

**“Project Management Using Earned Value”
Case Study Solution 34.1**



34.1

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**Highway
Case Study**

SOLUTION

1. Cost/Schedule Variance Percentages

$$\begin{aligned}
 \text{a. Schedule Variance Percentage} &= \frac{\text{Schedule Variance}_{\text{cum}}}{\text{Budget}_{\text{cum}}} \times 100 \\
 &= \frac{-4}{17.5} \times 100 \\
 &= -22.9\% \text{ unfavorable}
 \end{aligned}$$

$$\begin{aligned}
 \text{b. Cost Variance Percentage} &= \frac{\text{Cost Variance}_{\text{cum}}}{\text{Earned Value}_{\text{cum}}} \times 100 \\
 &= \frac{-1.0}{13.5} \times 100 \\
 &= -7.4\% \text{ unfavorable}
 \end{aligned}$$

2. Performance Indices (PI)

$$\begin{aligned}
 \text{a. Cost Performance Index}_{\text{efficiency}} &= \frac{\text{Earned Value}}{\text{Actuals}} \\
 &= \frac{13.5}{14.5} \\
 &= .93
 \end{aligned}$$

$$\begin{aligned}
 \text{b. Cost Performance Index}_{\text{performance}} &= \frac{\text{Actuals}}{\text{Earned Value}} \\
 &= \frac{14.5}{13.5} \\
 &= 1.07
 \end{aligned}$$

$$\begin{aligned}
 \text{c. Schedule Performance Index} &= \frac{\text{Earned Value}}{\text{Budget}} \\
 &= \frac{13.5}{17.5} \\
 &= .77
 \end{aligned}$$

3. Schedule Conversion Techniques

$$\begin{aligned}
 \text{(1) Months (ahead or behind)} &= \frac{\text{Schedule Variance}_{\text{cum}}}{\text{Budget}_{\text{average}}} \\
 &= \frac{-4}{2.5} \\
 &= -1.6 \text{ months behind}
 \end{aligned}$$

$$(2) \text{ Months (ahead or behind)} = \frac{\text{Schedule Variance}}{\text{Budget}_{\text{current}}}$$

In this example with planned linear accomplishment Budget_{average} and Budget_{current} are the same, thus this answer will also be -1.6 months behind.

$$\begin{aligned} (3) \text{ Months (ahead or behind)} &= \frac{\text{Schedule Variance}_{\text{cum}}}{\text{Earned Value}_{\text{average}}} \\ &= \frac{-4}{1.93} \\ &= -2.07 \text{ months behind} \end{aligned}$$

$$\begin{aligned} (4) \text{ Months (ahead or behind)} &= \frac{\text{Schedule Variance}_{\text{cum}}}{\text{Earned Value}_{\text{current}}} \\ &= \frac{-4}{4} \\ &= -1 \text{ month behind schedule} \end{aligned}$$

Methods (3) and (4) for calculating the number of months a task is ahead or behind schedule are preferred to methods (1) and (2) as (3) and (4) are based on actual performance data rather than budget data.

The results of method (4) should consider any unique events which impact the incredibly favorable Earned Value in month 7.

Method (3) does not consider any trends found in the data. However, it normalizes the effect of the month 7 data by averaging it with the other 6 data points.

4. **Percent Complete/Spent**

$$\begin{aligned} \text{a. Percent Complete} &= \frac{\text{Earned Value}_{\text{cum}}}{\text{Budget at Completion}} \times 100 \\ &= \frac{13.5}{30.0} \times 100 \\ &= 45\% \end{aligned}$$

$$\begin{aligned} \text{b. (1) Percent Spent} &= \frac{\text{Actuals}_{\text{cum}}}{\text{Budget at Completion}} \times 100 \\ &= \frac{14.5}{30.0} \times 100 \\ &= 48.3\% \end{aligned}$$

$$\begin{aligned} \text{(2) Percent Spent} &= \frac{\text{Actuals}_{\text{cum}}}{\text{Estimate at Completion}} \times 100 \\ &= \frac{14.5}{30.5} \times 100 \\ &= 47.5\% \end{aligned}$$

5. **To Complete Performance Index** =

$$\begin{aligned} \frac{\text{Budget for Work Remaining}}{\text{Estimate to Complete}} &= \frac{\text{Budget at Completion} - \text{Earned Value}_{\text{cum}}}{\text{Estimate at Completion} - \text{Actuals}_{\text{cum}}} \\ &= \frac{30-13.5}{30.5-14.5} \\ &= \frac{16.5}{16} \\ &= 1.03 \end{aligned}$$

6. **Independent Estimate at Completion I_{EAC}**

$$I_{EAC} = \text{Actuals} + \text{Performance Factor} \times (\text{Budget at Completion} - \text{Earned Value})$$

$$\begin{aligned} \text{(a)} \quad &= 14.5 + 1.075 (30-13.5) \\ &= 32.238 \end{aligned}$$

$$\text{Performance Factor} = \frac{1}{\text{Cost Performance Index}_{\text{efficiency}}} = \frac{1}{.93} = 1.075$$

$$\begin{aligned} \text{(b)} \quad &= 14.5 + 1.114 (30-13.5) \\ &= 32.881 \end{aligned}$$

$$\text{Performance Factor} = \frac{1}{[(.8 \times \text{CPI}_E) + (.2 \times \text{SPI})]} = \frac{1}{.898} = 1.114$$

$$\begin{aligned} \text{(c)} \quad &= 14.5 + 1.397 (30-13.5) \\ &= 37.551 \end{aligned}$$

$$\text{Performance Factor} = \frac{1}{(\text{CPI}_E \times \text{SPI})} = \frac{1}{.716} = 1.397$$

7. **Estimated Completion Date (ECD)**

$$\text{Estimated Completion Date} = \text{Months to Complete} + \text{Time Now (months)}$$

$$\begin{aligned} \text{(1) ECD} &= \frac{\text{Budget at Completion} - \text{Earned Value}_{\text{cum}}}{\text{Budget}_{\text{current}}} + \text{Time Now (months)} \\ &= \frac{30-13.5}{2.5} + 7 \\ &= 13.6 \end{aligned}$$

$$\text{(2) ECD} = \frac{\text{Budget at Completion} - \text{Earned Value}_{\text{cum}}}{\text{Budget}_{\text{average}}} + \text{Time Now (months)}$$

In this example with planned linear accomplishment Budget_{average} and Budget_{current} are the same, thus the answer will also be an Estimated Completion Date of 13.6 months.

$$\text{Estimated Completion Date} = \text{Months to Complete} + \text{Time Now (months)} \text{--Continued}$$

$$\begin{aligned} \text{(3) ECD} &= \frac{\text{Budget at Completion} - \text{Earned Value}_{\text{cum}}}{\text{Earned Value}_{\text{current}}} + \text{Time Now (months)} \\ &= \frac{30-13.5}{4.0} + 7 \\ &= 11.13 \end{aligned}$$

$$\begin{aligned} \text{(4) ECD} &= \frac{\text{Budget at Completion} - \text{Earned Value}_{\text{cum}}}{\text{Earned Value}_{\text{average}}} + \text{Time Now (months)} \\ &= \frac{30-13.5}{1.93} + 7 \\ &= 15.55 \end{aligned}$$

Estimated Completion Date calculation methods (3) and (4) are preferred to methods (1) and (2) as (3) and (4) are based on actual performance data rather than budget data.

The results of method (3) should consider any unique events which impacted the incredibly favorable current Earned Value in month 7.

Method (4) does not consider any trends found in the data. However, it normalized the effect of the month 7 data by averaging it with the other 6 data points.

8. **Performance to Date vs. Estimated Completion Dates (ECD)**

Average Performance to Date vs. Average Performance Rate Required to achieve Estimated Completion Date is:

$$\begin{array}{rcl} \frac{\text{Earned Value}_{cum}}{\text{Months to Date}} & \text{vs.} & \frac{\text{BAC} - \text{Earned Value}_{cum}}{\text{ECD} - \text{Months to Date}} \\ = \frac{13.5}{7} & & = \frac{30-13.5}{15-7} = \frac{16.5}{8} \\ = 1.93 & & = 2.06 \end{array}$$

Only in months 3, 6, and 7 were they able to earn value in excess of 2.0. In each of these months the Cost Performance Index was .88. There is enough evidence to suggest that the projected date of completion (month 15) and the EAC (\$30,500,000) are not achievable or consistent.

9. **Best, Worst and Most Likely EACs.** Discussion.

The contractor’s last CPR shows the program’s outcome: \$3,450,000 overrun and completion in month 20 (8 months late). This Case Study is based upon an actual program; the name and timeframe have been changed to retain confidentiality. (See comments that follow the CPR.)

Notes on Final CPR:

1. The Program Management/Support (LOE) costs continued during the 8 month slip (budget ended in month 12) resulting in an overrun of \$150K. An underrun of \$600K was predicted in the month 7 CPR.
2. General and Administrative (G&A) costs at 17.33% contributed to nearly \$600K of the program’s overrun.
3. While the Materials were firm fixed price (FFP), the costs of Excavation and Hauling were the primary drivers to the program’s overrun. Consequently, it is important to note that when performing analysis using only level 1 data, where LOE is a part of the program data, the results can often be a more optimistic estimate at completion (EAC) prediction than the outcome. When LOE is not being performed because of schedule problems on the program (reference contractors month 7 CPR, which shows Program Management/Support CV of \$500K) the cost variance is not a true underrun, but merely LOE, which has yet to be performed. Favorable LOE cost variances must be considered when conducting program level analysis.

Classification (When filled in)

Cost Performance Report Format 1 - Work Breakdown Structure													Dollars In <u>\$000</u>			Classification (When filled in)		
1. Contractor				2. Contract				3. Program				4. Report Period						
a. Name Wippity Bipp Construction Co.				a. Name CALTRANS 20				a. Name Highway 73 Extension				a. From (YYMMDD)						
b. Location (Address & Zip Code) 1 Briarpatch Lane Thumperville, CA 90633				b. Number XX-0763		c. Type CPFF		d. Share Ratio N/A		b. Phase (X one) <input type="checkbox"/> RDT&E <input checked="" type="checkbox"/> Production		b. To (YYMMDD) Month 20						
5. Contract Data																		
a. Quantity	b. Negotiated Cost	c. Est. Cost Auth. Unpriced Work		d. Target Profit/Fee	e. Target Price	f. Estimated Price		g. Contract Ceiling		h. Estimated Contract Ceiling								
1	\$30,000,000	0		\$3,000,000	\$33,000,000	\$36,450,000		N/A		N/A								
6. Estimated Cost at Completion						7. Authorized Contractor Representative												
Management Estimate at Completion (1)		Contract Budget Base (2)		Variance (3)		a. Name (Last, First, Middle Initial) Quick, I.M.			b. Title Program Manager			d. Date Signed (YYMMDD) Month 21, 10th.						
a. Best Case		33,450				c. Signature I.M. Quick												
b. Worst Case		33,450																
c. Most Likely		33,450		30,000											- 3,450			
8. Performance Data																		
Item (1)	Current Period					Cumulative To Date					Reprogramming Adjustments		At Completion					
	Budgeted Cost		Actual Cost Work Performed (4)	Variance		Budgeted Cost		Actual Cost Work Performed (9)	Variance		Cost Variance (12)	Budget (13)	Budgeted (14)	Estimated (15)	Variance (16)			
	Work Scheduled (2)	Work Performed (3)		Schedule (5)	Cost (6)	Work Scheduled (7)	Work Performed (8)		Schedule (10)	Cost (11)								
a. WBS																		
Program Mgmt./Support	0	0	115	0	-115	1,950	1,950	2,100	0	-150			1,950	2,100	-150			
Excavation/Base	0	0	0	0	0	8,000	8,000	8,900	0	-900			8,000	8,900	-900			
Hauling	0	75	110	75	-35	3,600	3,600	5,350	0	-1,750			3,600	5,350	-1,750			
Materials	0	0	0	0	0	10,500	10,500	10,500	0	0			10,500	10,500	0			
Testing/Inspection	0	10	12	10	-2	750	750	803	0	-53			750	803	-53			
b. Cost Of Money	0	0	0	0	0	0	0	0	0	0			0	0	0			
c. Gen. & Admin.	0	15	41	15	-26	5,200	5,200	5,797	0	-597			5,200	5,797	-597			
d. Undistributed Budget																		
e. Subtotal (Performance Measurement Baseline)	0	100	278	100	-178	30,000	30,000	33,450	0	-3,450			30,000	33,450	-3,450			
f. Management Reserve													0					
g. TOTAL	0	100	278	100	-178	30,000	30,000	33,450	0	-3,450			30,000					
9. Reconciliation To Contract Budget Base																		
a. Variance Adjustment																		
b. Total Contract Variance																		

Classification (When filled in)