



# Agile Methods with Performance-Based Earned Value

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**Systems & Software Technology Conference**  
**Salt Lake City** **April 20, 2009**



# Agenda

- **Customer wants valid Earned Value (EV)**
- **Agile methods and EV**
- **DOD, CMMI and Systems Engineering guidance**
- **Incremental functionality**
- **Scrum application**
- **Agile EV Summary**



# Value of Earned Value



**EVM data will be reliable and accurate only if:**

- **The right base measures of technical performance are selected**
- and
- **Progress is objectively assessed**

**PB-EV link, *Integrating SE with EVM*, Defense AT&L Magazine, May 2004**



# EVM Not Working for DOD

## 7/07 USD AT&L Memo, *Use of EVM in the DOD*

- Use of EVM ...department-wide, is **insufficient**
- EVM is **not serving** its intended function in the internal control process

## 2/08 Dept. of the Navy Memo, *EVM Reviews*

- Broad deficiencies in EVM compliance
  - **Failure** to manage and document **changes to the baseline**
  - **Lack of integration** across the cost, schedule, and work authorization systems
  - **Intentional masking** of cost and schedule *variances*
  - **Inadequate reporting** of EAC



# Deficiencies in Use of EVM

GAO Report	Title	Findings and Recommendations
08-448	<b>Defense Acquisitions: Progress Made in Fielding Missile Defense, but Program Short of Meeting Goals (Missile Defense Agency (MDA))</b>	<p><b><u>Deferred Functionality</u></b>  <b>MDA <i>did not track</i> the cost of work <i>deferred</i> from one block to another.</b></p> <ul style="list-style-type: none"> <li>• <b>Cost of first block understated.</b></li> <li>• <b>Cost of second block overstated.</b></li> </ul>



# Agile Methods and EV



# Agile Methods Characteristics

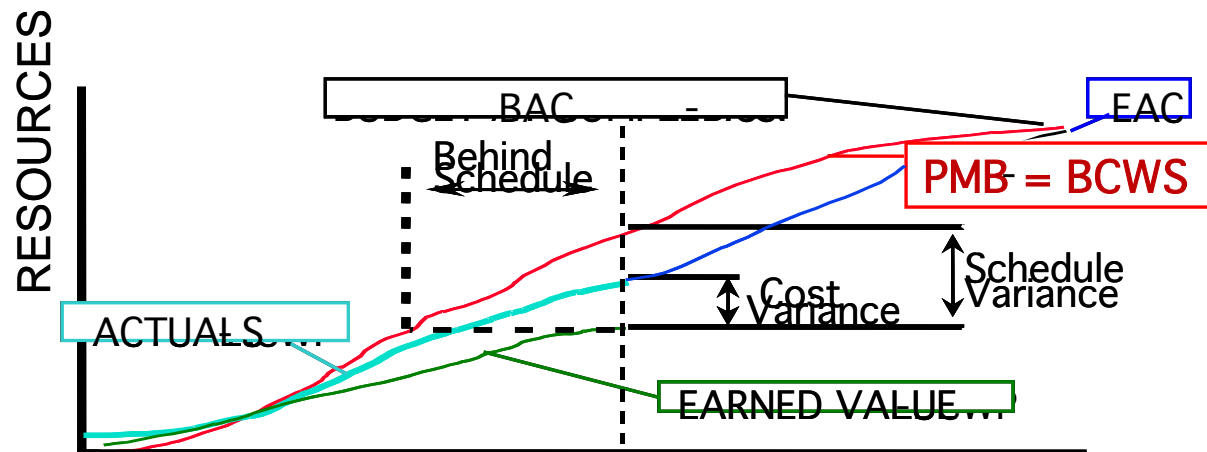
- **Next iteration of work is detail planned in work package**
- **Product burndown is a planning package for remaining features**
- **Features often deferred from the current iteration to the product burndown**
- **Features and priorities frequently revised**



# Agile and EVMS Constraints

But EVMS Guideline requires *maintaining* the Performance Measurement Baseline (**PMB**)

- Time-phased scope, schedule, and associated budget through the end of the contract (a)



(a) National Defense Industrial Association, EVMS Intent Guideline 8





# Agile Focus on Near Term May Break Link with PMB

***Giving full credit to meeting near term goals***

- ***May break link with the PMB***
- ***Loses track of progress of plan to satisfy requirements***





# **DOD, CMMI and Systems Engineering Guidance Augment EVMS, Support Agile**



# DOD Guides: Technical Baselines

**DoDI 5000.02, Operation of the Defense Acquisition System (POL), 12/2008**

**Defense Acquisition Guidebook (DAG) 10/8/04**

**Systems Engineering Plan (SEP) Preparation Guide 4/08**

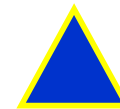
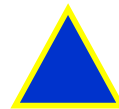
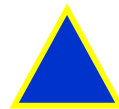
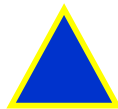
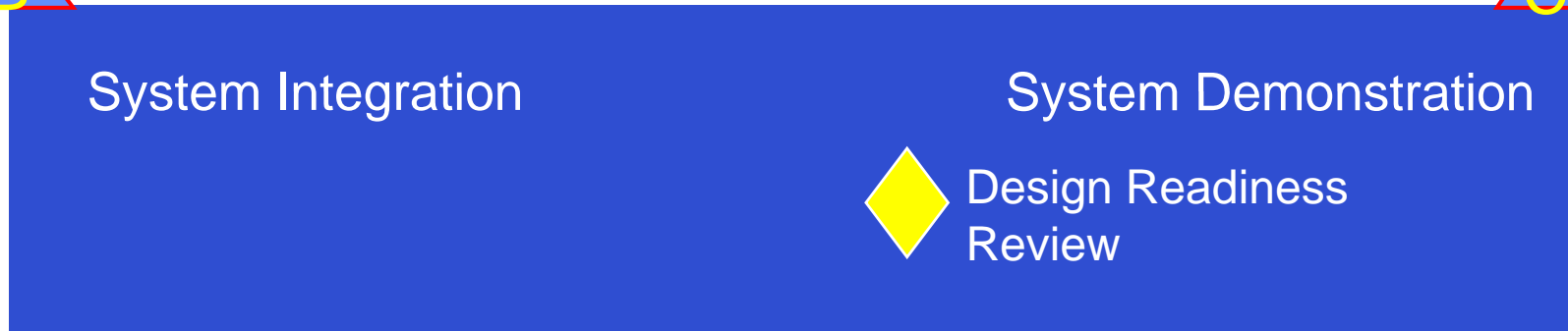
**WBS Handbook, Mil-HDBK-881A (WBS) 7/30/05**

**Integrated Master Plan (IMP) & Integrated Master Schedule Preparation & Use Guide (IMS) 10/21/05**

**Guide for Integrating SE into DOD Acquisition Contracts (Integ SE) 12/06**



# Technical Baselines



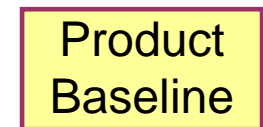
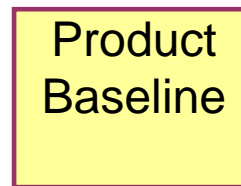
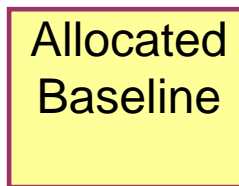
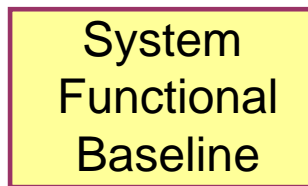
SFR

PDR

CDR

PRR

DAG:



IEEE 1220: Validated Requirements      Verified Physical Architecture

PMBOK Guide: Performance Measurement Baseline (PMB) including *technical and quality parameters*



# Technical Baselines

<b>DoD Policy or Guide</b>	<b>POL</b>	<b>DAG</b>	<b>SEP</b>	<b>WBS</b>	<b>IMP/ IMS</b>	<b>Integ SE</b>
<b>Technical Reviews:</b>						
<b>Event-driven timing</b>	X	X	X	X	X	X
<b>Success criteria</b>	X	X	X	X	X	X
<b>Include entry and exit criteria in IMP and IMS</b>			X			X
<b>Assess technical maturity</b>		X	X	X		X



# Guidance from SE Standards and CMMI

- **Processes for Engineering a System (ANSI/EIA-632)**
- **Standard for Application and Management of the SE Process (IEEE 1220)**
- **Capability Maturity Model Integration (CMMI®)**
  - **CMMI for Development, Version 1.2**
  - **CMMI for Acquisition, Version 1.2**





# CMMI: Traceability




- CMMI: Traceability and consistency

## Requirements



## Work

### •Project Plans

Task 1 

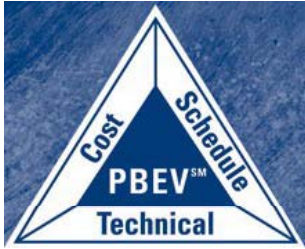
Task 2 

Task 3 

### •Activities

### •Work Products

Source: CMMI Requirements Management Process Area (PA), Specific Practice (SP) 1.5



# CMMI

- **CMMI Process and Product Quality Assurance PA, SP 1.2**
  - *Objectively* evaluate work products against **clearly stated criteria**
  - *Evaluate at* **selected milestones in their development**





# Requirements and Product Metrics

<u>IEEE 1220</u>	<u>EIA-632</u>
6.8.1.5 Performance-based progress measurement	4.2.1 Req. 10: Progress against requirements
<p>6.8.1.5 d) Assess</p> <ul style="list-style-type: none"> <li>• <i>Development maturity</i></li> <li>• Product's ability to <i>satisfy requirements</i></li> </ul> <p>6.8.6 <b>Product metrics at pre-established control points:</b></p> <ul style="list-style-type: none"> <li>• Evaluate system <i>quality</i></li> <li>• <b>Compare to planned goals and targets</b></li> </ul>	<p>Assess <i>progress ...</i></p> <ul style="list-style-type: none"> <li>• Compare system definition <i>against requirements</i></li> </ul> <p>a) Identify <b>product metrics</b> and <i>expected values</i></p> <ul style="list-style-type: none"> <li>▪ <i>Quality</i> of product</li> <li>▪ <b>Progress towards satisfying requirements</b></li> </ul> <p>d) <i>Compare</i> results against requirements</p>



# Incremental Functionality



# Incremental Software Capability

- Document baseline content of each build
  - Testable, functional requirements (TR)
- Establish build milestones and completion criteria
- Establish work packages and EV metrics for builds
- Take EV based on enabling work products and functionality *achieved*
- Account for deferred (to next build) functionality

PB-EV [link](#), *PBEV Webinar*, DOD Data and Analysis Center for Software (DACS), August 2008





# Internal Replanning of Deferred Functionality

- If build is released short of planned functionality:
  - Take partial EV and leave work package open
  - or
  - Take partial EV and close work package
    - Transfer deferred scope and budget to first month of work package for next build
      - EV mirrors technical performance
      - Schedule variance retained
    - Disclose shortfall and slips on higher schedules





# Example: Deferred Functionality

**SOW: Software Requirements in 2 Builds:**

<u>Build</u>	<u>Allocated TRs</u>	<u>Budget/TR</u>	<u>BAC</u>
<b>A</b>	<b>100</b>	<b>5</b>	<b>500</b>
<b>B</b>	<b>60</b>	<b>5</b>	<b>300</b>



# SW Build Plan

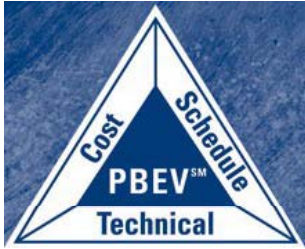
	Jan	Feb	Mar	Apr	May	Jun	Jul	Total
<b>Build A</b>								
<b>Planned Reqs. met</b>	<b>25</b>	<b>25</b>	<b>25</b>	<b>25</b>				<b>100</b>
<b>Budget/Req.: 5 hours</b>								
<b>BCWS current (cur)</b>	<b>125</b>	<b>125</b>	<b>125</b>	<b>125</b>				<b>500</b>
<b>BCWS cumulative (cum)</b>	<b>125</b>	<b>250</b>	<b>375</b>	<b>500</b>				<b>500</b>
<b>Build B</b>								
<b>Planned Reqs. Met</b>					<b>20</b>	<b>20</b>	<b>20</b>	<b>60</b>
<b>BCWS cur</b>					<b>100</b>	<b>100</b>	<b>100</b>	<b>300</b>



# Deferred Functionality Status

	Jan	Feb	Mar	Apr	Total
<b>Build A</b>					
Planned Reqs. Met cur	25	25	25	25	100
Actual Reqs. Met cur	20	20	25	25	90
BCWS cur	125	125	125	125	500
EV cur	100	100	125	125	450
BCWS cum	125	250	375	500	
EV cum	100	200	325	450	
<b>Schedule variance (SV):</b>					
Reqs. Met	-5	-10	-10	-10	
SV	-25	-50	-50	-50	

**Release  
Build A.  
Move 10 reqs  
to Build B.**



# Deferred Functionality Replan

	Apr	May	Jun	Jul	Total
<b>Close Build A work package</b>					
<b>Schedule variance (cum.):</b>					
Req Not Met	- 10				-10
BCWP remaining	- 50				-50
<b>Build B</b>					
<b>Before Replan</b>					
Planned Req Met		20	20	20	60
BCWS cur		100	100	100	300
<b>Plus transfer budget from Build A:</b>					
Req Not Met		+10			
BCWP remaining		+50			
<b>After replan:</b>					
Planned Req Met		30	20	20	70
BCWS cur		150	100	100	350

**Transfer to 1<sup>st</sup> month of receiving work package to retain schedule variance**





# Deferred Functionality Status

	May	Jun	Jul	Total
<b>Build B After Replan:</b>				
<b>Planned Reqs. Met</b>	<b>30</b>	<b>20</b>	<b>20</b>	<b>70</b>
<b>BCWS cur</b>	<b>150</b>	<b>100</b>	<b>100</b>	<b>350</b>
<b>Actual Reqs. Met cur</b>	<b>20</b>			<b>20</b>
<b>EV cur</b>	<b>100</b>			<b>100</b>
<b>Schedule variance cum:</b>				
<b>Reqs. Met</b>	<b>-10</b>			
<b>SV</b>	<b>-50</b>			

**May status: 20 reqs met, but still behind schedule**



# Scrum Application





# Sprint Review Meeting

## Replanning/EV Actions

- **Agree on features that were not delivered**
- **Product Owner reviews/changes priorities of Product Breakdown Items (PBI)**
- **Better understanding of needed features**
- **Revise Estimate at Completion (EAC)**
- **Develop revised Product Backlog and burndown chart**



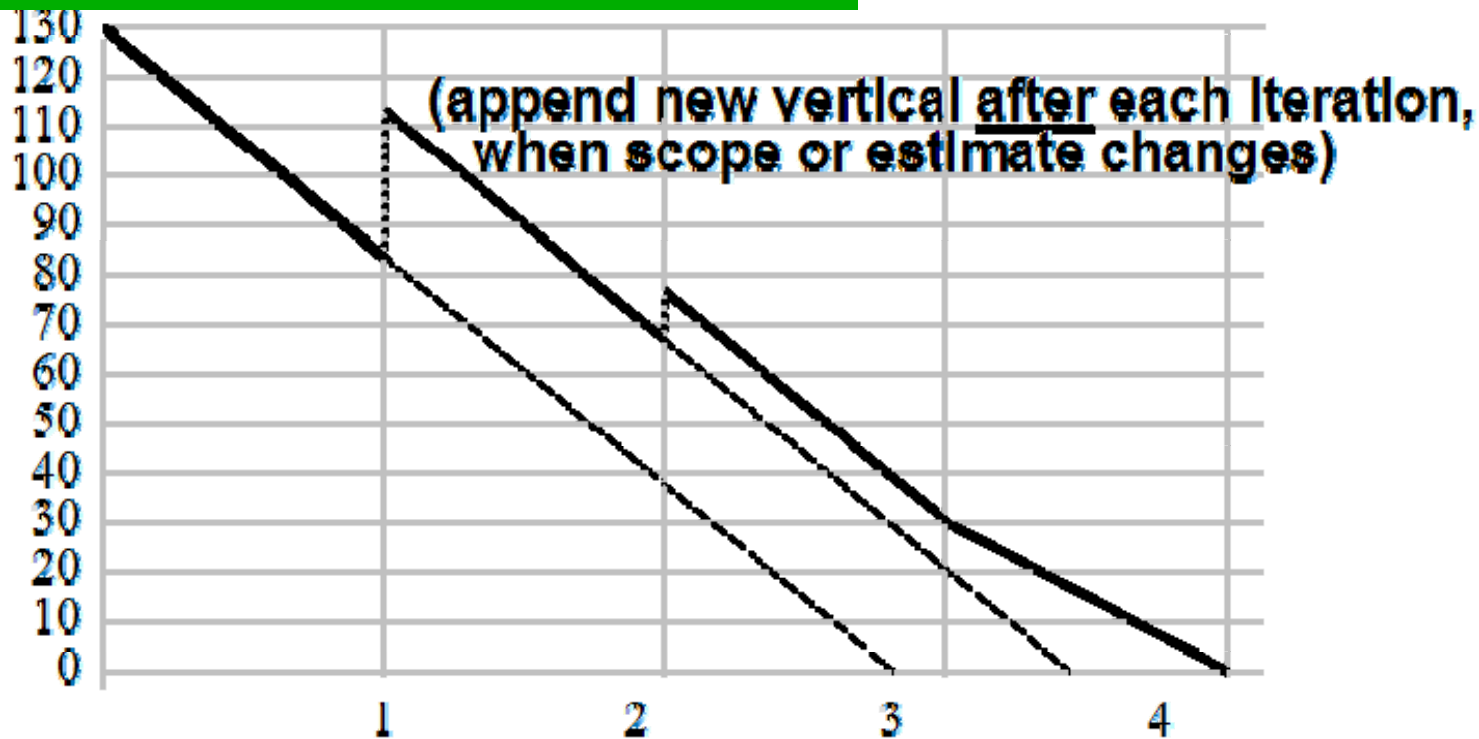
# Burndown Chart

- **How many features remain to be completed**
- **Captures scope change**
- **“Features” to be developed could be story points, use cases or other nonfunctional requirements**
- **“Completion” based on acceptance or unit tests passed**



# Burndown Chart

**# of PBIs still to complete**



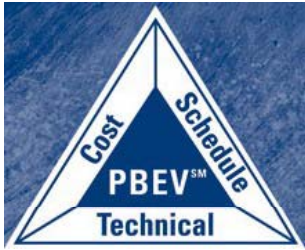
Burndown chart showing scope or estimate increase after each iteration. From A. Cockburn, *Crystal Clear*.



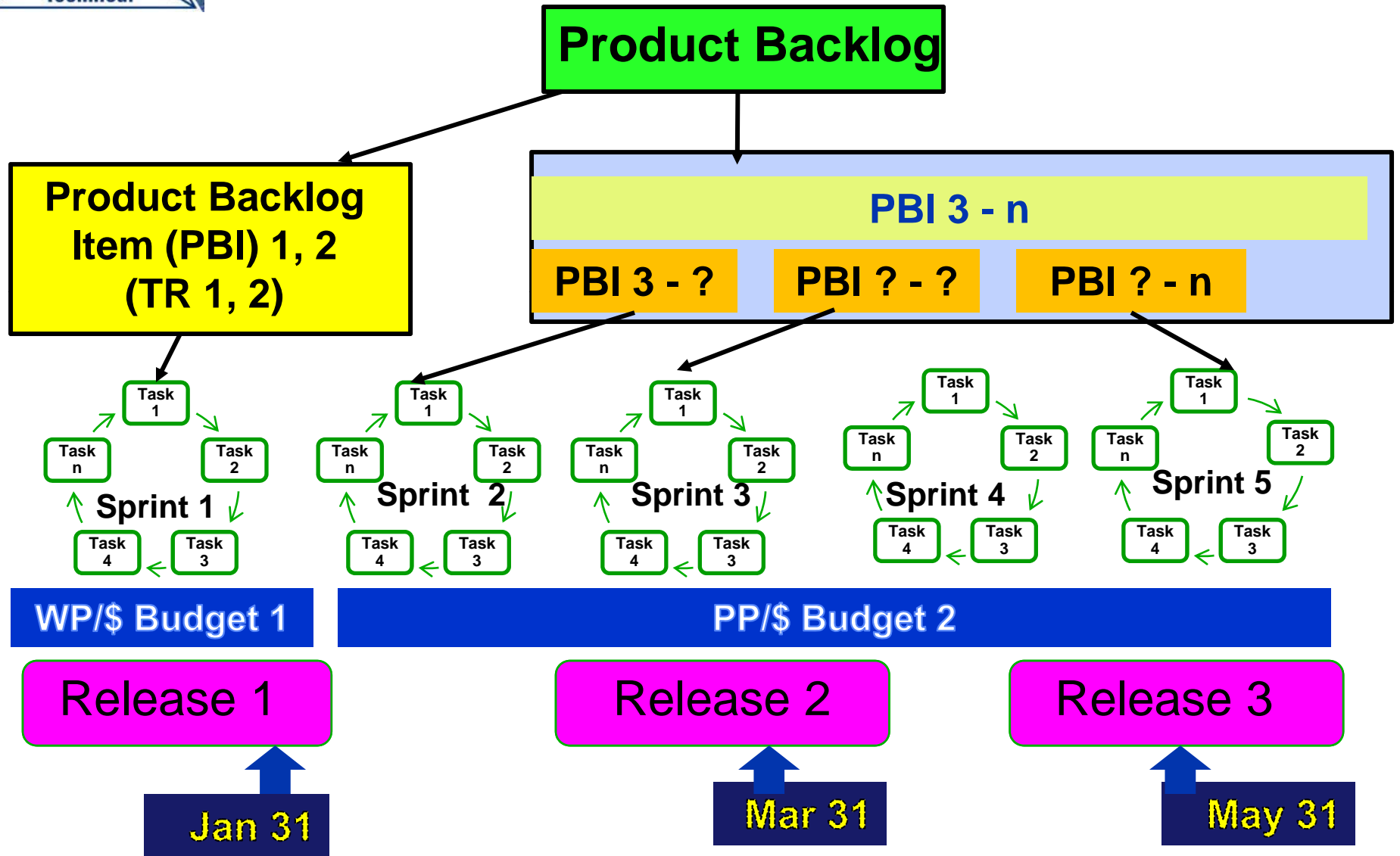
# Sprint Review Meeting: EV Constraints

## Budget baseline considerations

- **Most features/PBIs are derived requirements**
  - **Derived from higher level functionality**
  - **Features changes usually do not change contract scope or total budget**
- **Maintain PMB and technical baseline**
- **Account for deferred features**
  - **Transfer budget with SOW**
  - **Maintain schedule variance (SV)**



# Agile Method





# Constraints & Assumptions 1/2

## Baseline Constraints/Assumptions:

- **Set of TRs = Product Backlog Items (PBIs)**
- **Functionality/PBIs traceable to**
  - **Releases**
  - **Modules**
- **Baseline Release milestones established**
- **Budget allocated to**
  - **3 Releases (Rel)**
  - **4 Modules (Mod)**
  - **11 PBIs**





## Constraints & Assumptions (2/2)

### Baseline Constraints/Assumptions (continued):

- **Budget = 5,000 hours**
- **Budget based on estimated hours/PBI**
- **Each PBI has 5 features**
  - **Each feature has equal estimated hours**
- **Sprint 1 in a work package (WP)**
- **Future sprints in a planning package (PP)**
- **Period of Performance : Jan 1 – May 31**



# Product Backlog

Release	Function	PBI	Priority	Function
<b>1</b>	<b>Login</b>	<b>1</b>	<b>1</b>	<b>Validate member's pin number</b>
	<b>and</b>	<b>2</b>	<b>2</b>	<b>Withdraw Menu</b>
	<b>Menu</b>	<b>3</b>	<b>3</b>	<b>Deposit Menu</b>
		<b>4</b>	<b>4</b>	<b>Balance Inquiry Menu</b>
		<b>5</b>	<b>5</b>	<b>Access Funds in Other Banks/Credit Cards</b>
		<b>6</b>	<b>6</b>	<b>Transfer Between Accounts</b>
<b>2</b>	<b>Withdraw</b>	<b>7</b>	<b>7</b>	<b>Enter Amount</b>
	<b>Functions</b>	<b>8</b>	<b>8</b>	<b>Select Fast Pay Amount</b>
		<b>9</b>	<b>9</b>	<b>Select Account (Checking, Savings)</b>
<b>3</b>	<b>Deposit</b>	<b>10</b>	<b>10</b>	<b>Enter Amount</b>
	<b>Functions</b>	<b>11</b>	<b>11</b>	<b>Select Account (Checking, Savings)</b>



# Plan

Function/ Release	Module	PBI	Est./ PBI	Features/Month					Total
				Jan	Feb	Mar	Apr	May	
<b>1</b>	<b>1</b>	<b>1</b>	200	<b>1-5</b>					
		<b>2</b>	200	<b>1-5</b>					
	<b>2</b>	<b>3</b>	250	<b>1-5</b>					
		<b>4</b>	150	<b>1-5</b>					
		<b>5</b>	300	<b>1-5</b>					
		<b>6</b>	<u>100</u>	<b>1-5</b>					
<b>Total/Rel</b>			<b>1200</b>						
<b>2</b>	<b>3</b>	<b>7</b>	500		<b>1-5</b>				
		<b>8</b>	600		<b>1-3</b>	<b>4,5</b>			
		<b>9</b>	<u>900</u>			<b>1-5</b>			
<b>Total/Rel</b>			<b>2000</b>						
<b>3</b>	<b>4</b>	<b>10</b>	800				<b>1-5</b>		
		<b>11</b>	<u>1000</u>				<b>1,2</b>	<b>3-5</b>	
<b>Total/Rel</b>			<b>1800</b>						
<b>Total</b>			<b>5000</b>						
<b>BCWS/Month</b>				<b>1200</b>	<b>860</b>	<b>1140</b>	<b>1200</b>	<b>600</b>	<b>5000</b>



# Accomplishment & EV Status

## 1 Determine EV and conduct Sprint Review at end of Sprint 1, Jan. 31

- All PBIs completed except PBI #5
- PBI #5, **Access other funds**: 2 of 5 features completed
- Customer adds 3 new features to existing functions/backlog
- Customer decision on remaining features:

Remaining Features	Decision	EV/budget impact
1. Draw cash from other bank accounts	Defer	Behind schedule: <ul style="list-style-type: none"><li>• Transfer to backlog</li><li>• Maintain SV</li></ul>
4. Draw cash from affiliated credit cards 5. Draw cash from other credit cards	Descope	Behind schedule: <ul style="list-style-type: none"><li>• Transfer to new features</li><li>• Maintain SV</li></ul>



# EV and Schedule Variance

Function/ Release	TR	Est./ TR	<u>Features/Month</u>					Total
			Jan EV	Feb	Mar	Apr	May	
1	1-4, 6	900	900					
	5	300	300, 120 or 0?					
<b>Total/Rel</b>		<b>1200</b>						
2	7	500		500				
	8	600		360	240			
	9	900			900			
<b>Total/Rel</b>		<b>2000</b>						
3	10	800				800		
	11	1000				400	600	
<b>Total/Rel</b>		<b>1800</b>						
<b>Total</b>		<b>5000</b>						
<b>BCWS/Month</b>			1200	860	1140	1200	600	5000
<b>Schedule Variance?</b>			0, -180, -300?					



# Agile EV Summary



# Agile EV Constraints

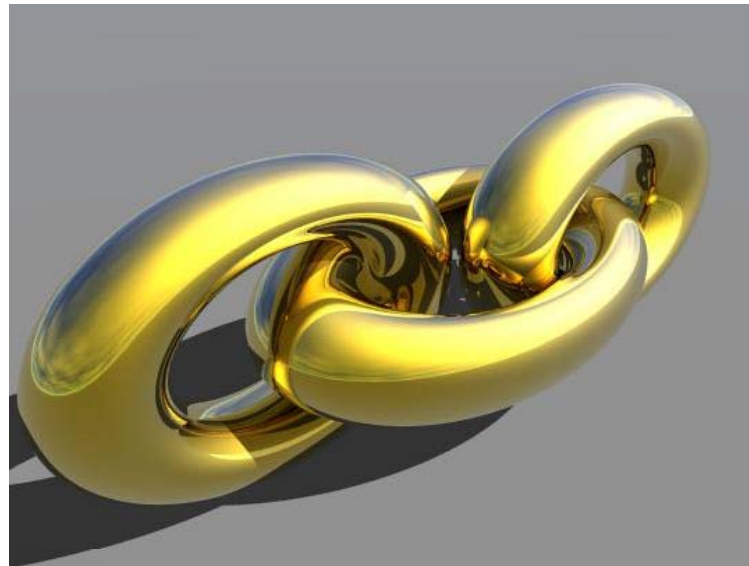
## Internal replanning guidance:

- **Maintain PMB when PBI burndown changes**
  - **Baseline finish dates of major releases**
  - **Technical baseline**
  - **Cumulative BCWS**
- **Transfer budget for deferred features to first period of next iteration/sprint**
- **Reallocate budget for descoped features to PBI unless a function was also descoped**
- **Maintain reported schedule variances**
- **Reallocate remaining EV ( $BAC - Cum. EV$ ) to revised product backlog after each iteration**
- **Revise EAC, compare to funding, reprioritize**



# Maintain Link with PMB

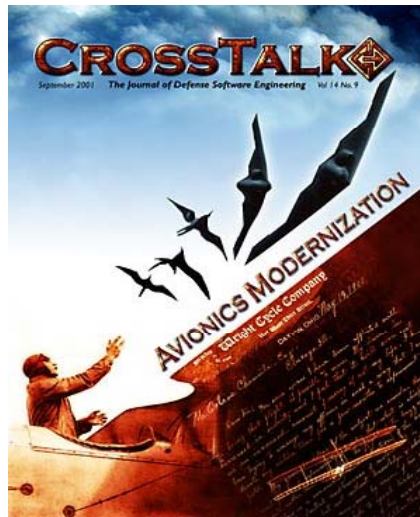
- **Performance-Based EV**
  - Measure delivered features vs. plan
- **Flexible planning for new priorities**
- **But measure progress towards meeting all requirements in the technical baseline**



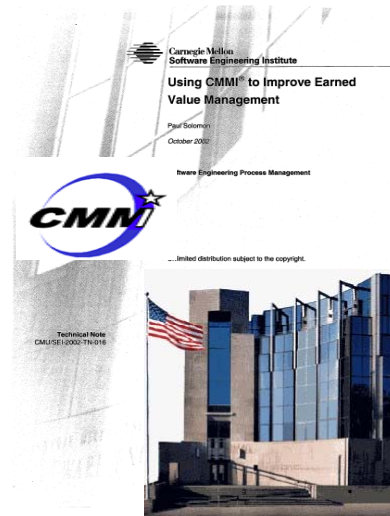




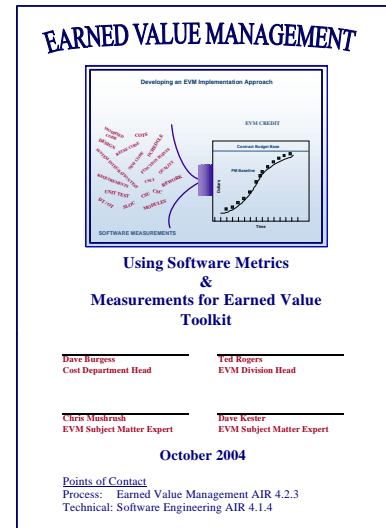
# PBEV Resources in Online Media



DOD



SEI



NAVAIR



DOD



ICFAI U.  
Press, India



PMI College of  
Performance Mgt.,  
"Measurable News"



**[www.PB-EV.com](http://www.PB-EV.com)**

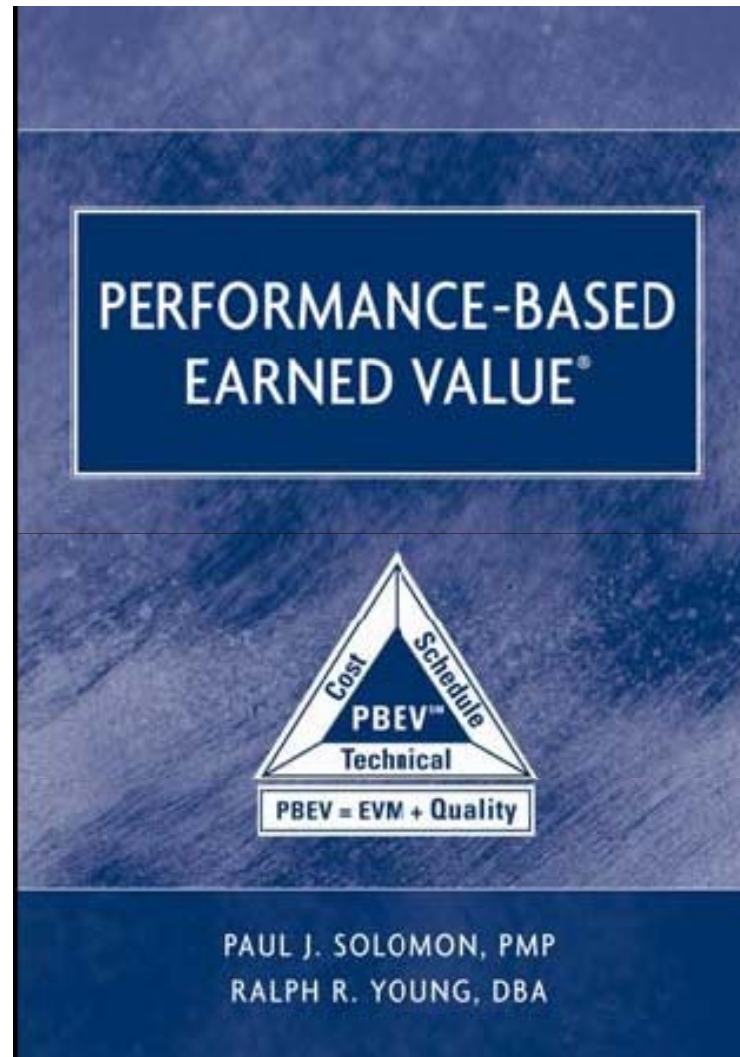


# Process Improvement Resources

Book includes

- Examples
- Templates
- Tips
- Standards
- Acquisition guidance

Published by:



Consulting:

Paul Solomon, PMP  
Performance-Based  
Earned Value®

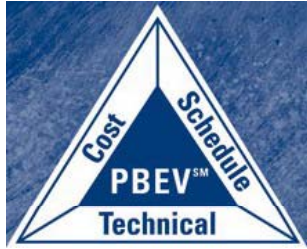
[paul.solomon@pb-ev.com](mailto:paul.solomon@pb-ev.com)

818-212-8462

- Process improvement
- EV training
- EV compliance
- Acquisition guidance
- IBR leadership
- Assess EAC and risk

Credentials:

[www.pb-ev.com](http://www.pb-ev.com)



# Acronyms

**BCWP: Budgeted Cost of Work Planned**

**BCWS: Budgeted Cost of Work Scheduled**

**EVM: Earned Value Management**

**CPI: Cost Performance Index**

**EAC: Estimate at Completion**

**PBI: Product Backlog Item**

**PMB: Performance Measurement Baseline**

**RTM: Requirements Traceability Matrix**

**SE: Systems Engineering**

**SEP: Systems Engineering Plan**

**SV: Schedule Variance**

**TR: Testable requirements**