Managing Out of Sequence Performance

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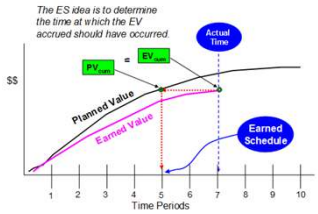

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Objectives

- What is Earned Schedule?
- How is ES computed?
- What is Schedule Adherence?
- How does ES enable the measure of SA?
- How is SA computed?
- How can SA help PMs with schedule performance control?

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Introduction to Earned Schedule

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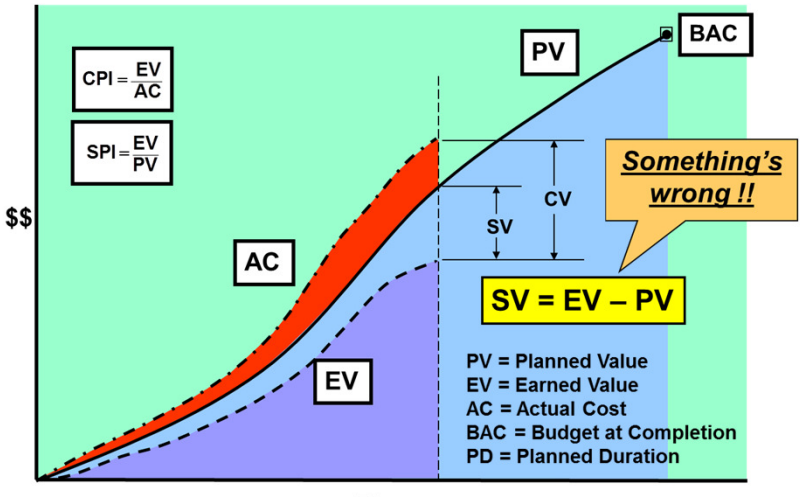
EVM Schedule Indicators



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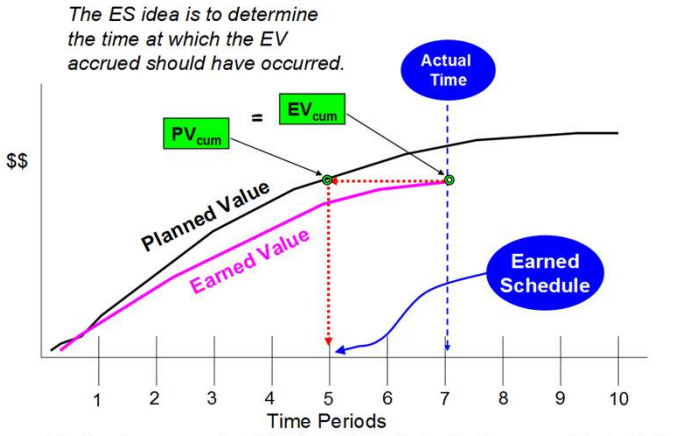
Earned Schedule Concept



For the above example, ES = 5 months …that is the time associated with the PMB at which PV equals the EV accrued at month 7.

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Earned Schedule Calculation

- ES (cumulative) is the:
  Number of time increments (C) of PMB for which EV accrued equals or exceeds PV_n, plus the fraction (I) of the subsequent increment (C + 1)
- ES = C + I where:
  C = Number of time increments of PMB for EV ≥ PV_n
  I = $(EV - PV_C) / (PV_{C+1} - PV_C) \times$ one time period

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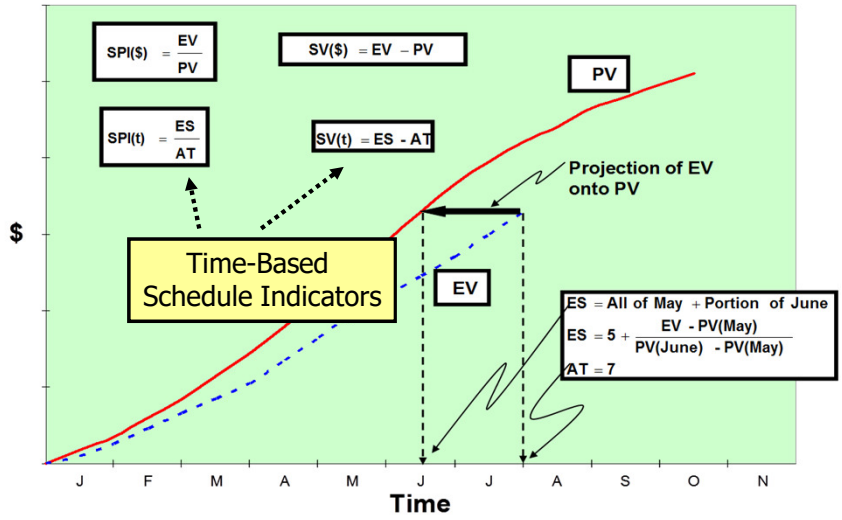
ES Computation Example



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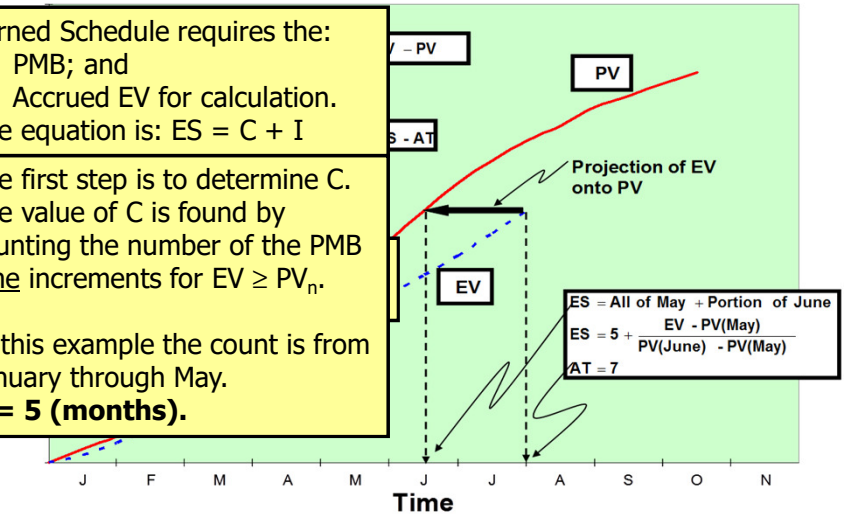
ES Computation Example

Earned Schedule requires the:
1) PMB; and
2) Accrued EV for calculation.
The equation is: ES = C + I

The first step is to determine C. The value of C is found by counting the number of the PMB time increments for EV ≥ PV_n.

In this example the count is from January through May.
C = 5 (months).



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ES Computation Example

Thus far, ES = 5 + I (months).
In the small box at the lower right, is the equation for calculating I.
For the example, let
1) EV = 100
2) PV_5 (May) = 90
3) PV_6 (June) = 110.

Let's calculate I:
I = (100 – 90) / (110 – 90) = 0.5

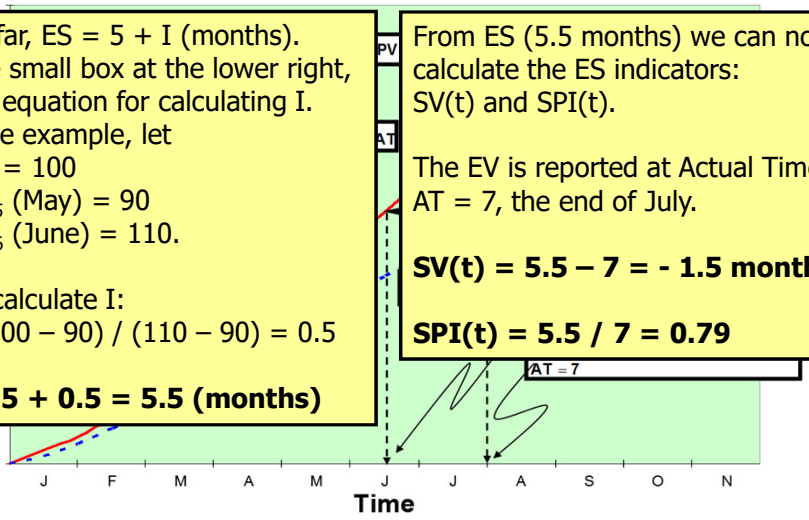
ES = 5 + 0.5 = 5.5 (months)

From ES (5.5 months) we can now calculate the ES indicators: SV(t) and SPI(t).

The EV is reported at Actual Time AT = 7, the end of July.

SV(t) = 5.5 – 7 = - 1.5 months

SPI(t) = 5.5 / 7 = 0.79



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Schedule Adherence

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Schedule Adherence

- Recall the initiatives to improve project performance and quality over the last 30+ years: SPC, TQM, SEI CMM®, and ISO 9001
- What was their message?

> *Undisciplined project execution leads to inefficient performance and defective products.*

- Then …doesn't it make sense to measure how well the plan (process) is being followed?

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Measuring Schedule Adherence

- We want to know:

> *Did the accomplishment match exactly the expectation from the planned schedule?*
> *- "Schedule Adherence" -*

- Earned Schedule provides a means to measure Schedule Adherence

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Measuring Schedule Adherence

- The connection between ES and the PMB is remarkable
  …*regardless of the project's position in time, we can know what <u>should</u> have been accomplished*
- For a claimed amount of EV at a status point AT, the portion of the PMB which should be accomplished is identified by ES

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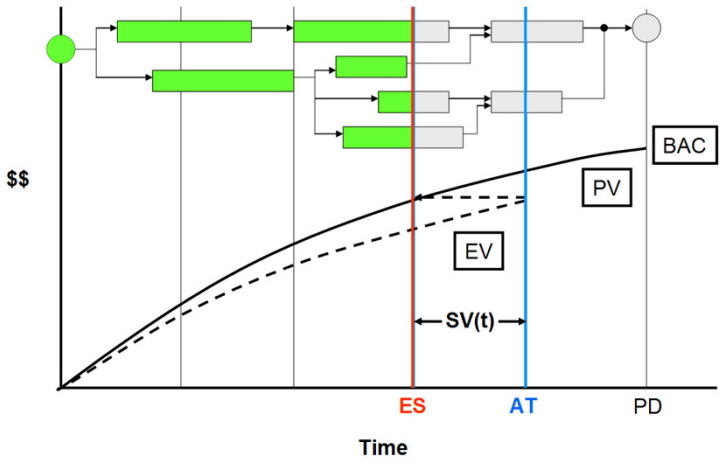
Measuring Schedule Adherence



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Measuring Schedule Adherence

- It is more likely performance is not synchronous with the schedule …EV is not being accrued in accordance with the plan
- The next chart is an example …the EV accrued is the same amount as shown on the previous chart, but has a different distribution

What do you see?

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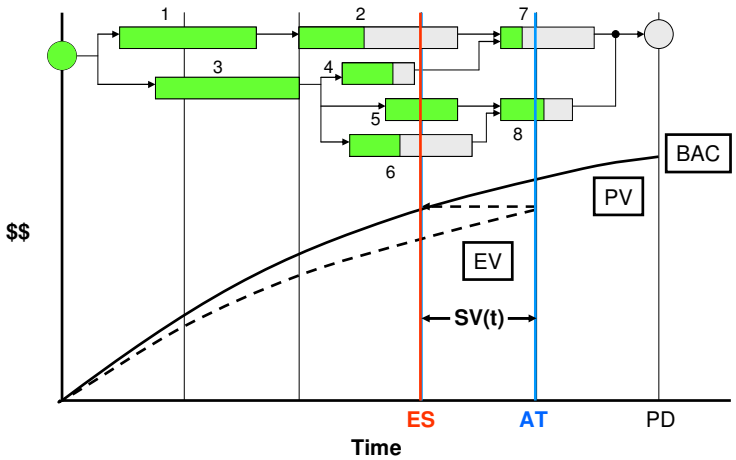
Measuring Schedule Adherence



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Measuring Schedule Adherence

- Tasks behind – indicates the possibility of impediments or constraints
- Tasks ahead – indicates the likelihood of future rework
- Both, lagging & ahead cause poor performance efficiency …ahead performance is most likely caused by the lagging tasks

Concentrating management efforts on alleviating impediments & constraints will have the greatest positive impact on project performance

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Measuring Schedule Adherence

- Ahead tasks are frequently performed without complete information
- Performers must anticipate the inputs from the incomplete preceding tasks
- When anticipation is incorrect a significant amount of rework is created
- Complicating the problem the rework created for a specific task will not be recognized for a time ….until all of the inputs are known or the output is incompatible for a dependent task

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Measuring Schedule Adherence

- By measuring the portion of the EV accrued that is congruent with the planned schedule we can have an indicator for controlling the process
- Schedule Adherence is defined as:

$$P = \Sigma EV_j / \Sigma PV_j$$

where the subscript j denotes the identity of the tasks comprising the planned accomplishment

- The value of ΣPV_j is equal to the EV accrued at AT
- ΣEV_j is the amount of EV for the j tasks, limited by the value of the corresponding PV_j

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Measuring Schedule Adherence

- Recall the question …

> *Did the accomplishment match exactly the expectation from the planned schedule?*

- The P-Factor is the indicator for answering the question
- Characteristics of the P-Factor
  - Its value must be between 0.0 and 1.0
  - P = 1.0 at project completion
  - P = 0.0 indicates accomplishment out of sequence
  - P = 1.0 indicates perfect conformance to schedule

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Measuring Schedule Adherence

- When the value of P is much less than 1.0 the PM has a strong indication of an impediment, overload of a constraint, or poor process discipline
- When P has a value very close to 1.0, the PM can feel confident the schedule is being followed ….and that milestones and interim products are occurring in the proper sequence

The PM now has an indicator which enhances the description of project performance portrayed by EVM & ES

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Example Application

- Notional data has been created to illustrate the application of *Schedule Adherence*
- The task numbers in the table are associated with the numbering shown on the chart of the network schedule
- By calculating the difference between PV@ES and EV@AT, impediments/constraints (I/C) and rework (R) can be identified to specific tasks

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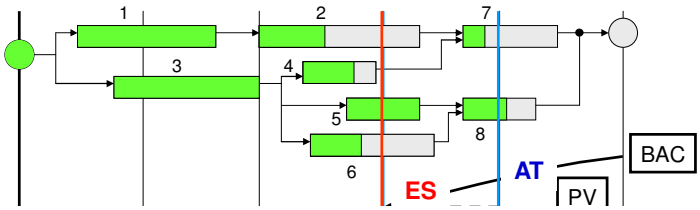
Example Application



Task	PV	PV@ES	EV@AT	EV - PV	I/C or R
1	10	10	10	0	
2	12	9	5	-4	I/C
3	10	10	10	0	
4	5	5	3	-2	I/C
5	5	2	5	+3	R
6	8	4	3	-1	I/C
7	7	0	1	+1	R
8	5	0	3	+3	R
Total	62	40	40	0	

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Example Application

- Three tasks identified as lagging: 2, 4, and 6
- PM should investigate these tasks for removal of impediments or alleviation of constraints
- Should no impeding problem be found, the PM has reason to suspect poor process discipline from one or more members of the project team
  - *It may be discovered that an employee is insufficiently skilled or trained*
  - *The employee to obtain a satisfactory performance review performed a down stream task because he knew how to do it*
  - *In this instance …..Who caused the problem?*

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Example Application

- Tasks identified for potentially creating rework are: 5, 7, and 8.
- Clearly tasks 7 & 8 are at risk of rework because some or all of the required inputs are absent
- The potential for rework is not so obvious for task 5. …it is not synchronous with the schedule, but the needed inputs are complete
  - By working ahead the worker presumes that his work is unaffected by other facets of the project
  - Subtle changes to task requirements often occur as more detail becomes known

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Example Application

- What is the value of the P-Factor for this example?

Task	PV	PV@ES	EV@AT	EV - PV	I/C or R
1	10	10	10	0	
2	12	9	5	-4	I/C
3	10	10	10	0	
4	5	5	3	-2	I/C
5	5	2	5	+3	R
6	8	4	3	-1	I/C
7	7	0	1	+1	R
8	5	0	3	+3	R
Total	62	40	40	0	

- It is seen that PV@ES = EV@AT … PV@ES identifies the tasks which should be in-work/complete: 1 through 6

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Example Application

Task	PV	PV@ES	EV@AT	EV - PV	I/C or R
1	10	10	10	0	
2	12	9	5	-4	I/C
3	10	10	10	0	
4	5	5	3	-2	I/C
5	5	2	5	+3	R
6	8	4	3	-1	I/C
7	7	0	1	+1	R
8	5	0	3	+3	R
Total	62	40	40	0	

- Sum of EV@AT for 1 thru 6 is equal to 36 …but the amount of EV for task 5 is +3 with respect to its corresponding task PV ...and thus, $\Sigma EV_j = 36 - 3 = 33$
- The P-Factor can now be calculated:

$$P = \Sigma EV_j / \Sigma PV_j = 33 / 40 = 0.825$$

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Example Application

- From the value of P …~80 percent of the execution is in conformance with the schedule
- Presuming all of the claimed accomplishment not in agreement with the schedule requires rework, i.e. 7 units ….then:
  - ~18 percent of claimed EV requires rework
  - Without a large amount of MR, successful completion is unlikely
  - The PM has much to do to save this project …however, without the P-Factor indicator and the analysis ES facilitates, it is unclear as to what he/she should investigate and take action to correct

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Schedule Adherence Summary

- Earned Schedule, an extension to EVM for schedule performance analysis, is extended further …creating a useful tool for PMs
- EV and ES with the PMB are used to develop the concept of *Schedule Adherence*
  - Measure for Schedule Adherence: $P = \Sigma EV_j / \Sigma PV_j$
  - Identification of Impediments/Constraints & Rework
- High value of P leads to …
  - Maximum performance for Cost & Schedule
  - Greater understanding of excellent project planning

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Final Remarks

- Some EVM experts & practitioners believe that schedule analysis is possible only through detailed examination of the network schedule
- *Schedule Adherence* is a PM tool for process control not available from traditional analysis of the network schedule
- Use of the P-Factor measure is encouraged …a calculator is available from the ES website

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P-Factor Calculator

P-Factor
Calculator

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