Understanding & Applying Earned Value: A '*Quick & Easy*' Approach for Monitoring Project Implementation[1]

Dr. Kenneth F. Smith, PMP

This article demystifies the **Earned Value Methodology (EVM)**, and provides several practical innovative techniques to monitor, analyze and report accurate integrated project schedule & cost performance status.

Earned Value Methodology (EVM) has been around since the 1960's and during project implementation is the **iconic 'Best Practice' for effectively monitoring, measuring, analyzing & forecasting integrated schedule and cost performance status.** However -- from my experience as a practitioner, trainer, consultant and itinerant observer -- EVM is the most misunderstood, and probably least-utilized technique in the project manager's arsenal. At numerous project management meetings which I have attended, I get predominantly negative feedback to my inquiries regarding other participants' grasp &/or on-the-job application of EV.

It seems as though even after being exposed to earned value concepts during preparation for exams -- such as the Project Management Professional (PMP) of the Project Management Institute (PMI) – subsequent application of earned value is shunned. One major barrier seems to be the **multiple measurements** *(18 at last count)* of which EVM consists -- replete with acronymic variables, indicators & equations.[2] After initial exposure, long-term retention is fleeting and -- *somewhat like calculus* -- atrophies for many. The other major factor is that **EVM is both radically different from – as well as largely unknown by -- professional accounting, financial management & auditing practices and practitioners.**

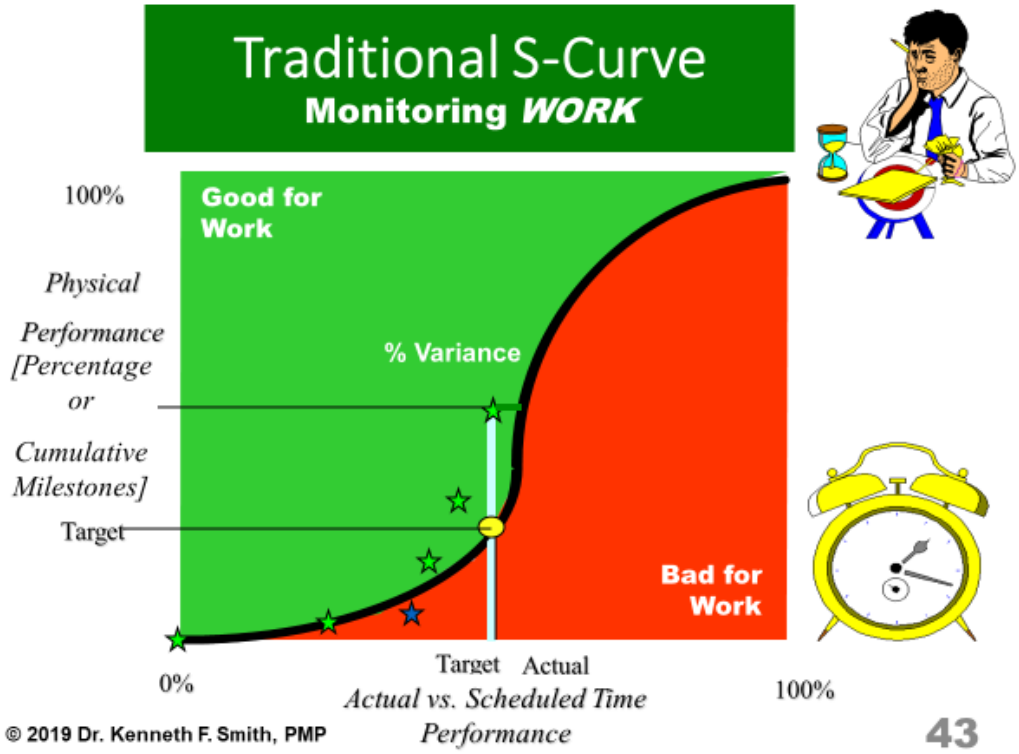
This is regrettable, because without applying earned value analysis, invalid cost performance assessments are usually made, which – *unless successfully rebutted by the project manager* – result in inappropriate recommendations, triggering incorrect executive management decisions and action!

[1] How to cite this article: Smith, K. F. (2019). Understanding & Applying Earned Value: A '*Quick & Easy*' Approach for Monitoring Project Implementation, *PM World Journal*, Vol. VIII, Issue V, June.

[2] Of which several indicators in this '*formula fog*' – IMO – are exhaustively, but pedantically trivial. Furthermore, some indicators are frighteningly complex – or deceptively simple – amalgamations of indicators with variables derived from other equations, and at least one is counter-intuitively formulated with the negative resultant being a positive outcome, and *vice versa*! ***But I digress . . . !***

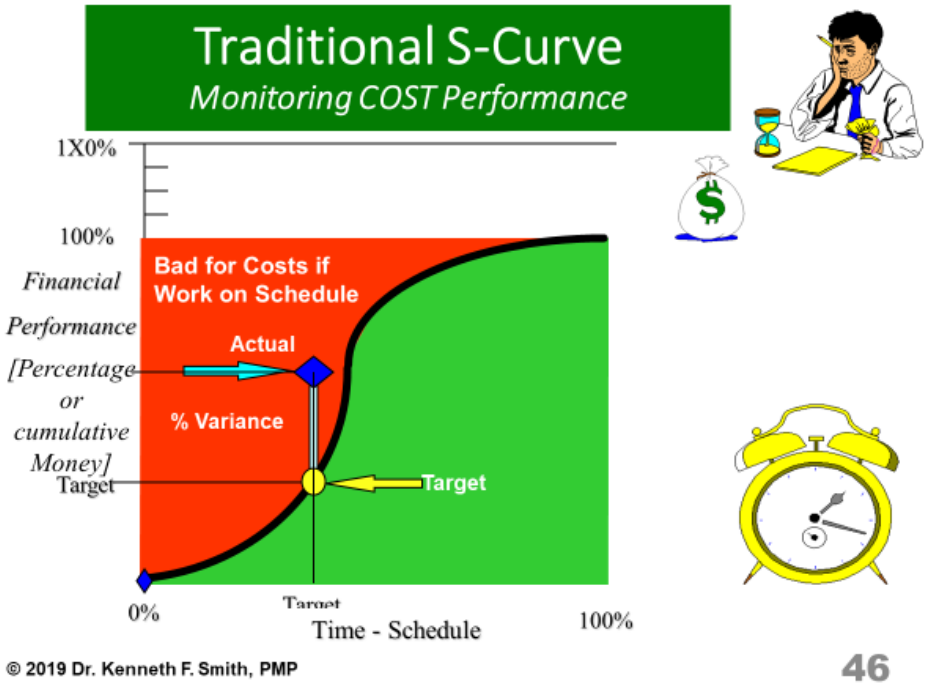
Comparing the **Actual Work Completed vs. the Baseline Work Schedule** during each reporting period – *as shown in Figure 1* -- is a logical and valid practice for monitoring physical work performance.

FIGURE 1– Work vs. Schedule



However, although perhaps useful for cash flow analysis and other financial management purposes, comparing the **Actual Cost vs. the Baseline Budget Schedule** for each time period (as shown in Figure 2) is **insufficient,** as it is **not relevant** – ***and mostly erroneous* – for assessing project Cost Performance.**

FIGURE 2 – Cost vs. Schedule



<u>The only time the baseline budget schedule is valid for cost performance analysis is when the project work is on schedule</u>. This is because **actual completion of the work is uncertain, and often gets accomplished at a different pace than originally planned.**

Whenever the work schedule is not maintained**,** rather than comparing cost performance against the scheduled budget, **the actual cost of the completed work should only be compared against the budget for the work that was completed**. If the work is behind schedule, the direct cost for that work should reasonably be less than budgeted to date, while if the work is ahead of schedule, more direct costs would most likely have been incurred than originally scheduled.

While implementing and monitoring the work is the project manager's prime concern, accountants and auditors focus on tracking the project's total expenditures, invoices and disbursements. **'Work accomplishment vs. the schedule'** is not their responsibility or concern, so – unfortunately -- the significance of its status is not usually taken into account, or appreciated by financial managers.

This fatal flaw in traditional project cost analysis precipitated the Earned Value Methodology (EVM), with creation of a unique '**Earned Value (EV)**' variable, as well as several other performance indicators to highlight the different perspective.

Essentially, the EVM approach is to first budget work costs by scheduled milestones which represent completed work. Then for cost performance analysis the actual costs related to those milestones should be identified and segregated from the costs of the other on-going activities.

In addition to the total budget for the project: BAC = Budgeted Cost at Completion, there are three other key EVM variables for monitoring cost performance:

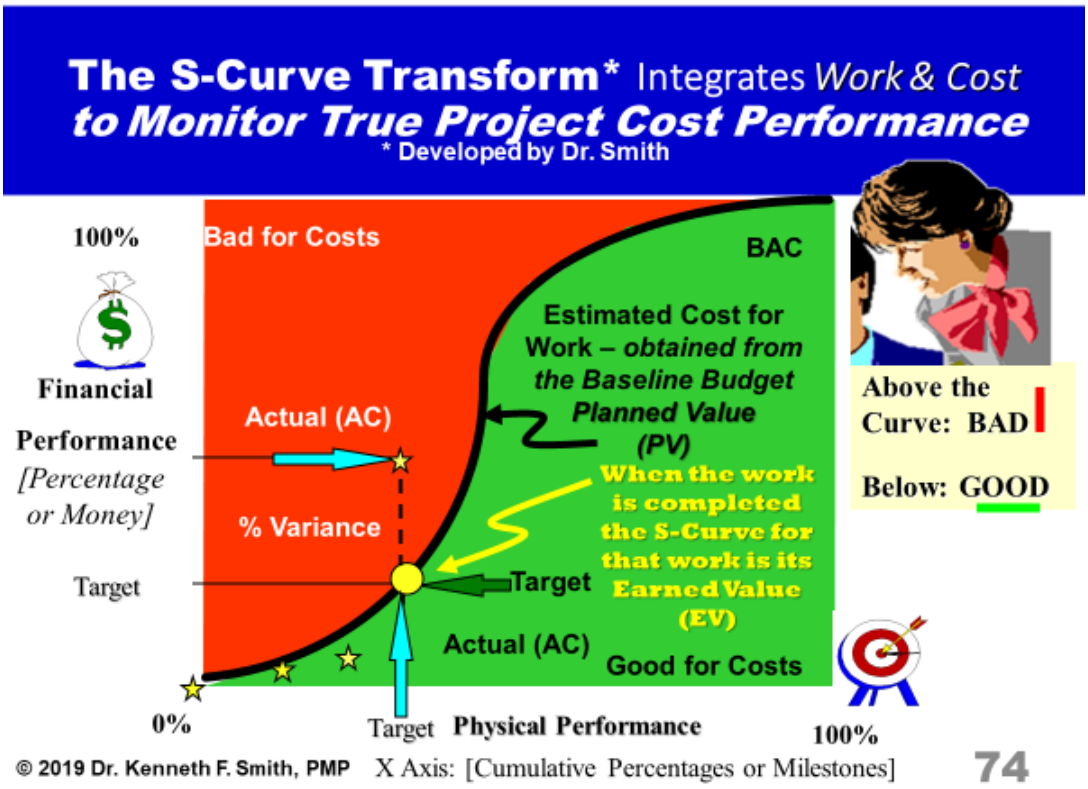
1. ***PV = Planned Value*** [Also known as the **Budgeted Cost of Work Scheduled**, **BCWS** or **BS**]. This is the traditional baseline budget; the cumulative amount planned to be spent for all the **Work Scheduled** to be done to date.

2. ***EV = Earned Value*** [Also known as the **Budgeted Cost of Work Performed**, **BCWP** or **BP**]. This is the cumulative amount planned to be spent for the **Work Actually Completed** to date: i.e. the **PV**. **If completed on schedule, the EV will equal PV. Otherwise, the EV will only be equal to the PV of the work that was completed -- *regardless of when the work was scheduled*.**

3. ***AC = Actual Cost*** - The Amount **Actually 'Spent'** to date for the Work Completed.

The essence of earned value analysis for cost performance assessment is to clearly differentiate between PV and EV, and then to compare the Actual Cost with the EV; rather than the PV. An **S-Curve 'Transform' of 'Budgeted Cost' vs. 'Planned Work' clearly depicts these relationships as indicated in Figure 3.**

FIGURE 3– Budgeted & Actual Cost vs. Planned Work



As indicated in Figure 3 above, the S-Curve 'Transform' of 'Cost vs. Work' depicts the relationship between PV and EV for the life of the project -– *regardless of whether the work is accomplished on time, earlier or later than planned* -- as well as the Project's Cost Performance Status (CPS) vs. the EV when the AC is reported.

The true indicator of cost performance is the Cost Variance (CV) derived from EVM:

CV = AC – EV*

If **AC** is less than **EV** you have a Cost Underrun, or Savings
If **AC = EV** you are ON Budget
If **AC** is greater than **EV** you incurred a Cost Overrun

[***NOTE:** The actual EVM equation is ***vice versa**,* i.e. CV = EV – AC, which is counter-intuitive]

In addition to the traditional **'Work vs. Schedule'** analysis, the PV EV relationship also indicates the schedule status condition; although the monetary amount reflects the budget drawdown, rather than the work schedule percentage:

Schedule Variance (SV) = EV - PV

If **EV** is less than **PV**	Work is Behind Schedule
If **EV = PV**	Work is ON Schedule
If **EV** is greater than **PV**	Work is Ahead of Schedule

Moreover, **thirteen (13) different work schedule & cost performance status conditions are possible during implementation** – essentially various combinations of PV, AC and EV. Of these, six are Good for each variable, four are Mixed, and three are Bad for all variables.

These thirteen states can also be color-coded for ready identification: i.e. red (negative), yellow (mixed), or green (positive), and triaged for 'Immediate Remedial Action,' 'Close Watch & Minor Adjustment,' or 'No Action Necessary.'

These conditions are shown in Figure 4 – with some illustrative data. They can also be rank-ordered -- on a "1 to 13" scale -- as a Project Performance Index (PPI).

Note, only three combinations are with the work being on schedule. The other ten situations -- indicated with an asterisk (*) -- result in misinterpretation of financial status.

FIGURE 4 – Thirteen Different Project Implementation Scenarios

Project Status Condition / Perform-ance Index PSC / PPI #	Budgeted Cost of Work Scheduled (BCWS) **Planned Value PV)**	Actual Cost of Work Performed (ACWP) **Actual Cost (AC)**	Budgeted Cost of Work Performed (BCWP) **Earned Value (EV)**	***PROJECT STATUS CONDITION*** **(PSC)**
1*	**$100**	**$70**	**$120**	**Good.** Work is ahead of schedule & with cost savings on the work done, as well as an apparent cost underrun on the budget.
2*	**$100**	**$100**	**$120**	**Good.** Work is ahead of schedule, with cost savings even though the budget has been spent as planned.
3	**$100**	**$80**	**$100**	**Good.** Work is on schedule, with cost savings.
4*	**$100**	**$120**	**$150**	**Good.** Work is ahead of schedule, with costs savings. *[But may have a cash flow problem if funds are released incrementally.]*
5*	**$100**	**$120**	**$120**	**Good.** Work is ahead of schedule, with costs as planned for work done. *[But may have a cash flow problem if funds are released incrementally.]*
6	**$100**	**$100**	**$100**	**"Ideal". Everything going according to plan – On Schedule & Spending.** ***[Extremely Rare!]***
7*	**$100**	**$60**	**$80**	**Mixed – Good & Bad.** Saving money on the work performed; but work is behind schedule.
8	**$100**	**$120**	**$100**	**Mixed – Good & Bad.** Work on schedule, but cost overrun incurred. *[May have a cash flow problem if funds are released incrementally.]*
9*	**$100**	**$80**	**$80**	**Mixed – Good & Bad.** Spending as planned; but work is behind schedule.
10*	**$100**	**$140**	**$120**	**Mixed – Good & Bad.** Work ahead of schedule, but a cost overrun has been incurred. *[May have a cash flow problem if funds released incrementally.]*
11*	**$100**	**$80**	**$60**	**Bad.** Spending is slower than planned, but the Value is low — indicating a cost overrun; and the work is also behind schedule.
12*	**$100**	**$100**	**$80**	**Bad.** Although the spending rate is as planned, since the Value is low, there is a cost overrun; and the work is also behind schedule.
13*	**$100**	**$130**	**$80**	**Bad.** Work behind schedule, cost overrun *[and possible cash flow problem.]*

The errors engendered by traditional financial management analysis for the ten "off schedule" situations – *indicated with an asterisk in the foregoing table* -- are highlighted in Figure 5:

FIGURE 5 -- Erroneous Assessments by Financial Managers – Descriptive

PSC / PPI	PV	AC	EV	SITUATION ASSESSMENT
1*	$100	$70	$120	A Traditional Financial S-Curve Incorrectly Assesses the Amount of this Cost Underrun as $30, instead of $50
2*	$100	$100	$120	A Traditional Financial S-Curve Incorrectly Assesses this Combination as "On Budget" instead of an Underrun of $20
3	$100	$80	$100	A Traditional Financial S-Curve portrays this situation accurately.
4*	$100	$120	$150	A Traditional Financial S-Curve Incorrectly Assesses this Combination as a Cost Overrun of $20 instead of an Underrun of $30
5*	$100	$120	$120	A Traditional Financial S-Curve Incorrectly Assesses this Combination as a Cost Overrun of $20 instead of "On Budget"
6	$100	$100	$100	A Traditional Financial S-Curve portrays this situation accurately.
7*	$100	$60	$80	A Traditional Financial S-Curve Incorrectly Assesses the Amount of this Cost Underrun as $40, instead of $20
8	$100	$120	$100	A Traditional Financial S-Curve portrays this situation accurately.
9*	$100	$80	$80	A Traditional Financial S-Curve Incorrectly Assesses this Combination as a Cost Underrun of $20 instead of "On Budget"
10*	$100	$140	$120	A Traditional Financial S-Curve Incorrectly Assesses the Amount of this Cost Overrun as $40, instead of $20
11*	$100	$80	$60	A Traditional Financial S-Curve Incorrectly Assesses this Combination as a Cost Underrun of $20 instead of an Overrun of $20
12*	$100	$100	$80	A Traditional Financial S-Curve Incorrectly Assesses this Combination as "On Budget" instead of a Cost Overrun of $20
13*	$100	$130	$80	A Traditional Financial S-Curve Incorrectly Assesses the Amount of this Cost Overrun as $30, instead of $50

*NOTE: Traditional 'Cost vs. Schedule' S-Curves used by Financial Managers **absolutely incorrectly assess Six (6) of the above Thirteen Conditions** (#s 2, 4, 5, 9, 11 & 12) – i.e. 46% -- as "Over" instead of "Under," or "Under" instead of "Over;" or "On" Budget; and **incorrectly assesses the amount of "Overrun" or "Underrun" for Four (4) additional conditions** (#s 1, 7, 10 & 13) – i.e. an additional 31% -- **for a TOTAL 77% ERROR RATE!**

I developed an Excel Template – IPPSTAT – that quickly identifies and computes **a Project Performance Index** as one of the foregoing 13 conditions, displays the related descriptive **Integrated Project Performance Status** with schedule and cost variances, forecasts the Project Completion, as well as displays the data in S-Curves and a control chart. [See Figures 6, 7 & 8 below.]

FIGURE 6 -- Integrated Project Performance Status Template I - Descriptive & Quantitative Assessment

INTEGRATED PROJECT PERFORMANCE STATUS (IPPSTAT)
for On-going Implementation Performance Assessment ©2016 Dr. Kenneth F. Smith, PMP

*Thirteen (13) different combinations of the Triple Variables for Successful Project Implementation Performance -- i.e. "Schedule, Cost and Quality * " -- are possible.*

	Planned Value (PV)	Actual Cost (AC)	Earned Value (EV)	Budget at Completion (BAC)	PERFOR-MANCE INDEX
	Budgeted Cost of Work Scheduled (BCWS)	Actual Cost of Work Performed (ACWP)	Budgeted Cost of Work Performed (BCWP)	Total Cost Planned for the Project (BAC)	PPI
ENTER:	3300	2400	2100	4000	11

*NOTE: Quality is implicit in successful Milestone attainment

The IPPSTAT analyzes a **Project's current Schedule & Cost performance status (on a numeric scale from *1 = High to 13 = Low*) as an *Integrated Project Performance Index (PPI)*, highlighted with a "Traffic Light" color code,** based on the **Four adjacent Variables (PV, AC, EV & BAC),** for project management review and possible corrective action. *[The **PPI** is compatible with the "**Best Practice**" **Earned Value** Methodology advocated by the international **Project Management Institute (PMI).**]* Other analyses for Planning, Monitoring & Evaluating Projects are contained in my **Project & Program M&E and EVA Tool Kits** available from : *kenfsmith@aol.com*

BAD: Spending slower than planned, but value is low, indicating a cost overrun and the work is also behind schedule

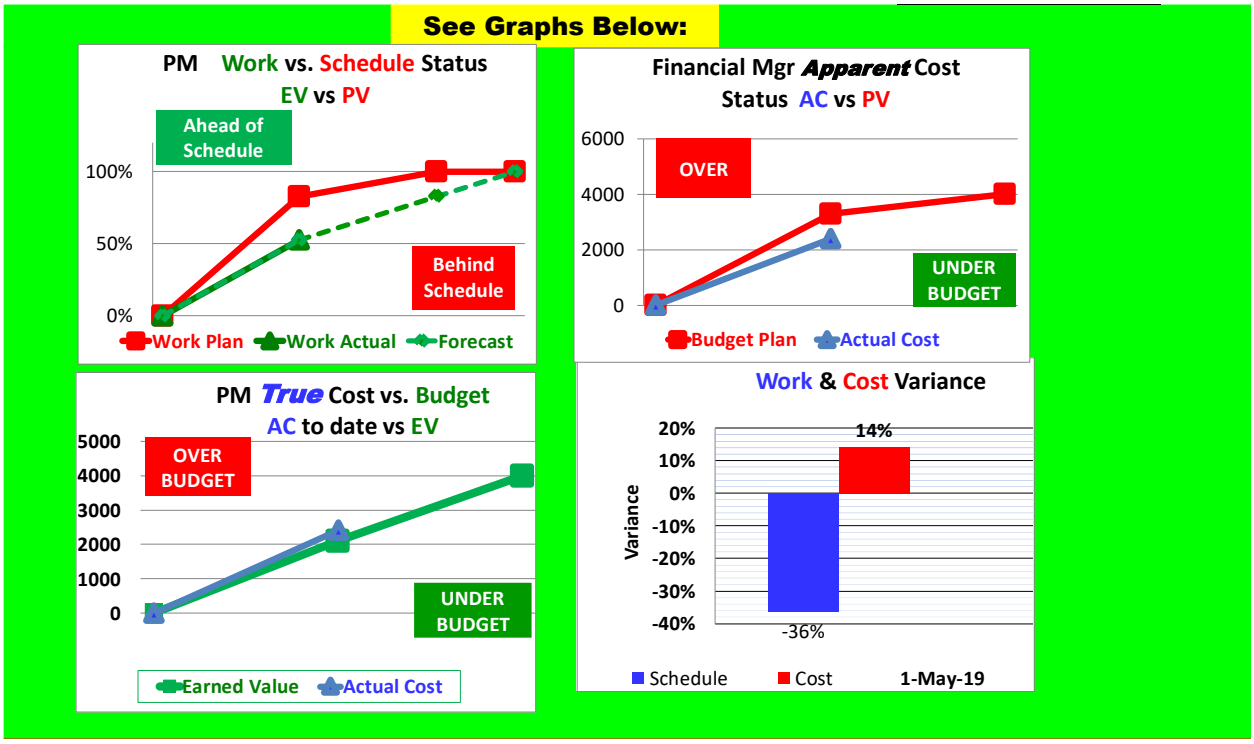
53% Complete	Schedule Variance :	-36%	Cost Variance :	14%
NOTE: Schedule Assessment is based on Project* Earned Value vs Planned Value; *NOT Completed Milestones	Behind Schedule		300	Over Budget
	Project Start Date (DDMMMYR)	**Current Date** (DDMMMYR)	**Scheduled Completion Date** (DDMMMYR)	

FIGURE 7 -- Integrated Project Performance Status Template II - Forecast

53% Complete	Schedule Variance :	-36%	Cost Variance :	14%
NOTE: Schedule Assessment is based on Project* Earned Value vs Planned Value; *NOT Completed Milestones	Behind Schedule		300	Over Budget
	Project Start Date (DDMMMYR)	**Current Date** (DDMMMYR)	**Scheduled Completion Date** (DDMMMYR)	
ENTER:	1-Oct-18	1-May-19	1-Dec-19	

FORECAST: If implementation continues at the *Current Pace*, assuming a linear "burn rate," then the project will most likely be completed by:	**8-Nov-19**
CAUTION: If "burn rate" is not linear, the above Forecast Completion Date *MAY NOT BE VALI*D. Variance from Scheduled Completion Date (SEE BELOW) MAY BE MORE APPROPRIATE.	
ALT. FORECAST: If Scheduled performance & "burn rate" are Irregular, Variance from Scheduled Completion Date MAY BE MORE APPROPRIATE: VERIFY Most Likely Estimate with '*PM Work vs. Schedule Status*' Graph.	**1-Apr-20**

FIGURE 8 -- Integrated Project Performance Status Template III Graphs



CONCLUSION

The Earned Value (EV) concept -- relating costs to the work accomplished, rather than the originally scheduled time -- is the Best Practice for analyzing project cost performance during any of the thirteen different implementation status scenarios.

Furthermore, by supplementing Earned Value Analysis with the following graphic and tabular tools:

1) An S-Curve Transform for the financial analysis

2) a 13 point-scale Project Performance Index, and

3) a template of a project's Overall Status, Current Status, and Forecast (such as IPPSTAT depicted in Figures 6, 7 & 8)

a Project's financial and budgetary status can be quickly, easily and, most importantly, accurately -- monitored, analyzed & reported during implementation.

About the Author

Dr. Kenneth F. Smith

Hawaii, USA

Dr. Kenneth Smith, PMP is a member of PMI and IPMA-USA, with many years of experience as a practitioner, researcher-evaluator, advisor, consultant and instructor/facilitator in project management. He was formerly a management systems specialist with the US Department of Defense; later a manager / advisor / evaluator on various sector projects -- world-wide -- as a representative of the US Government and the international development donor community -- i.e. the U.S. Agency for International Development (USAID), the World Bank Group, African Development Bank, the UN, and the Asian Development Bank. Dr. Smith now conducts workshop-seminars in various aspects of project management, monitoring and evaluation for PMI as well as other government, academic, and private sector organizations. [These and other analytical techniques for project planning, monitoring and evaluation are contained and available in his recently published book **Project Management PRAXIS**, available from Amazon.]

For further information, contact Dr. Smith at kenfsmith@aol.com.