32.63	39.00	15.00	38.18
ACWP ($)	59,700	17,950	5,850	35,900
BCWP ($)	57,600	19,500	6,600	31,500
BCWS ($)	66,188	18,750	16,500	30,938
CV ($)	−2,100	1,550	750	−4,400
SV ($)	−8,588	750	−9,900	[illegible]

Example (Cont. of table)

SV (DAYS)	−1.95	0.17	−2.24	0.13
CPI	0.96	1.09	1.13	0.88
SPI	0.87	1.04	0.40	1.02
FCV ($)	−6,436	3,974	5,000	−11,524
FSV (DAYS)	−5.96	0.44	−14.96	0.33

Example

- In the analysis of the results, we can make the following six comments:

1. looking at the overall budget, we find that the mass excavation operation is slightly ($2,100) over bud get, we find that the main reason for this budget overrun is rock excavation, which is $4,400 over budget.
2. When we look at the schedule, the only meaningful number is the overall schedule variance, which tells us that the mass excavation operation is almost 2 days behind schedule.
3. Looking at forecasted variances indicates that, if work continues at the same pace and in the same pattern, the mass excavation operation will finish 6 days behind schedule and with a $6,436 deficit.

Example

4. We can describe activities with negative variance as “substandard performance “ as compared with the “above-standard performance “ for those positive performance.