

Evaluating EVM

January 13, 2016

EVM Issues and Opportunities

- EVM Basics
- EVM Issues
- EVM ETC and EAC Calculations
- EVM Cost and Schedule Value Calculations
- CPI and SPI vs Cost and Schedule Variance
- EVM and Alternate Lifecycle models
- Summary

I'll tell you a bit about Earned Value Management, how you do it, and why the big client wants everyone to use it.

Then I'm going to spend most of the time telling you the ways things go wrong in it.

There are general issues with it, and then issues specific to some of the calculations and expectations from the results.

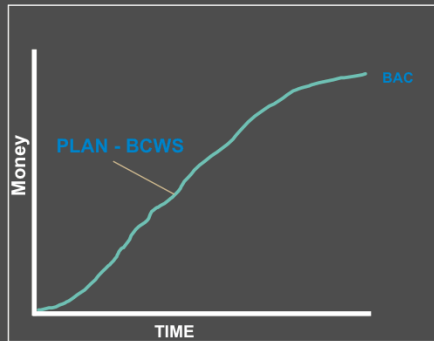
Estimate to Complete and Estimate at Complete get recalculated at every reporting period. Different calculation choices can produce very different results.

Reporting how much time and money you have spent is clear, but saying how much value you have received, not so much.

The usual reporting of how far off you are is with an index, so it doesn't sound worse on really big programs. But reporting actual variance is helpful too.

And EVM was started with the idea that you planned the whole project up front, and executed a traditional waterfall method, but most programs aren't done that way any more.

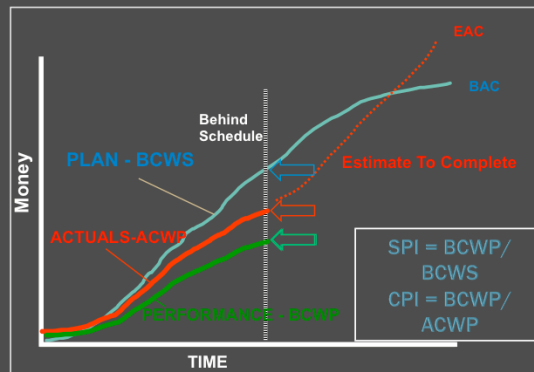
EVM Basics: Planning



- Establish a Baseline across manageable units of time
 - What was planned to get done for the time
 - What was planned to get done for the money
 - Baseline or Budgeted Cost of Work Scheduled BCWS
- Risk Assessment and Reality Check
 - Is this what you promised would happen?
 - Is it possible without divine intervention?
- At the start, and only then $EAC=BAC$

EVMS Basics: Execution

- Measure
 - What did get done in that time?
 - How much did you spend to get it?
- Risk Assessment and Reality Check
 - Is this what you promised would happen?
 - Is everything just the way you thought it would be?



Example Chart that shows a project behind schedule and spending too much for the work.

The dotted white vertical is the shown at the time of the latest measurement.

The hollow blue arrow says where we claimed we would be.

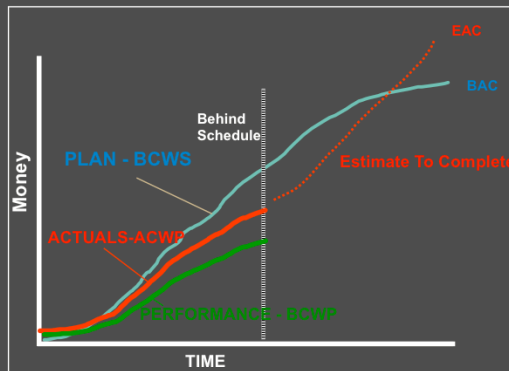
The red line and hollow red arrow shows how much we have paid for the work we have accomplished. ACWP

The green line and arrow shows how much we expected to pay for that much work. BCWP

The cost variance is the difference between how much we meant to pay for the work we got done, and how much we actually did pay. Green minus red. It can be positive or negative.

The schedule variance is between how much we got done and how much we expected to have gotten done. Bright green minus blue, again, it can be positive or negative.

EVM Basics: Forecasting



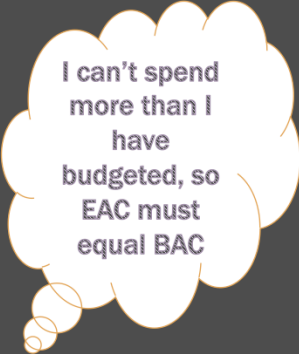
- Basic Predictions
 - If you've been spending too much for the work so far, it is likely to continue
 - If you aren't finishing the work on time, it is likely to continue
 - Estimate To Complete = the amount you have to spend to get done on time
 - Estimate At Complete = The total amount you will have spent at the end, that is, Actual Cost + ETC.

The PMI Guide on EVM wants people to understand that these forecasts are trend based.

This picture represents a case where you haven't spent what you planned, and you haven't gotten what you expected even for that amount of money. Even though the cost is under-running, the schedule is under-running too.

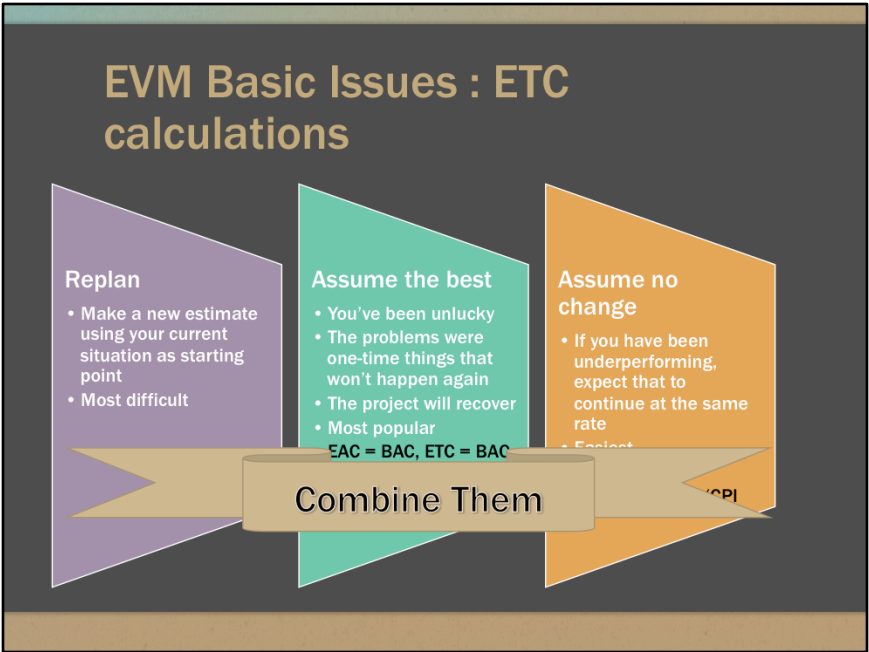
EVM Issues

- Does not work right if you don't do it right
 - There are choices to make on calculations
- Not easy, takes training, time, and schedule to execute
- Some smart people have a real mental block about it



I can't spend more than I have budgeted, so EAC must equal BAC

People also get hung up on end dates. The due date will come, and you are supposed to figure out if you can be done, and what it will take to accomplish that. You don't just say the end has come so we must be done.



This is where you do causal analysis.
 Analytical, ? Statistical

EAC Calculations

Assumption	Example Formula
Future cost performance will be performed at the budgeted rate	$EAC = AC + (BAC - EV)$ Data Example: $EAC = 48 + (150 - 32) = 166$
Future cost performance will be the same as all past cost performance	$EAC = AC + [(BAC - EV) / CPI] = BAC / CPI$ Data Example: $EAC = 48 + [(150 - 32) / 0.67] = 150 / 0.67 = 225$
Future cost performance will be the same as the last three measurement periods (l, j, k)	$EAC = AC + [(BAC - EV) / ((EV_l + EV_j + EV_k) / (AC_l + AC_j + AC_k))]$
Future cost performance will be influenced additionally by past schedule performance	$EAC = AC + [(BAC - EV) / (CPI \times SPI)]$ Data Example: $EAC = 48 + [(150 - 32) / (0.67 \times 0.80)] = 269.3$
Future cost performance will be influenced jointly in some proportion by both schedule and cost indices	$EAC = AC + [(BAC - EV) / (0.8 \text{ CPI} + 0.2 \text{ SPI})]$ Data Example: $EAC = 48 + [(150 - 32) / (0.8 \times 0.67) + (0.2 \times 0.80)] = 218.2$

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This table is from the PMI publication on EVM
Practice Standard for Earned Value Management 2nd Ed.

EVM Cost Management Issues

- Different situations need to be measured differently.
- Need to examine at a lower level of the WBS, but not too low
- Special cases
 - LOE activities, e.g. Project Management. If Actual \neq Plan then you planned to a different model.
 - Discrete allocation of large costs . If you have a bunch of money going out at once, even if it planned, it will mess up your calculations. Picture the graph.
 - If you choose to allocate Earned Value 25% on task start, and 75% at completion, but your Planned Value curve assumes even distribution, you will get meaningless variances.
- Using Actual money out instead of Actual Costs Incurred.

EVM Cost Management Issues

- **Retroactive Adjustments**
 - Cost data arrives late. Have a consistent and mathematically valid process.
- **Scope Changes**
 - If you add stuff to scope you need to replan
 - If you take stuff out because work packages are cancelled, you need to make an alternate plan, maybe more than one.
- **Done wasn't really done**
 - If you don't plan for rework you will re-open closed tasks and mess up your EV.
- **Divide by zero – see the next section**

EVM Schedule Management Issues

Boundary Conditions

- Time marches on, and you reach the end date whether or not you are done.

SPI = 1 when work is complete

SPI = 1 when the baseline completion date is reached.

Obviously, you need to work around this problem. This problem is mostly ignored in US practice.

SPI = EV/PV, CPI = EV/AC and 0

- Time passed, nothing happened aka late start
 $0/0 = ?$
- Time passed, people charged to the contract, but didn't accomplish anything
 $0/PV = 0, 0/AC = 0$
- Some work shows up as done in activities not started
 $EV/0 = ?$

EVM and Alternate Lifecycle Models

EVM Intended for Waterfall Model

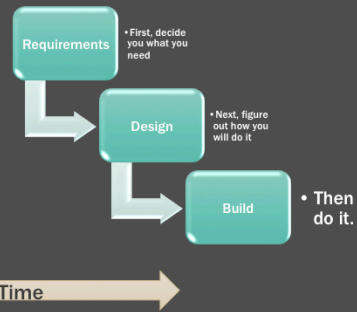
- All planning up front in Waterfall
- Requirements are defined early in project, so if it looks like the project plan is unrealistic after the requirements phase you can rebaseline.
- You define the completion state and can tell if you are making progress towards it.

Adapt EVM to Agile Models

- The plan is to figure out what you are doing as you go along.
- Functional and performance end states are not defined
- Incremental, Evolutionary, and Spiral models all require adjustments.

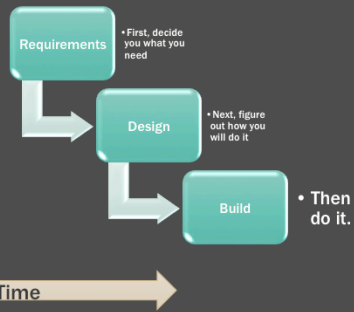
Waterfall Lifecycle Model

- Waterfall lifecycle models developed for large scale items where there is potentially significant lead time and expense for the product being built.
- Steps are sequential, and you don't make something until you have specified what you are making and how you will do it.
- Satellites and Aircraft Carriers are built this way.



Waterfall Lifecycle Model

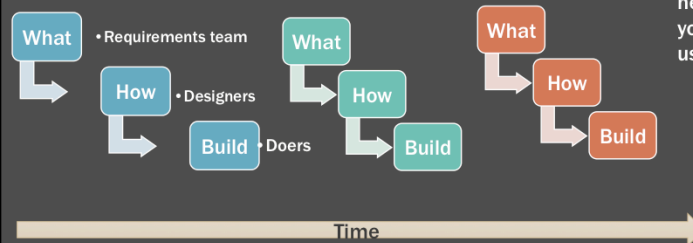
- Waterfall lifecycle models and EVMS work together easily. For the big projects you are expected to have clearly defined endpoints at which you can take credit for completed work.
- DoD Acquisition Milestones are when the customer accepts that you have completed the phase.
- Your project schedule and WBS are detailed enough that your Value determination is fairly easy.



Spiral Lifecycle (and parallel subsystems)

In the spiral model, the teams functional, rather than associated with a product. As a team finishes a product, they move on to apply their skills to the next product.

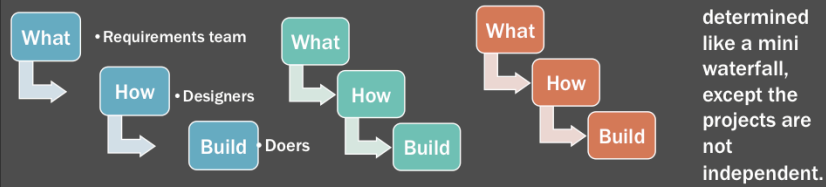
People resist planning each step. You need to plan if you need to use EVM



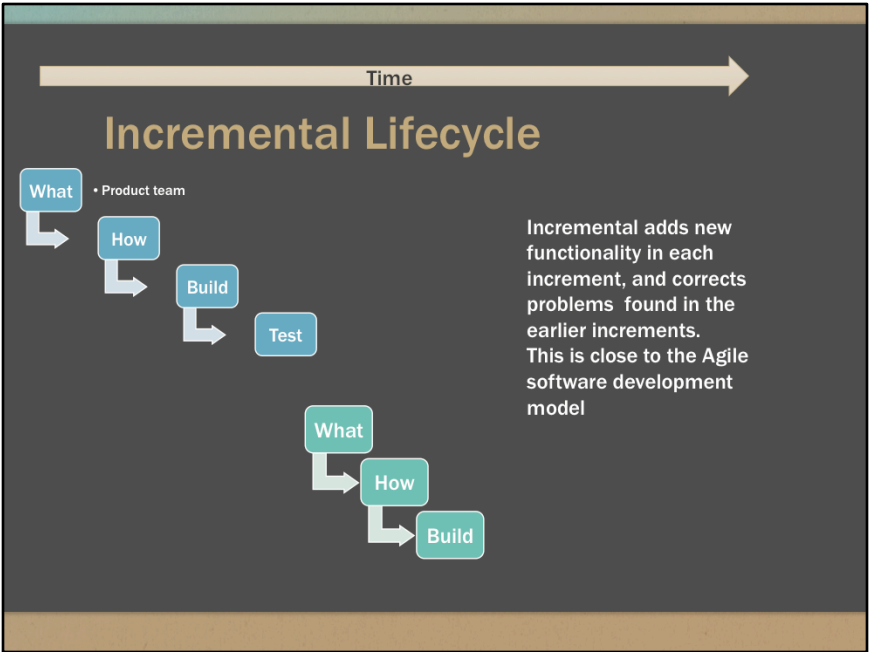
In situation like this and the incremental lifecycle, it is hard to define value for each activity as a portion of the whole, because the whole has not been defined. It often is a choice of fixed budget or defined capability. That is, you work until you run out of money, and design your project so that each chunk is useful so that you've been helpful for the money. This scenario is easier for determining earned value. If you define capability for the final deliverable, and keep creating subprojects until you get what you need/want/asked for then you will plan each section and take earned value on the subprojects.

(Spiral Lifecycle and) parallel subsystems

Subsystems of the satellites and aircraft carriers are done in parallel, completing each phase at approximately the same time.



The subprojects are done approximately in parallel, though some design will be dependent on the design of dependent subsystems. The resistance to EVM in this situation comes from the fact that another team can prevent your team from completing on time.



Summary

Questions?

- EVM ETC and EAC Calculations
 - Different methods available.
 - Combine them if needed to get the best results.
- EVM Cost and Schedule Value Calculations
 - Depend on the kind of contract and task
 - Depend also on how you want to define Value
- CPI and SPI vs Cost and Schedule Variance
 - Ratios and when you have a scale difference in your numbers.
- EVM and Alternate Lifecycle models
 - Adds complexity to the Cost and Schedule Value calculations

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I told you about general issues with it, and then issues specific to some of the calculations and expectations from the results.

Like optimism, pessimism, and Estimate to Complete and Estimate at Complete. Choosing how to calculate and report value and costs.

The problems with indices, calculated as ratios and percentages (with division) as opposed to variance, based on subtraction.

And finally adjusting to alternate lifecycles. A layer of complexity on the meaning of value and the value of predictability.