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E.V.A. - 10
Symposium
May 17-20, 2005
London, England

Earned Schedule

…an extension to EVM theory

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Purpose

To discuss and encourage the application of a new method of schedule analysis derived from Earned Value Management, termed "*Earned Schedule*."

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Overview

- **The Problem with EVM**
- ***Earned Schedule* Concept**
- **Applications**
- **Status & Future**
- **Summary**

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The Problem

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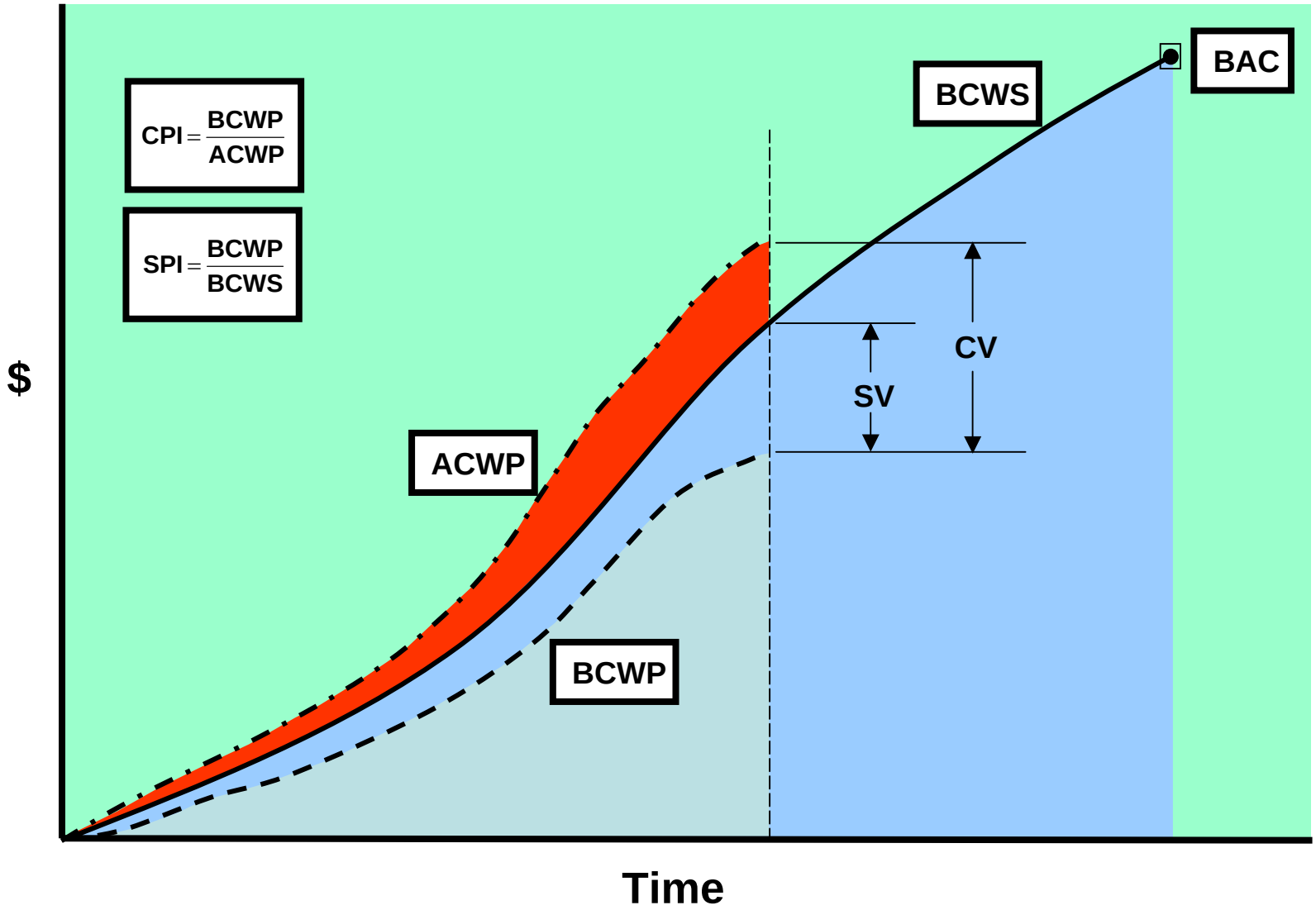
Earned Value Basics



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So, what's the problem?

- Traditional schedule EVM metrics are good at beginning of project
  - Show schedule performance trends
- But the metrics don't reflect real schedule performance at end
  - Eventually, all "budget" will be earned as the work is completed, no matter how late you finish
    - **SPI improves and ends up at 1.00 at end of project**
    - **SV improves and ends up at $0 variance at end of project**
  - Traditional schedule metrics lose their predictive ability over the last third of project
    - Impacts schedule predictions, EAC predictions
- **Project managers don't understand schedule performance in terms of budget**
  - **Like most of us!**

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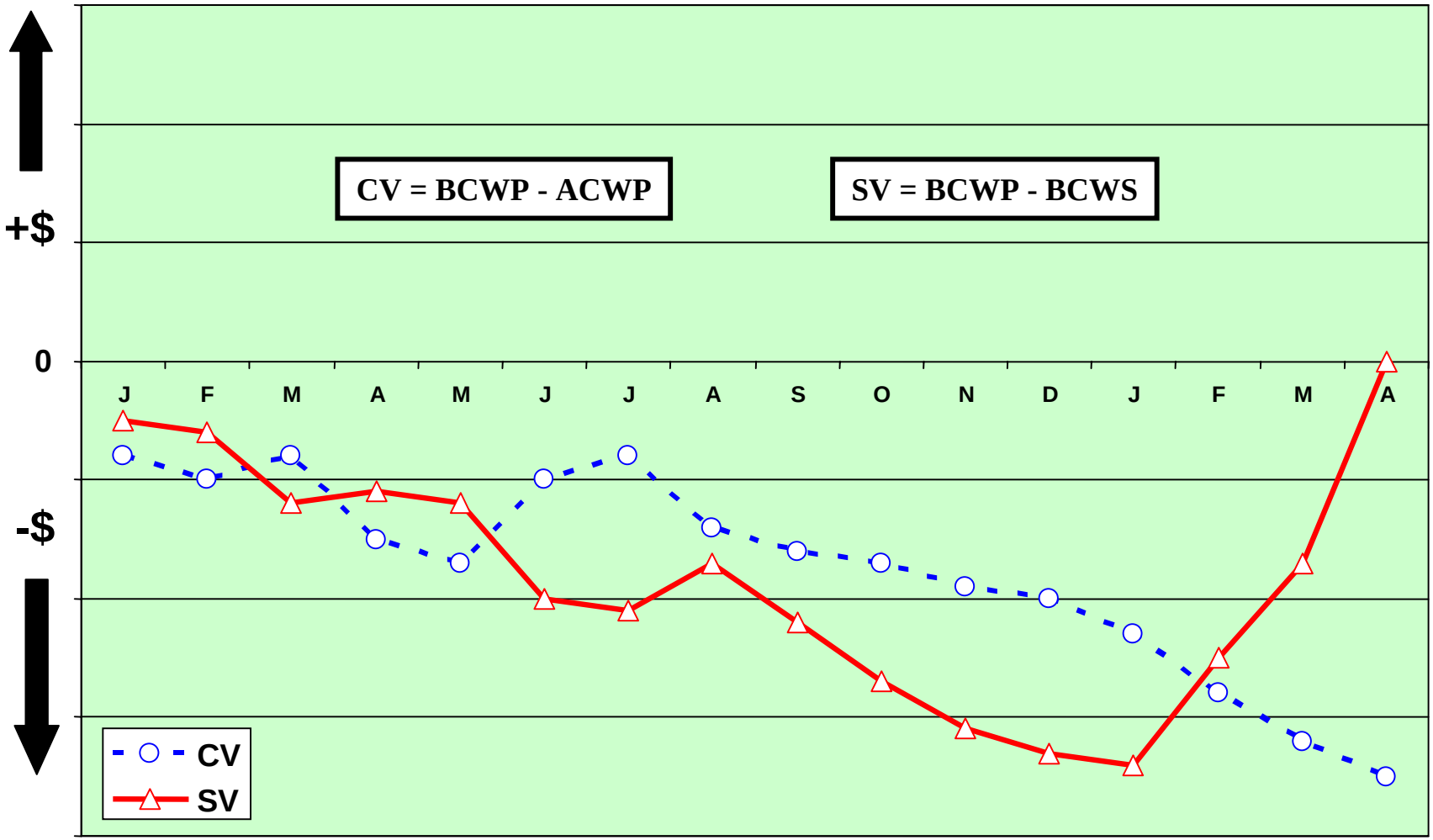
Earned Value
Cost and Schedule Variances



Note: Project completion was scheduled for Jan 02, but completed Apr 02.

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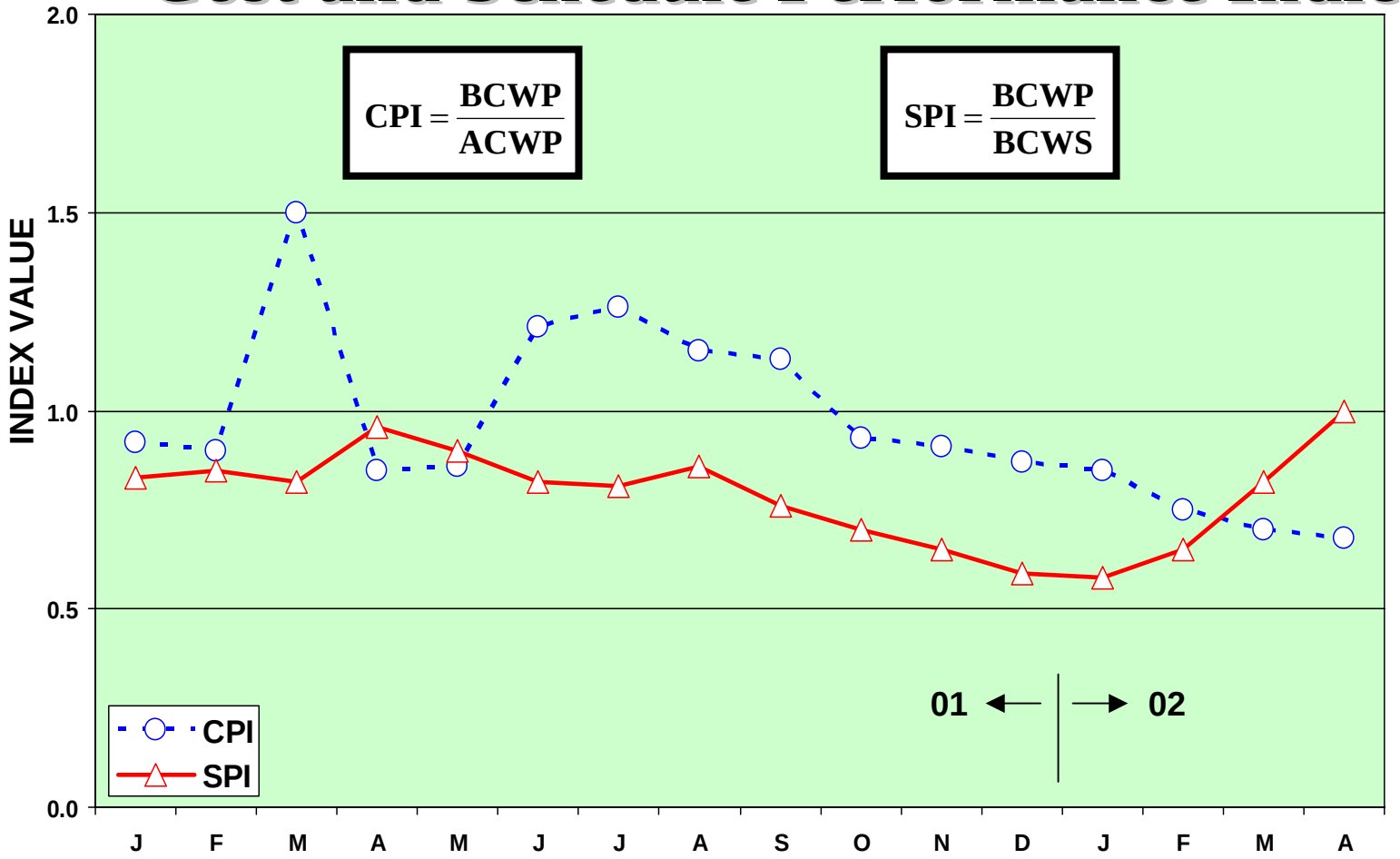
Earned Value

Cost and Schedule Performance Indices



Note: Project completion was scheduled for Jan 02, but completed Apr 02.

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Earned Schedule

Concept

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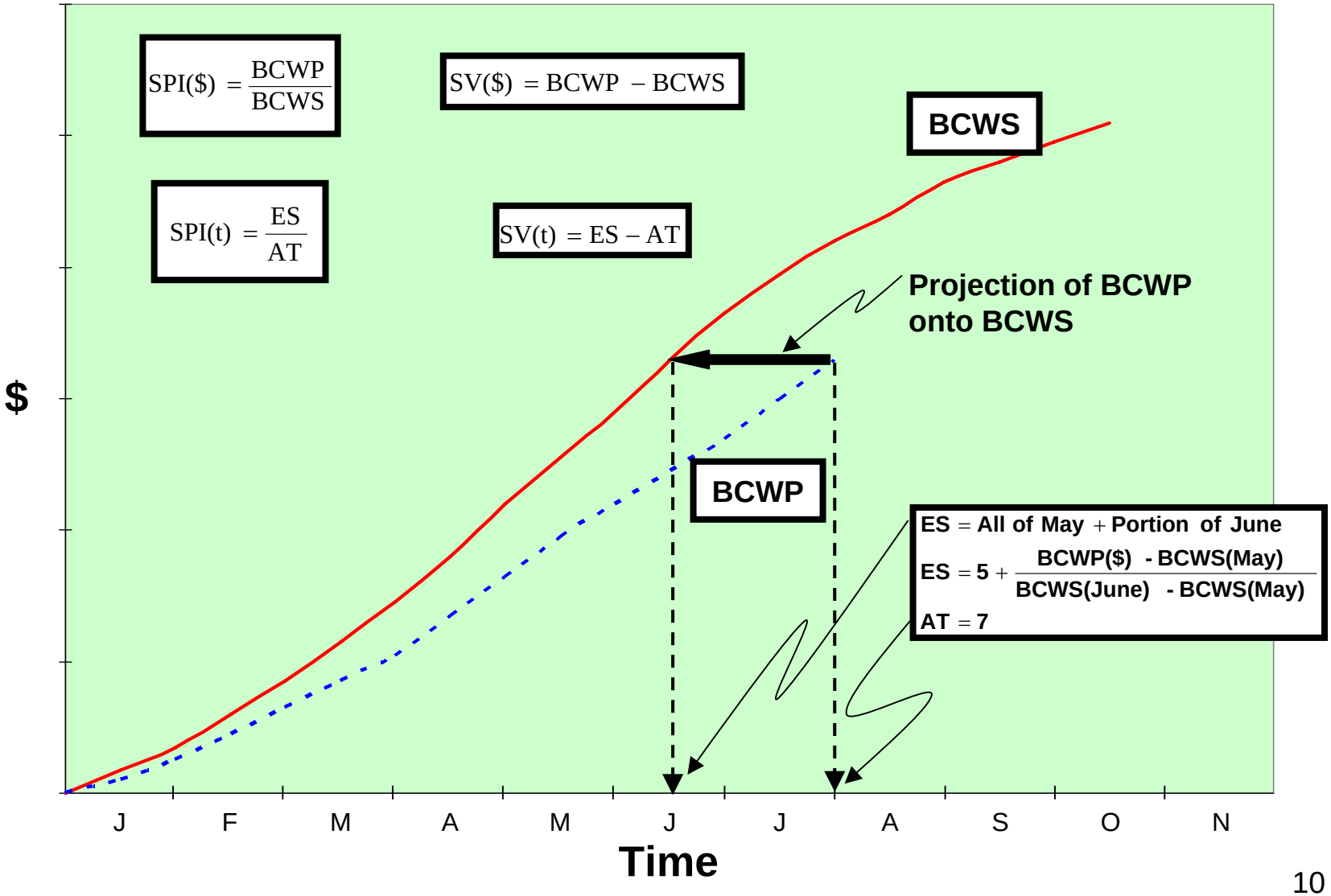
Earned Schedule Concept



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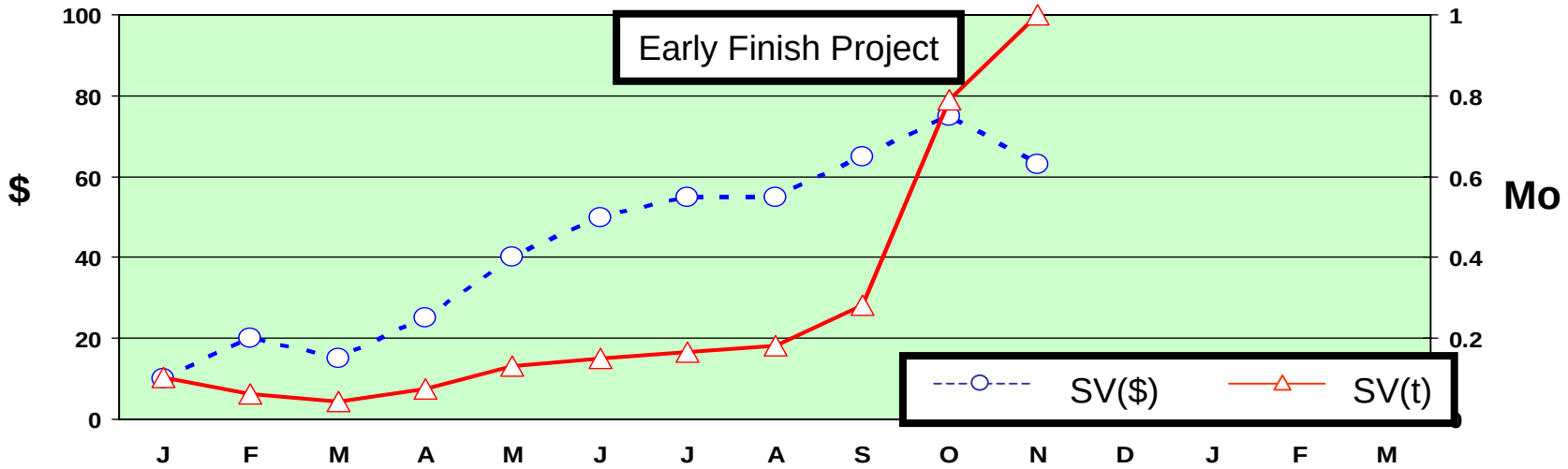
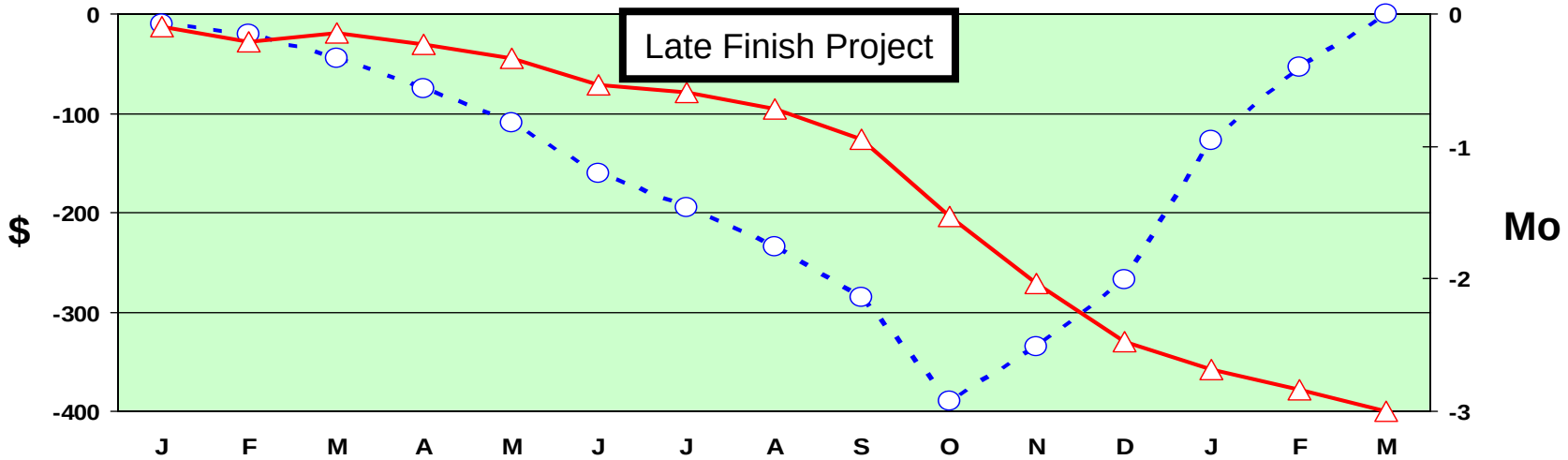
Schedule Variance Comparison





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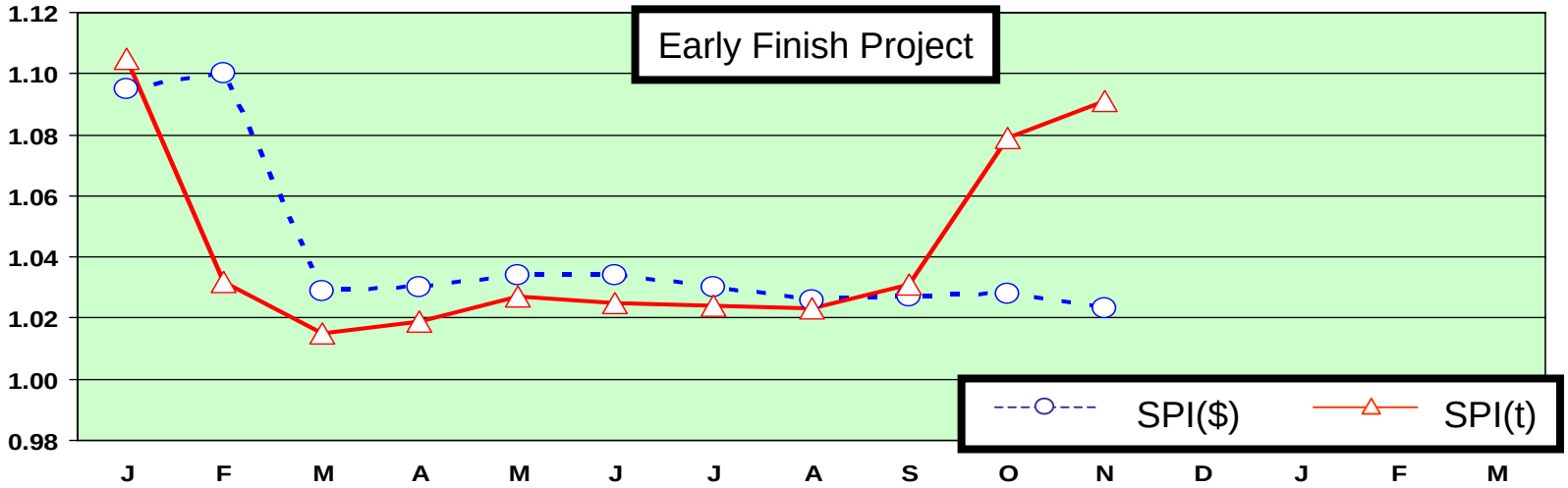
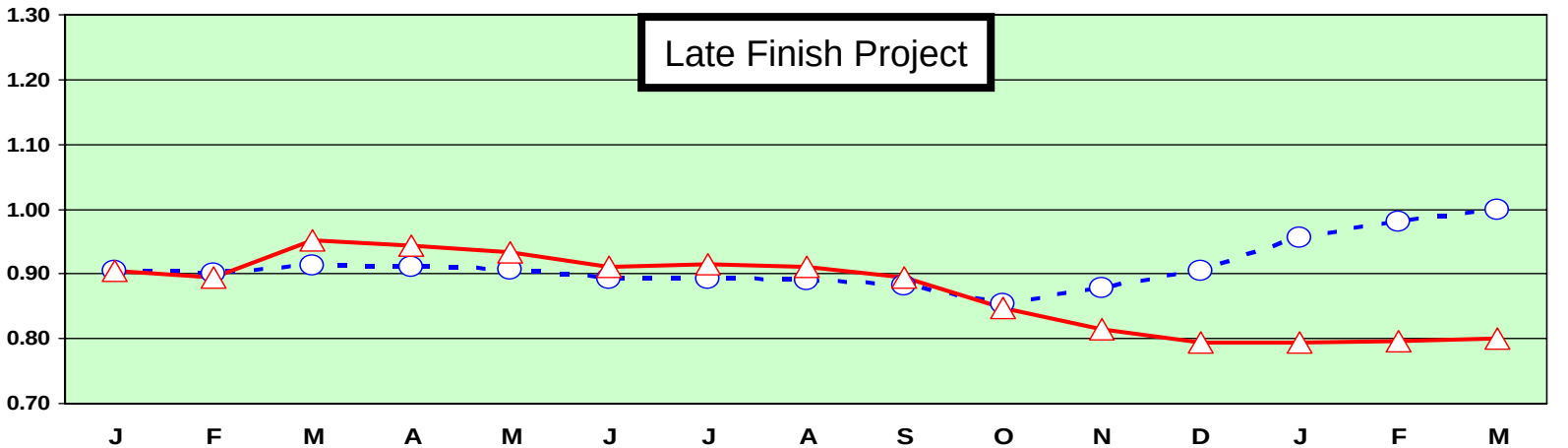
Schedule Performance Index Comparison





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Earned Schedule Indicators

- **Key Points:**
  - **ES Indicators constructed to behave in an analogous manner to the EVM Cost Indicators, CV and CPI**
  - **SV(t) and SPI(t) are not constrained by BCWS calculation reference**
  - **SV(t) and SPI(t) provide duration based measures of schedule performance**

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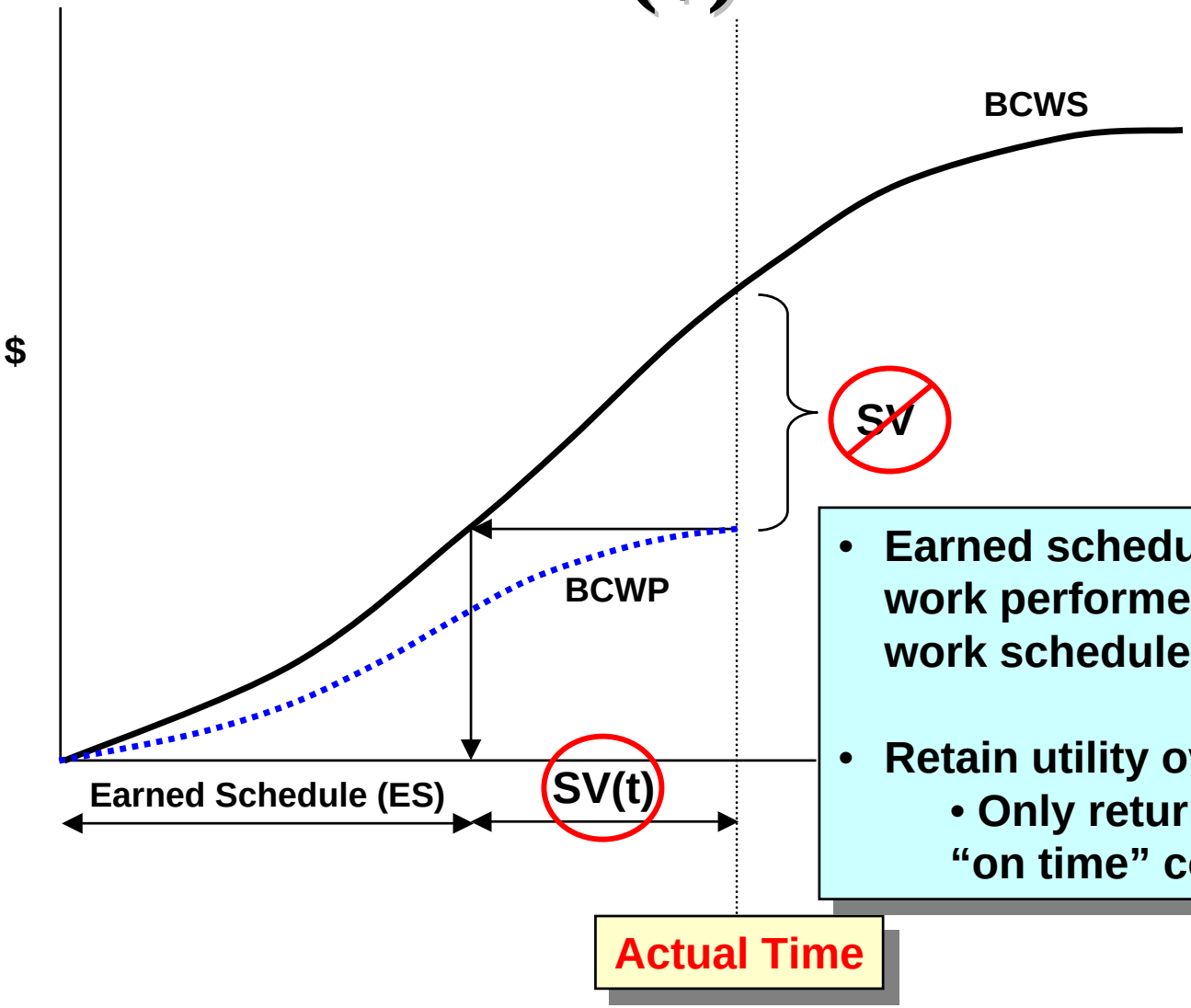
SV($) versus SV(t)



- Earned schedule metrics relate work performed to actual time, not work scheduled
- Retain utility over time
  - Only return to 0 or 1.00 where "on time" completion achieved

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Applications

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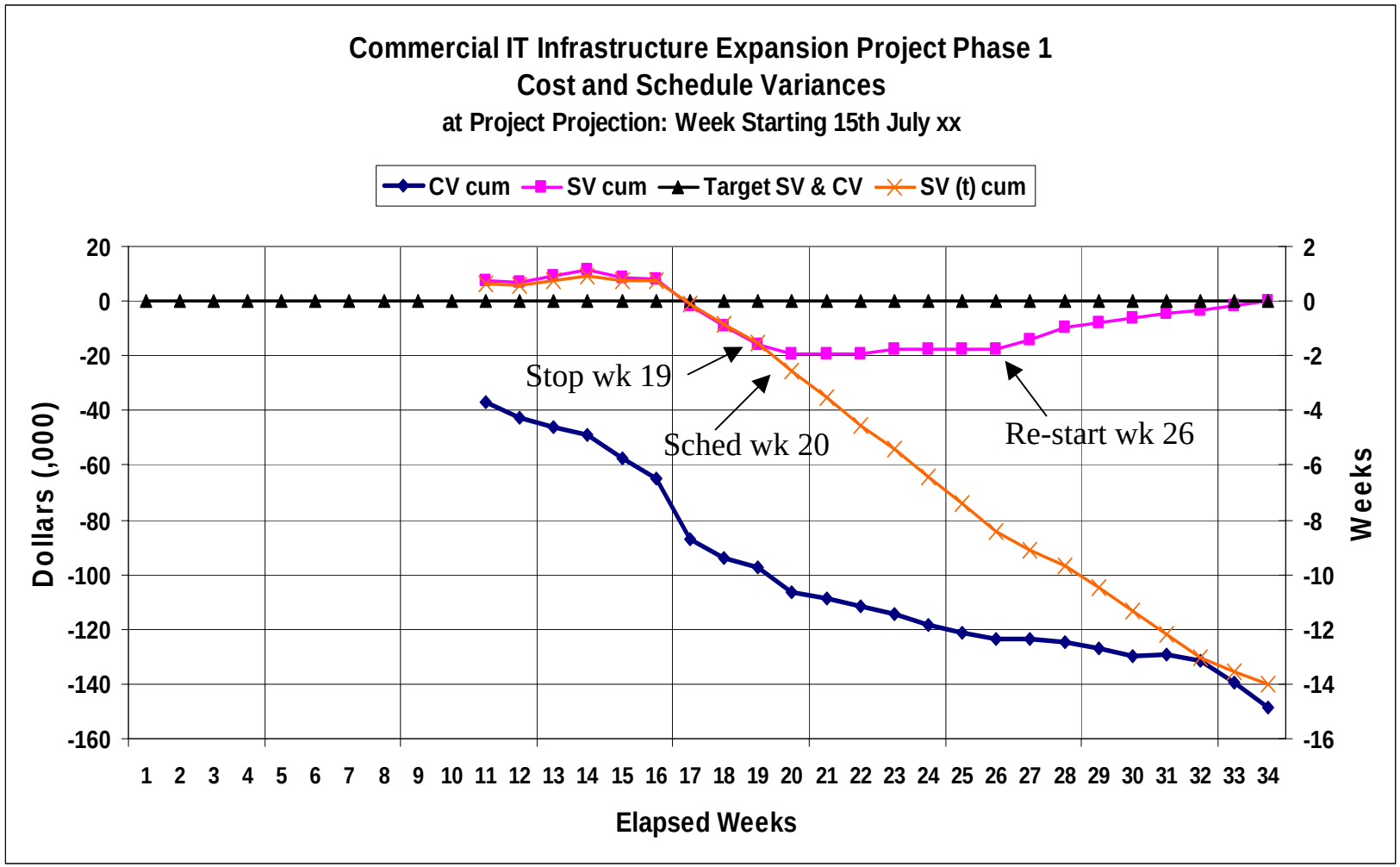
ES Applied to Real Project Data:
Late Finish Project: SV($) and SV(t)



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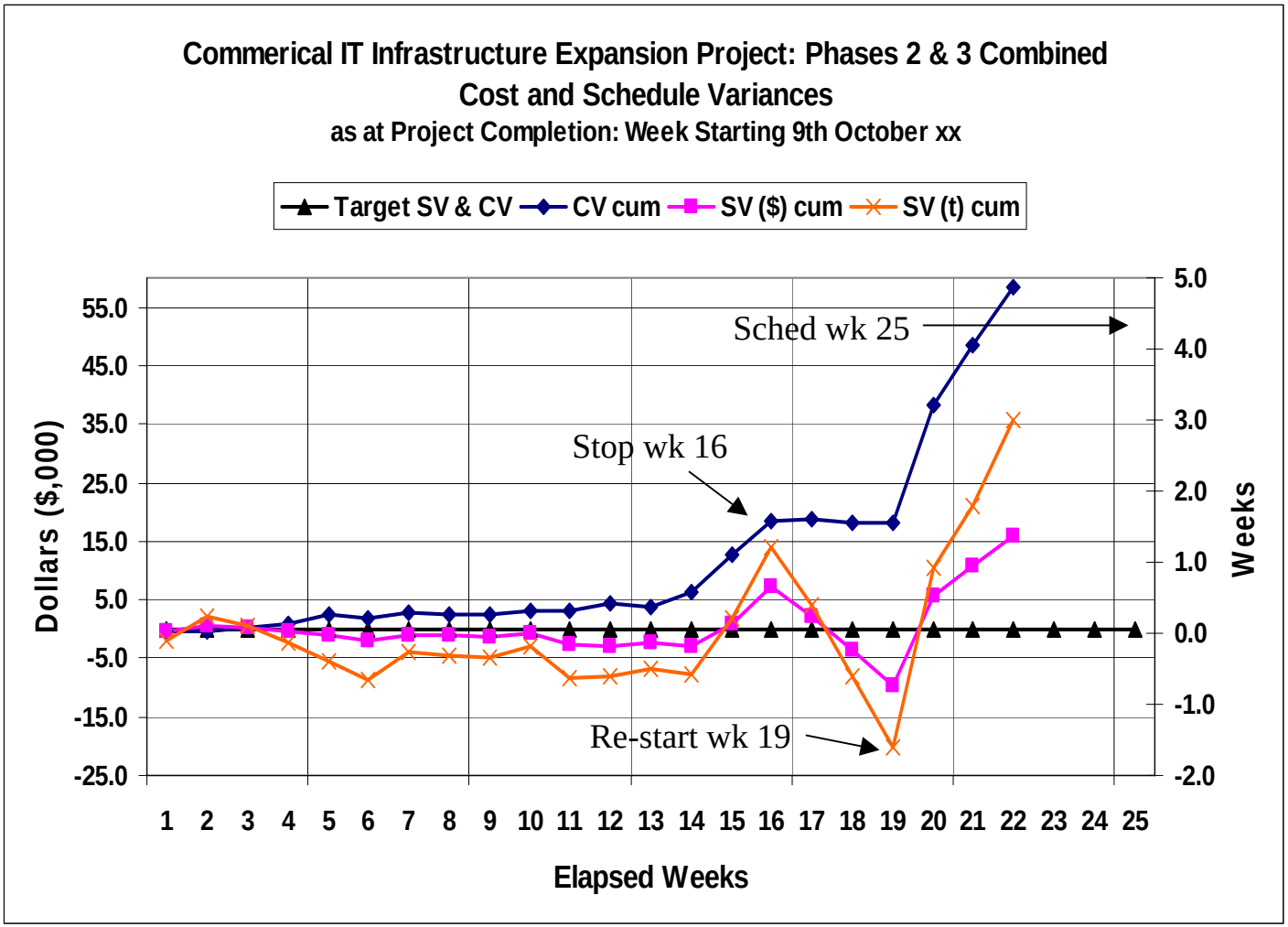
Early Finish Project: SV($) and SV(t)



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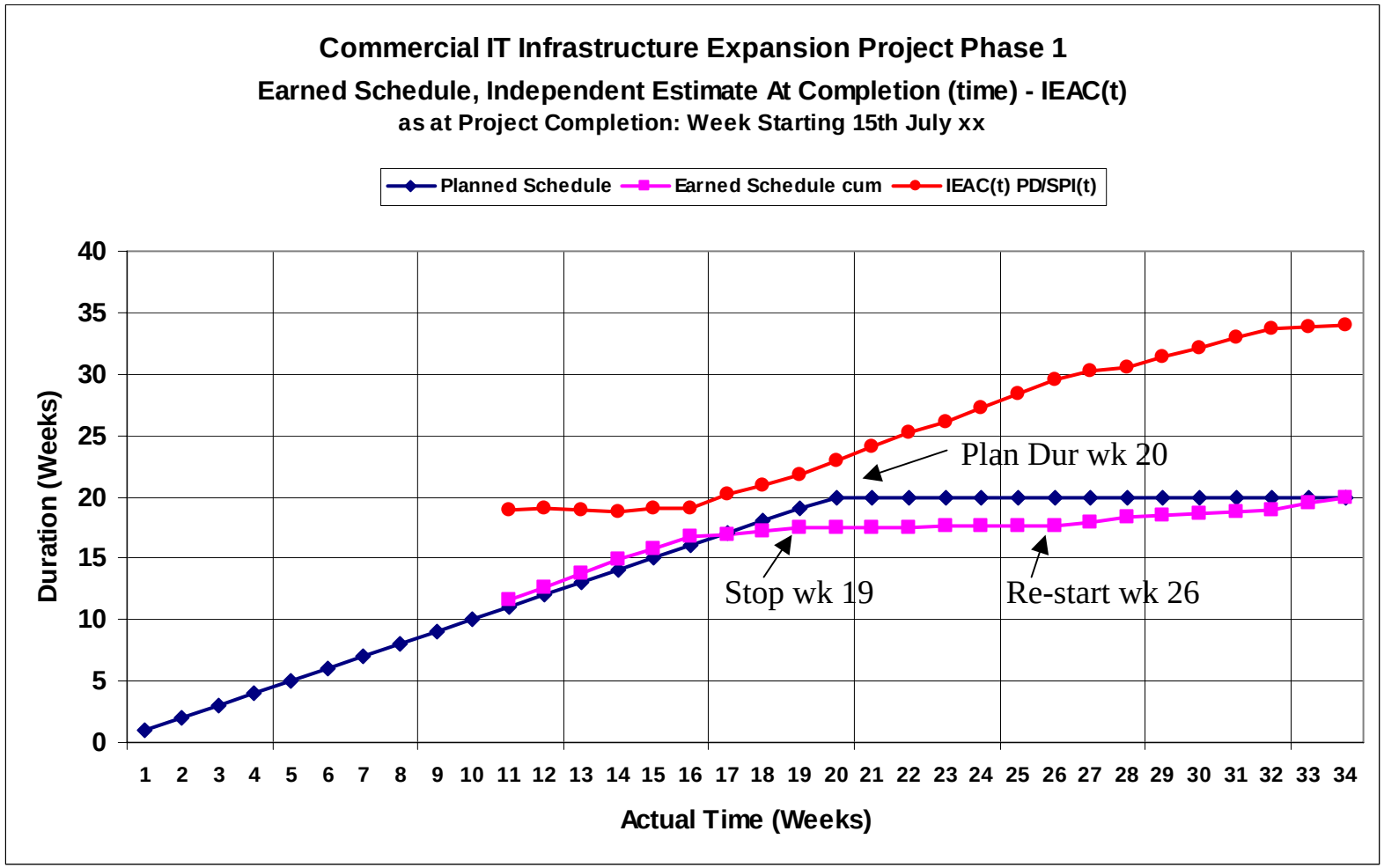
IEAC(t) Predictions using ES Techniques: Weekly Plots of IEAC(t)

Late Finish Project Example



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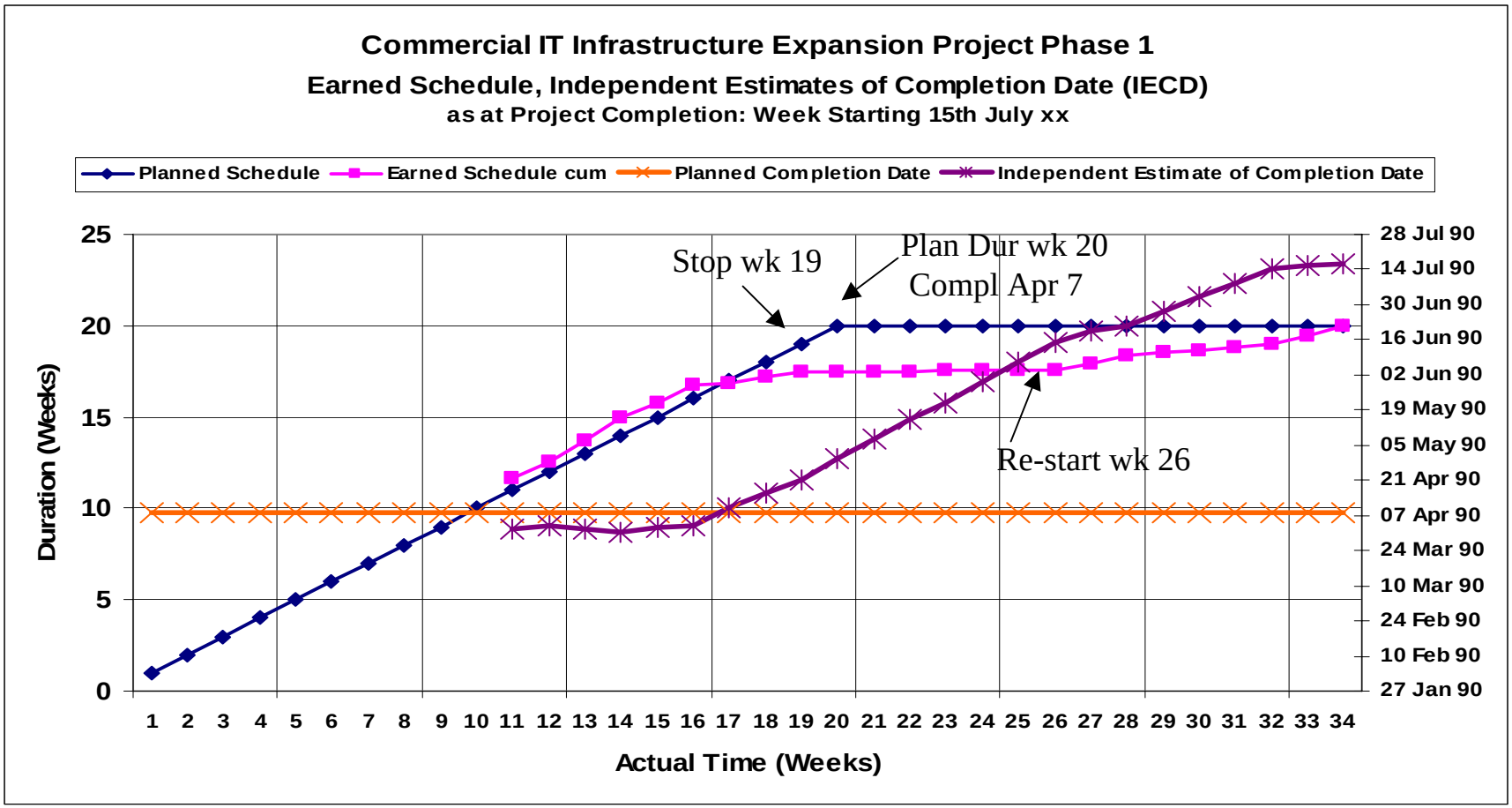
IECD Predictions using ES Techniques: Weekly Plots of *Independent Estimate of Completion Date*



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ES vs EVM Comparison

Earned Schedule	Earned Value
SV(t) and SPI(t) valid for entire project, including early and late finish	SV($) and SPI($) validity limited to early finish projects
Duration based predictive capability analogous to EVM's cost based indicators	Limited prediction capability No predictive capability after planned completion date exceeded
Facilitates Cost – Schedule Management (using EVM and ES)	EVM Management focused to Cost

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Status & Future

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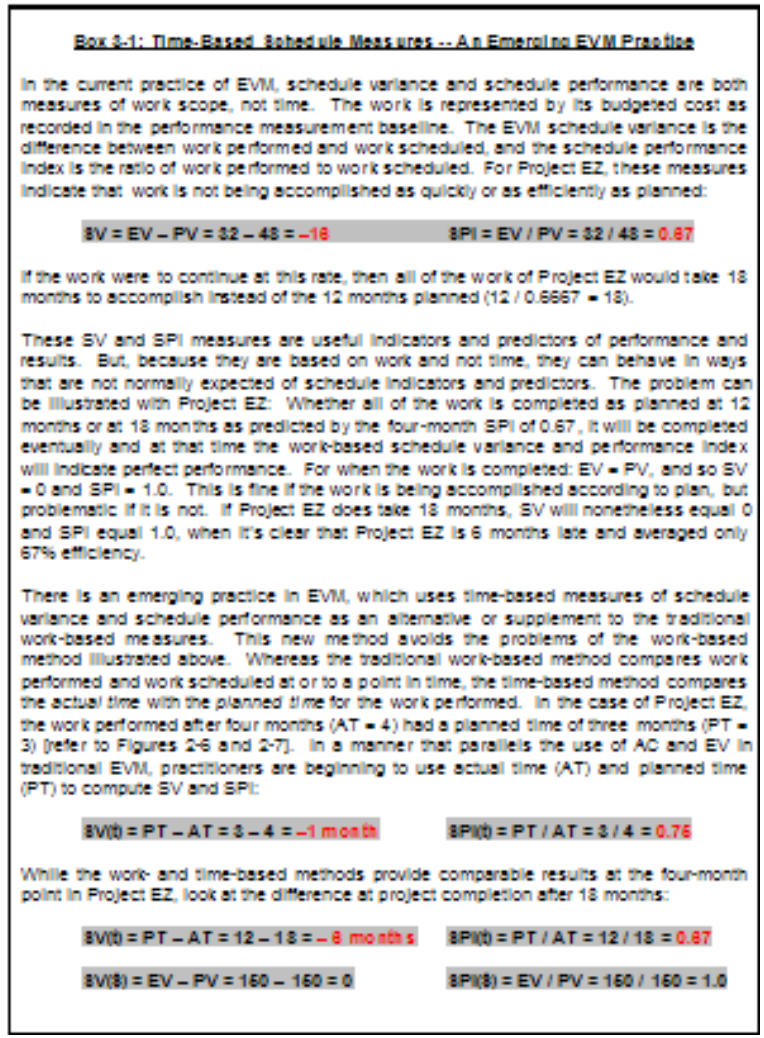
Time-Based Schedule Measures – An Emerging EVM Practice

- **Inclusion of Emerging Practice Insert into PMI - EVM Practice Standard**
  - **Dr. John Singley, VP of CPM**
- **Included in Box 3-1 of EVM Practice Standard**
  - **Describes basic principles of "Earned Schedule"**
  - **Provides foundation for further development of and research intended to result in Earned Schedule acceptance as a valid extension to EVM**
- **EVM Practice Standard released at 2004 IPMC Conference**



Box 3-1: Time-Based Schedule Measures -- An Emerging EVM Practice

In the current practice of EVM, schedule variance and schedule performance are both measures of work scope, not time. The work is represented by its budgeted cost as recorded in the performance measurement baseline. The EVM schedule variance is the difference between work performed and work scheduled, and the schedule performance index is the ratio of work performed to work scheduled. For Project EZ, these measures indicate that work is not being accomplished as quickly or as efficiently as planned:

SV = EV – PV = 32 – 48 = –16 SPI = EV / PV = 32 / 48 = 0.67

If the work were to continue at this rate, then all of the work of Project EZ would take 18 months to accomplish instead of the 12 months planned (12 / 0.6667 = 18).

These SV and SPI measures are useful indicators and predictors of performance and results. But, because they are based on work and not time, they can behave in ways that are not normally expected of schedule indicators and predictors. The problem can be illustrated with Project EZ: Whether all of the work is completed as planned at 12 months or at 18 months as predicted by the four-month SPI of 0.67, it will be completed eventually and at that time the work-based schedule variance and performance index will indicate perfect performance. For when the work is completed: EV = PV, and so SV = 0 and SPI = 1.0. This is fine if the work is being accomplished according to plan, but problematic if it is not. If Project EZ does take 18 months, SV will nonetheless equal 0 and SPI equal 1.0, when it's clear that Project EZ is 6 months late and averaged only 67% efficiency.

There is an emerging practice in EVM, which uses time-based measures of schedule variance and schedule performance as an alternative or supplement to the traditional work-based measures. This new method avoids the problems of the work-based method illustrated above. Whereas the traditional work-based method compares work performed and work scheduled at or to a point in time, the time-based method compares the actual time with the planned time for the work performed. In the case of Project EZ, the work performed after four months (AT = 4) had a planned time of three months (PT = 3) [refer to Figures 2-6 and 2-7]. In a manner that parallels the use of AC and EV in traditional EVM, practitioners are beginning to use actual time (AT) and planned time (PT) to compute SV and SPI:

SV(t) = PT – AT = 3 – 4 = –1 month SPI(t) = PT / AT = 3 / 4 = 0.75

While the work- and time-based methods provide comparable results at the four-month point in Project EZ, look at the difference at project completion after 18 months:

SV(t) = PT – AT = 12 – 18 = – 6 months SPI(t) = PT / AT = 12 / 18 = 0.67

SV($) = EV – PV = 160 – 160 = 0 SPI($) = EV / PV = 160 / 160 = 1.0

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Early Adopters

- **Incorporation of ES into EVM Instruction**
  - Several instruction sources now offer ES "as part of EVM"
- **Requests for information and ES calculator**
  - Calculator provided freely to > 50 requestors
- **Tool vendor interest**
- **Growing evidence of use on <u>real projects</u>**
  - Evidence of use in a number of countries
    - USA, Australia, Sweden, Belgium …
  - Applications across weapons programs, construction, software development, …
  - Range of project size from very small and short to extremely large and long duration

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Foreseen Uses of *Earned Schedule*

- **Enables independent evaluation of schedule estimates: ETC(t), EAC(t)**
  - *Client, Contractor, Program and Project Manager ….*
- **Facilitates insight into network schedule performance**
  - Duration based Schedule indicators
  - Identification of impediments/constraints and potential future rework
  - Evaluation of adherence to plan
- **Improvement to Schedule *and Cost* prediction**
  - *Client, Contractor, Program and Project Manager ….*
- **Application of direct statistical analysis of schedule performance**

Summary

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Summary

- **Derived from EVM data … only**
- **Provides time-based schedule indicators**
- **Indicators do not fail for late finish projects**
- **Application is scalable up/down, just as is EVM**
- **Schedule prediction is better than any other EVM method presently used**
  - **SPI(t) behaves similarly to CPI**
  - **IEAC(t) = PD / SPI(t) behaves similarly to IEAC = BAC / CPI**
- **Facilitates bridging EVM to the schedule**

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2. **"Earned Schedule: A Breakthrough Extension to Earned Value Theory? A Retrospective Analysis of Real Project Data," *The Measurable News*, Summer 2003 [Kym Henderson]**
3. **"Further Developments in Earned Schedule," *The Measurable News*, Spring 2004 [Kym Henderson]**
4. **"Connecting Earned Value to the Schedule," *The Measurable News*, Winter 2004 [Walt Lipke]**
5. **"'Forecasting Project Schedule Completion' by Using Earned Value Metrics" Presentation by Ing. Stephan Vandevoorde, Senior Project Manager, Fabricom Airport Systems, Belgium**
6. **"Earned Schedule in Action", *Publication pending*, [Kym Henderson]**

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