

Earned Schedule in Action

**Achieving RISK LEADERSHIP IN COMPLEX
PROJECT MANAGEMENT**

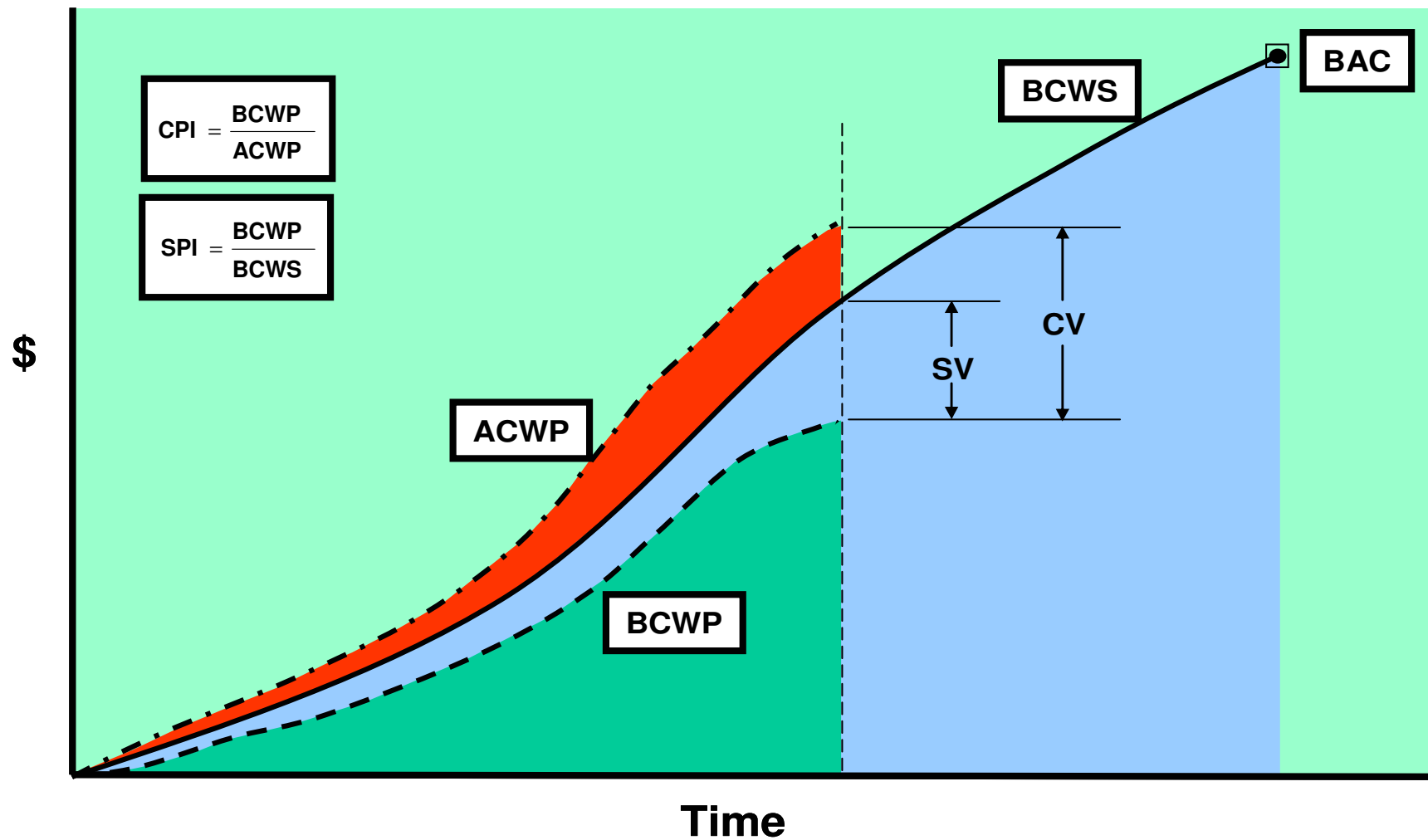
Learning Network Solutions

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EVM Schedule Indicators



EVM Schedule Indicators

- ◆ SV & SPI behave erratically for projects behind schedule
 - SPI improves and concludes at 1.00 at end of project
 - SV improves and concludes at \$0 variance at end of project
- ◆ Schedule indicators lose predictive ability nominally over the last third of the project

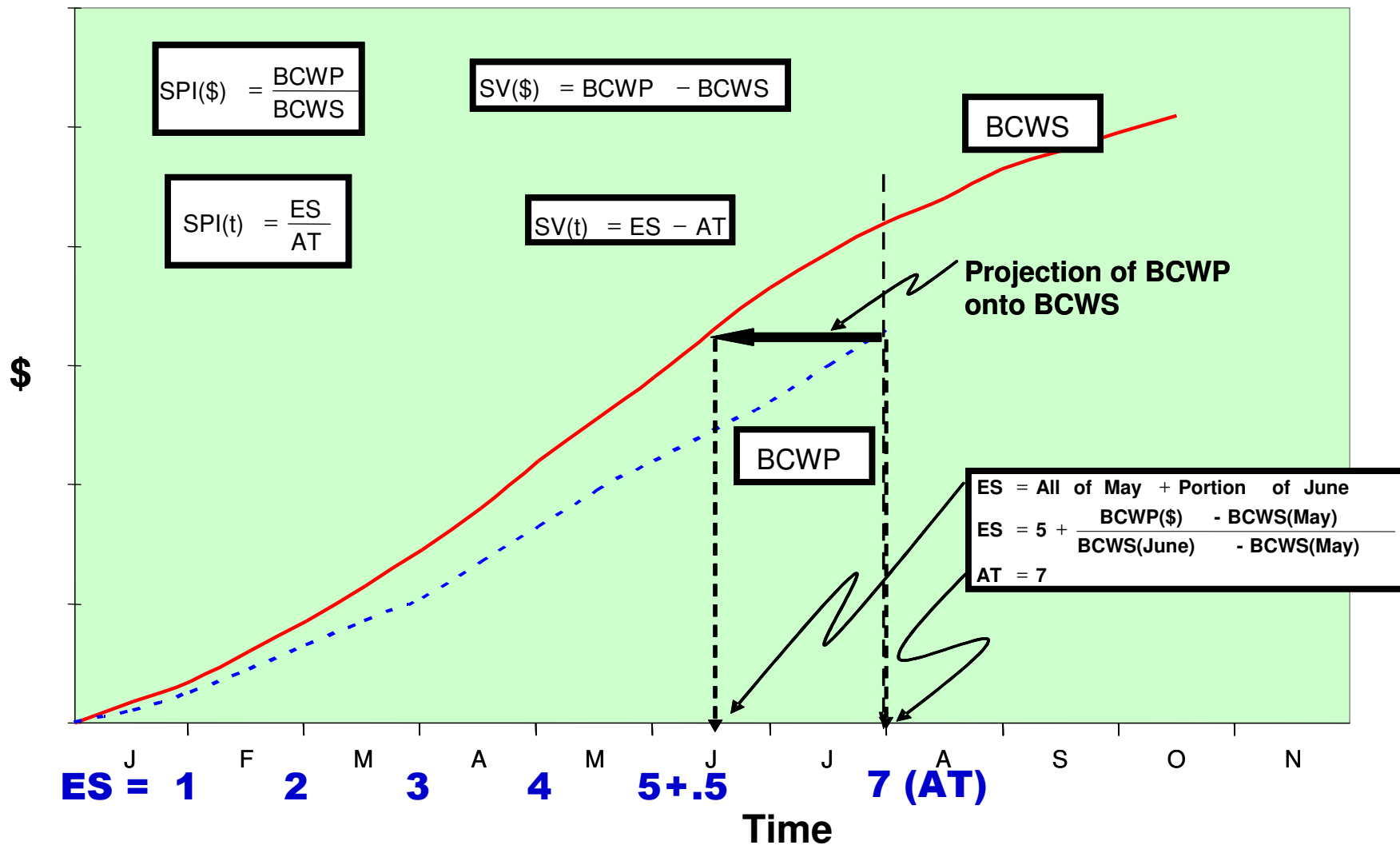
EVM Schedule Indicators

- ◆ Why does this happen?
 - $SV = BCWP - BCWS$
 - $SPI = BCWP / BCWS$
- ◆ At planned completion $BCWS = BAC$
- ◆ At actual completion $BCWP = BAC$
- ◆ When actual completion > planned completion
 - $SV = BAC - BAC = \$000$
 - $SPI = BAC / BAC = 1.00$

Regardless of lateness !!

Introduction to Earned Schedule

Earned Schedule Concept



Earned Schedule Metrics

- ◆ Required measures
 - Performance Management Baseline (PMB) – the time phased planned values (BCWS) from project start to completion
 - Earned Value (BCWP) – the planned value which has been “earned”
 - Actual Time (AT) - the actual time duration from the project beginning to the time at which project status is assessed
- ◆ All measures available from existing EVM data

Earned Schedule Metrics

- ◆ ES_{cum} is the:

Number of completed BCWS time increments BCWP exceeds + the fraction of the incomplete BCWS increment

- ◆ $ES_{cum} = C + I$ where:

C = number of time increments for $BCWP \geq BCWS$

$I = (BCWP - BCWS_C) / (BCWS_{C+1} - BCWS_C)$

- ◆ $ES_{period}(n) = ES_{cum}(n) - ES_{cum}(n-1) = \Delta ES_{cum}$

- ◆ AT_{cum}

AT = Actual Time (time now)

- ◆ $AT_{period}(n) = AT_{cum}(n) - AT_{cum}(n-1) = \Delta AT_{cum}$

ΔAT_{cum} is normally equal to 1

Earned Schedule Indicators

◆ Schedule Variance: $SV(t)$

- Cumulative: $SV(t) = ES_{cum} - AT_{cum}$
- Period: $\Delta SV(t) = \Delta ES_{cum} - \Delta AT_{cum}$

◆ Schedule Performance Index: $SPI(t)$

- Cumulative: $SPI(t) = ES_{cum} / AT_{cum}$
- Period: $\Delta SPI(t) = \Delta ES_{cum} / \Delta AT_{cum}$

Earned Schedule Indicators

- ◆ What happens to the ES indicators, $SV(t)$ & $SPI(t)$, when the Planned project Duration (PD) is exceeded (BCWS = BAC)?

They Still Work ...Correctly!!

- ◆ ES will be $\leq PD$, while $AT > PD$
 - $SV(t)$ will be negative (time behind schedule)
 - $SPI(t)$ will be < 1.00

Reliable Values from Start to Finish !!

Earned Schedule Predictors

- ◆ Long time goal of EVM ... *Prediction of total project duration from present schedule status*
- ◆ Independent Estimate at Completion (time)
 - **$IEAC(t) = PD / SPI(t)$**
 - **$IEAC(t) = AT + (PD - ES) / PF(t)$**
where $PF(t)$ is the Performance Factor (time)
 - Analogous to IEAC used to predict final cost
- ◆ Independent Estimated Completion Date (IECD)
 - **$IECD = \text{Start Date} + IEAC(t)$**

Earned Schedule Key Points

- ◆ ES Indicators constructed to behave in an analogous manner to the EVM Cost Indicators, CV and CPI
- ◆ $SV(t)$ and $SPI(t)$
 - Not constrained by BCWS calculation reference
 - Provide duration based measures of schedule performance
 - Valid for entire project, including early and late finish
- ◆ Facilitates integrated Cost/Schedule Management (using EVM with ES)

Critical Path Study

Critical Path Study Outline

- ◆ **The Scheduling Challenge**
- ◆ **Case Study Project**
 - The project
 - The EVM, Earned Schedule and Network Schedule approach
- ◆ **Earned Schedule vs Critical Path predictors**
- ◆ **Real Schedule Management with Earned Schedule**
 - Initial experience and observations
- ◆ **Conclusion and Final Thoughts**

The Scheduling Challenge

- ◆ **A realistic project schedule is dependent on multiple, often complex factors including accurate:**
 - Estimation of the tasks required,
 - Estimates of the task durations
 - Resources required to complete the identified tasks
- ◆ **Identification and modeling of dependencies impacting the execution of the project**
 - Task dependencies (e.g. F-S process flows)
 - “Dependent” Milestones (internal and external)
 - “Other logic”

The Scheduling Challenge

- ◆ From small projects into large projects and programs, scheduling requirements becomes exponentially more complex
- ◆ Integration
 - Of schedules between “master” and “subordinate” schedules
 - Often across multiple tiers of
 - Activities and
 - Organisationscontributing to the overall program of work
- ◆ Essential for producing a useful integrated master schedule

To further compound schedule complexity

- ◆ **Once an initial schedule baseline has been established progress monitoring inevitably results in changes**
 - Task and activity durations change because “actual performance” does not conform to plan
 - Additional unforeseen activities may need to be added
 - Logic changes as a result of corrective actions to contain slippages; and
 - Improved understanding of the work being undertaken
 - Other “planned changes” (Change Requests) also contribute to schedule modifications over time

Wouldn't it be nice

- ◆ **To be able to explicitly declare “Schedule Reserve” in the project “schedule of record”**
 - Protect committed key milestone delivery dates
- ◆ **To have schedule macro level indicators and predictors**
 - Ideally, derived separately from the network schedule!
 - Provides a means for comparison and validation of the measures and predictors provided by the network schedule
 - An independent predictor of project duration would be a particularly useful metric
 - “On time” completion of projects usually considered important
- ◆ **Just like EVM practitioners have for cost**
 - **The potential offered by Earned Schedule**

Case Study Project

- ◆ **Commercial sector software development and enhancement project**
 - **Small scale:** 10 week Planned Duration
 - **Time critical:** Needed to support launch of revenue generating marketing campaign
 - **Cost budget:** 100% labour costs
- ◆ **Mixture of:**
 - 3 tier client server development
 - Mainframe, Middleware, Workstation
 - 2 tier client server development
 - Mainframe to Workstation direct

The EVM and ES Approach

◆ Microsoft Project 2002 schedule

- Resource loaded for time phased effort and cost estimation
- Control Account – Work Package views developed in the schedule
- Actual Costs captured in SAP time recording system
 - Limited (actual) cost – schedule integration
- Contingency (Management Reserve) managed outside the schedule

◆ Top level Planned Values cum “copied and pasted” into Excel EVM and ES template

- High level of cost – schedule integration achieved

Baseline Schedule: CAP and WP View (Excluding Risk)

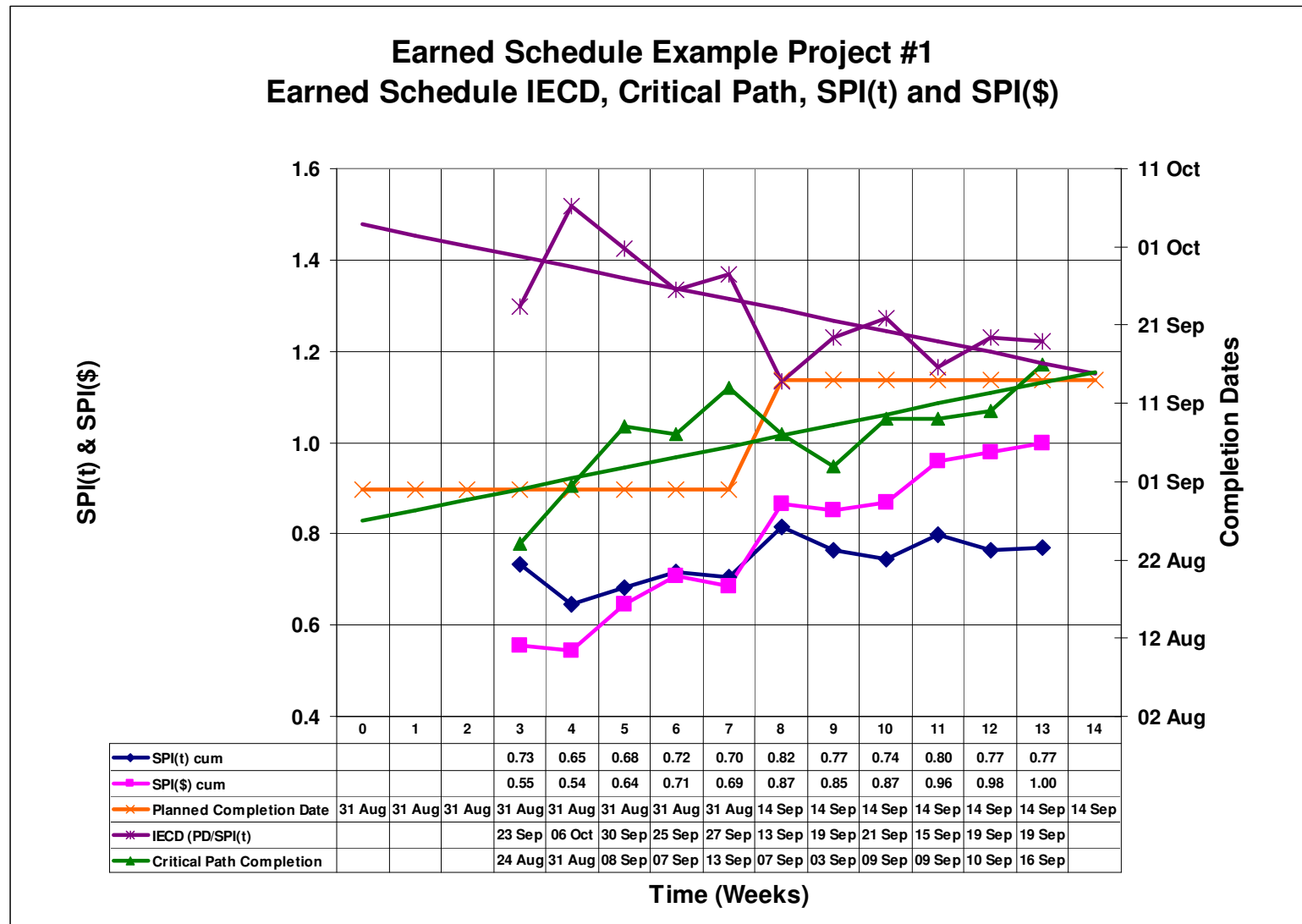
Task Name	Baseline Work	Baseline Cost	Duration	Details	July	August	September
Project: ES Example #1 Initial Baseline Schedule	1,675 hrs	\$167,857	87 days	Cost	\$74,084	\$57,310	
				Cum. Cost	\$75,852	\$133,162	\$133,162
CAP 1 PROJECT MANAGEMENT	297 hrs	\$38,610	44 days	Cost	\$14,139	\$17,680	
				Cum. Cost	\$15,907	\$33,587	\$33,587
CAP 5 BUSINESS REQUIREMENTS	192 hrs	\$0	34 days	Cost			
				Cum. Cost	\$0	\$0	\$0
CAP 7 SOLUTION DESIGN	160 hrs	\$16,567	9.5 days	Cost	\$6,367		
				Cum. Cost	\$6,367	\$6,367	\$6,367
CAP 8 BUILD & UNIT TEST	720 hrs	\$77,760	30.25 days	Cost	\$45,128	\$13,760	
				Cum. Cost	\$45,128	\$58,888	\$58,888
01 Mainframe Stream 1	192 hrs	\$24,960	19.38 days	Cost	\$12,168		
				Cum. Cost	\$12,168	\$12,168	\$12,168
02 Mainframe Stream 2	64 hrs	\$6,400	10 days	Cost	\$4,240		
				Cum. Cost	\$4,240	\$4,240	\$4,240
03 Frontend	104 hrs	\$10,400	19 days	Cost	\$7,920	\$1,440	
				Cum. Cost	\$7,920	\$9,360	\$9,360
04 Connect	40 hrs	\$4,000	6.25 days	Cost	\$4,000		
				Cum. Cost	\$4,000	\$4,000	\$4,000
05 Database	8 hrs	\$800	1.25 days	Cost	\$800		
				Cum. Cost	\$800	\$800	\$800
06 Middle Tier	208 hrs	\$20,800	25 days	Cost	\$12,320	\$6,880	
				Cum. Cost	\$12,320	\$19,200	\$19,200
07 Reporting	104 hrs	\$10,400	21.5 days	Cost	\$3,680	\$5,440	
				Cum. Cost	\$3,680	\$9,120	\$9,120
CAP 9 SYSTEM TEST	104 hrs	\$13,520	29.06 days	Cost	\$8,450	\$5,070	
				Cum. Cost	\$8,450	\$13,520	\$13,520
CAP 10 UAT	45 hrs	\$5,040	3.75 days	Cost		\$5,040	
				Cum. Cost		\$5,040	\$5,040
CAP 11 PRODUCTION IMPLEMENTATION	96 hrs	\$10,260	11.81 days	Cost		\$10,260	
				Cum. Cost		\$10,260	\$10,260

Schedule Management

- ◆ **Weekly schedule updates from week 3 focusing on:**
 - Accurate task level percentage work completion updates
 - The project level percentage work completion (cumulative) calculated by Microsoft Project
 - Percentage work complete transferred to the EVM and ES template to derive the progressive Earned Value (cumulative) measures
- ◆ **Schedule review focusing on critical path analysis**
 - Schedule updates occurred as needed with
 - Revised estimates of task duration and
 - Changes to network schedule logic
 - particularly when needed to facilitate schedule based corrective action
- ◆ **Actual costs entered into the EVM template as they became available (~ weekly)**

An Integrated Schedule Analysis Chart

Critical Path, IECD, SPI(t) and SPI(\$\$) on one page



Schedule Analysis

◆ Initial expectation

- The critical path predicted completion date would be more pessimistic than the IECD

◆ In fact

- The ES IECD trend line depicted a “late finish” project with improving schedule performance
- The critical path predicted completion dates showed an “early finish project” with deteriorating schedule performance

◆ Became the “critical question” in Week 8

- ES IECD improvement trend reversed
- Continued deterioration in the critical path predicted completion dates

Schedule Analysis Result

- ◆ **IECD the more credible predictor in this circumstance**
 - Work was not being accomplished at the rate planned
 - No adverse contribution by critical path factors
 - e.g. Externally imposed delays caused by “dependent milestone”
- ◆ **Two weeks schedule delay communicated to management**
 - Very late delay of schedule slippage a very sensitive issue
- ◆ **Corrective action was immediately implemented**
 - Resulted in two weeks progress in one week based on IECD improvement in week 9
 - Project substantively delivered to the revised delivery date

The IECD vs Critical Path Predictors

- ◆ **Network schedule updates do not usually factor past (critical path) task performance into the future**
 - Generally concentrate on the current time window
 - Task updates
 - Corrective action to try and contain slippages
 - **Critical path predicted completion date is not usually calibrated by past actual schedule performance**
- ◆ **The ES IECD**
 - Cannot directly take into account critical path information
 - **BUT does calibrate the prediction based on historic schedule performance as reflected in the SPI(t)**

Further Observations

- ◆ **Much has been written about the consequences of not achieving work at the EVM rate planned**
 - At very least, incomplete work needs to be rescheduled ...
 - Immediate critical vs non critical path implication requires detailed analysis of the network schedule
 - Sustained improvement in schedule performance is a difficult challenge
 - SPI(t) remained in the .7 to .8 band for the entire project!
 - In spite of the corrective action and recovery effort
 - **Any task delayed eventually becomes critical path if not completed!**
- ◆ **SPI(t) a very useful indicator of schedule performance**
 - **Especially later in the project when SPI(\$) resolving to 1.0**

Questions of Scale

- ◆ **We know that ES is scalable as is EVM**
 - Issues of scale did not arise due to small size of the project
- ◆ **Detailed analysis of the ES metrics is required**
 - The same as EVM for cost
 - The “masking” or “washout” effect of negative and positive ES variances at the detailed level can be an issue
 - The same as EVM for cost
- ◆ **Apply Earned Schedule to the Control Accounts and Work Packages on the critical path**
 - And “near” critical path activities
- ◆ **Earned Schedule augments network schedule analysis – it doesn’t replace it**
 - Just as EVM doesn't replace a bottom up ETC and EAC

Real Schedule Management with Earned Schedule

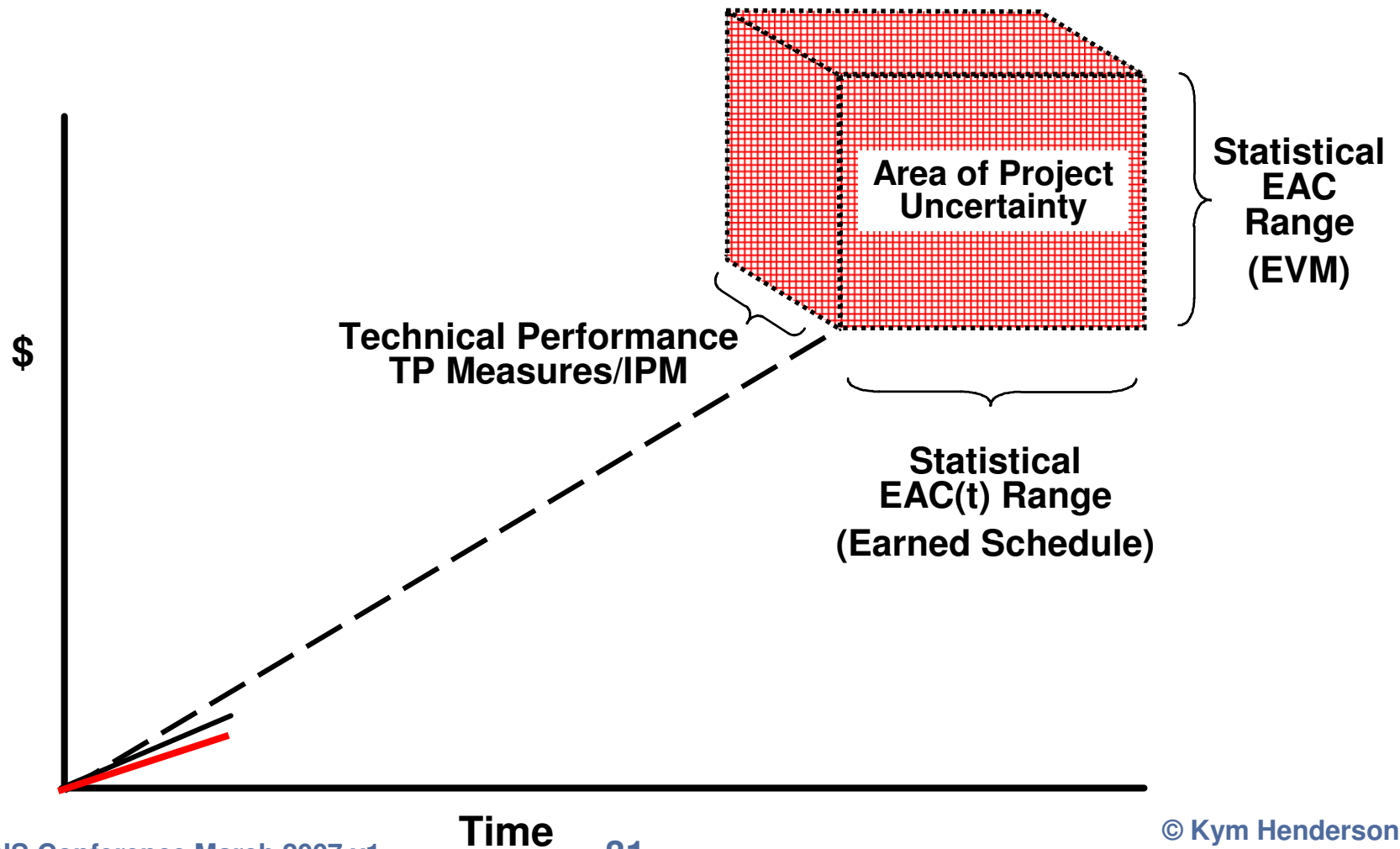
- ◆ **ES is of considerable benefit in analysing and managing schedule performance**
- ◆ **The “time critical” dichotomy of working to “optimistic” predicted task completions and setting and reporting realistic completion dates was avoided**
 - ES metrics provided an independent means of sanity checking the critical path predicted completion date
 - **Prior to communicating overall schedule status to management**
- ◆ **ES focused much more attention onto the network schedule than using EVM alone**

Final Thoughts

- ◆ **ES is expected be of considerable value to the schedule management for large scale projects and programs**
 - Exponential increase in the network scheduling complexities which is both
 - Unavoidable and essential on those programs which means
 - **The need and benefits of independent techniques to sanity check schedules of such complexity is much greater**
- ◆ ***ES is anticipated to become the “bridge” between EVM and the Network Schedule***

Earned Value, Earned Schedule & TPM

An integrated solution for managing project uncertainty



Available Resources

Publications

1. “Schedule is Different,” *The Measurable News*, March & Summer 2003 [Walt Lipke]
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. “Earned Schedule in Action,” *The Measurable News*, Spring 2005 [Kym Henderson]
6. “Not Your Father’s Earned Value,” *Projects A Work*, February 2005 [Ray Stratton]

<http://sydney.pmichapters-australia.org.au/>

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Presentations

1. Earned Schedule – An Emerging Practice, 16th IIPM Conference, November 2004 [Walt Lipke, Kym Henderson]
2. Schedule Analysis and Predictive Techniques Using Earned Schedule, 16th IIPM Conference, November 2004 [Walt Lipke, Kym Henderson, Eleanor Haupt]
3. Earned Schedule – an Extension to EVM Theory, EVA-10 Conference (London), May 2005 [Walt Lipke, Kym Henderson]
4. Forecasting Project Schedule Completion by Using Earned Value Metrics, EVM Training at Ghent University (Belgium), January 2005 [Stephan Vandevoorde]

<http://sydney.pmichapters-australia.org.au/>

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Presentations

5. New Concept in Earned Value – *Earned Schedule*, PMI Southeast Regional Conference, June 2005 [Robert Handshuh]
6. Forecasting Project Schedule Completion by Using Earned Value Metrics, Early Warning Signals Congress (Belgium), June 2005 [Stephan Vandevoorde, Dr. Mario Vanhoucke]

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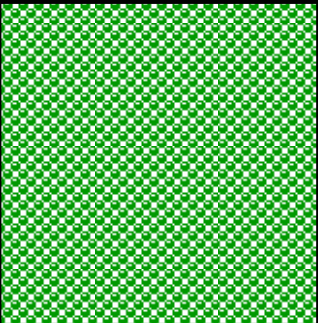
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Calculator & Analysis Tools

- ◆ **Freely provided upon email request**
 - Application assistance if needed
- ◆ **Please respect copyright ©**
- ◆ **Feedback requested**
 - Improvement / Enhancement suggestions
 - Your assessment of value to Project Managers
 - Disclosure of application and results (with organization permission and/or anonymously)

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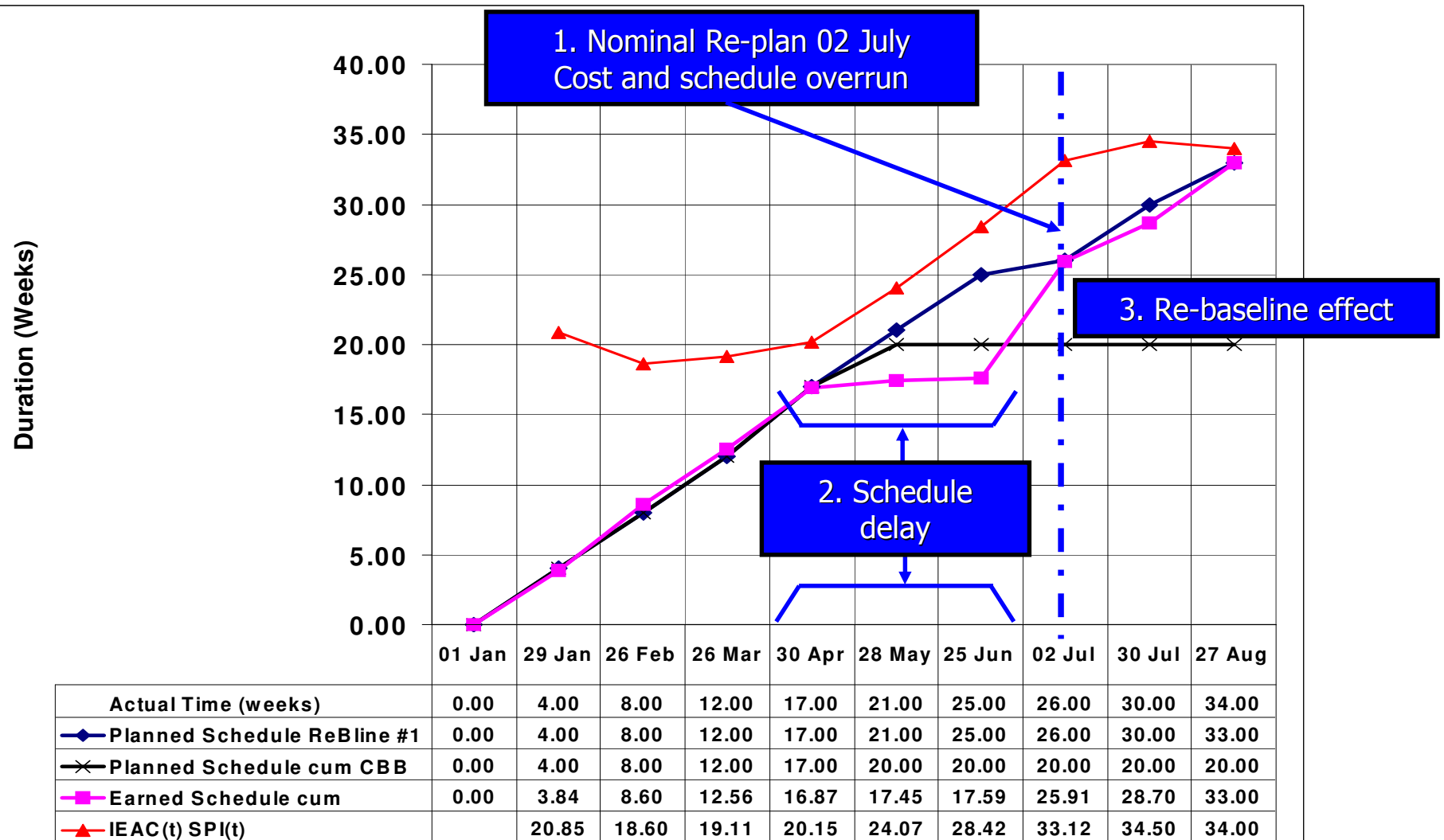
Appendix: ES and Re-Baselining

ES and Re-Baselining

- ◆ **ES indicators are affected by re-baselining**
 - Behaviour of $SV(t)$ and $SPI(t)$ is analogous to CV and CPI
 - See examples
- ◆ **PMB change affects schedule prediction similarly to cost**
- ◆ **Earned Schedule brings attention to the potential schedule impact of a declared “cost only” change**

Earned Schedule – Re-Baseline Example

Real project data – nominal re-baseline



Earned Schedule – Re-Baseline Example

CV , $SV(\$)$ and $SV(t)$

