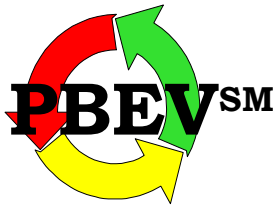
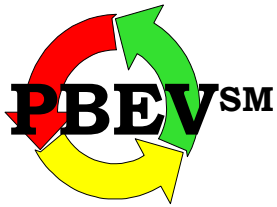


Performance-Based Earned Value®

NDIA Systems
Engineering Conference
San Diego, CA
October 27, 2005

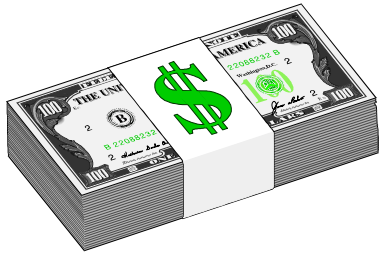
Paul J. Solomon PMP
Performance-Based Earned Value
SolomonPBEV@msn.com



Agenda

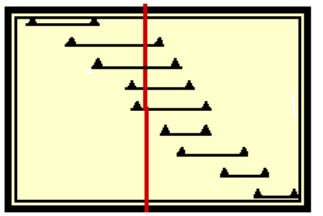
- Is Earned Value Management (EVM) Working?
- DoD Acquisition Policy
- Systems Engineering (SE) Standards
- Performance-Based Earned Value® (PBEV^{SM})
- Supplier Acquisition Management
- Process Improvement

Does EVMS Really Integrate?

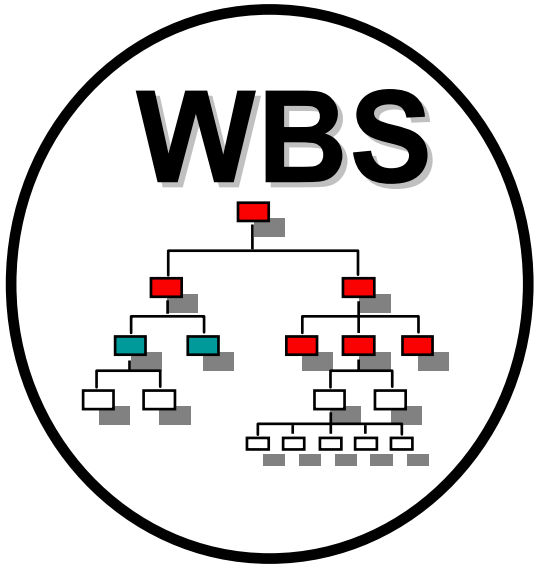


COST

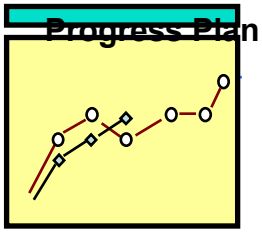
EVMS



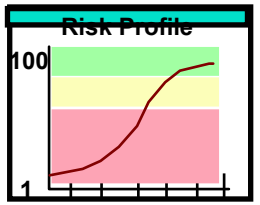
SCHEDULE



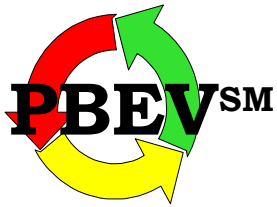
TECHNICAL PERFORMANCE



RISK



Technical Performance Measures (TPM)

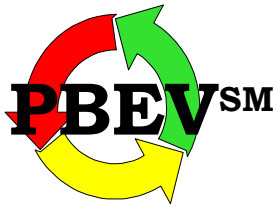


Value of Earned Value

EVM data will be reliable and accurate only if:

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

EVMS 3.8: EVMS measures quantity of work, not quality and technical content



Revitalization of SE

M. Wynne and M. Schaeffer, OUSD Acquisition, Technology & Logistics (AT&L):

"Definite linkage between

- **Escalating costs and**
- **Ineffective application of SE."**

"The earlier that requirements are intensively managed by the SE processes,

the greater the likelihood that the program's cost and schedule estimates will be on target."

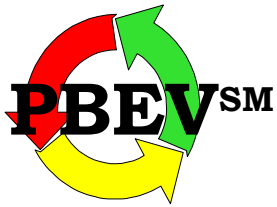
DoD Policy & Guidance on SE

Policy for Systems Engineering in DoD (Policy), 2/20/04

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

Systems Engineering Plan Preparation Guide (SEP), 10/8/04

"DoD Handbook, Work Breakdown Structures MIL-HDBK-881A (WBS), 7/30/05

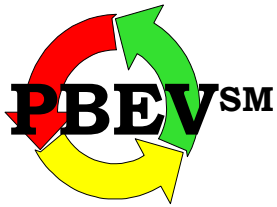


DoD Policy & Guides

Policy or Guideline (1 of 2)	Policy	DAG	SEP	WBS
Develop *Systems Engineering Plan (SEP)*	P	4.2.3.2	1.0	
Event-Driven Timing of *Technical Reviews*	P	4.5.1	3.4.4	3.2.3.1
Success Criteria of Technical Reviews	P	4.5.1	3.4.4	3.2.3.1
Assess *Technical Maturity* in Technical Reviews		4.5.1	3.4.4	3.2.3.1
Integrate SEP with: • *Integrated Master Plan* • *Integrated Master Schedule* • *Technical Performance Measures (TPM)* • *EVM*		4.5.1	 3.4.5 3.4.5 3.4.4 3.4.5	

DoD Policy & Guides

Policy or Guideline (2 of 2)	Policy	DAG	SEP	WBS
Use *TPMs* to Compare: Actual vs. *Planned Technical Development* and *Design Maturity*		4.5.5	3.4.4	
Use *TPMs* to Report Degree to Which *System Requirements are Met* in Terms of Performance, Cost, and Schedule		4.5.5	3.4.4	
Use *Standards and Models* to Apply SE		4.2.2 4.2.2.1		
Requirements Management and Traceability		4.2.3.4	3.4.4	2.2.3
Use *EVM*		11.3.1		1.4.2

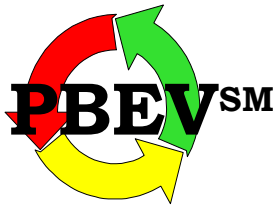


Product Requirement

IEEE 1220: Product Requirement

Requirement: Statement that identifies a product characteristic or constraint.

- **Operational, functional or design**
- **Unambiguous, testable or measurable**
- **Necessary for product acceptability by**
  - **consumer or**
  - **internal quality assurance guidelines**



Functional Requirement

IEEE 1220:

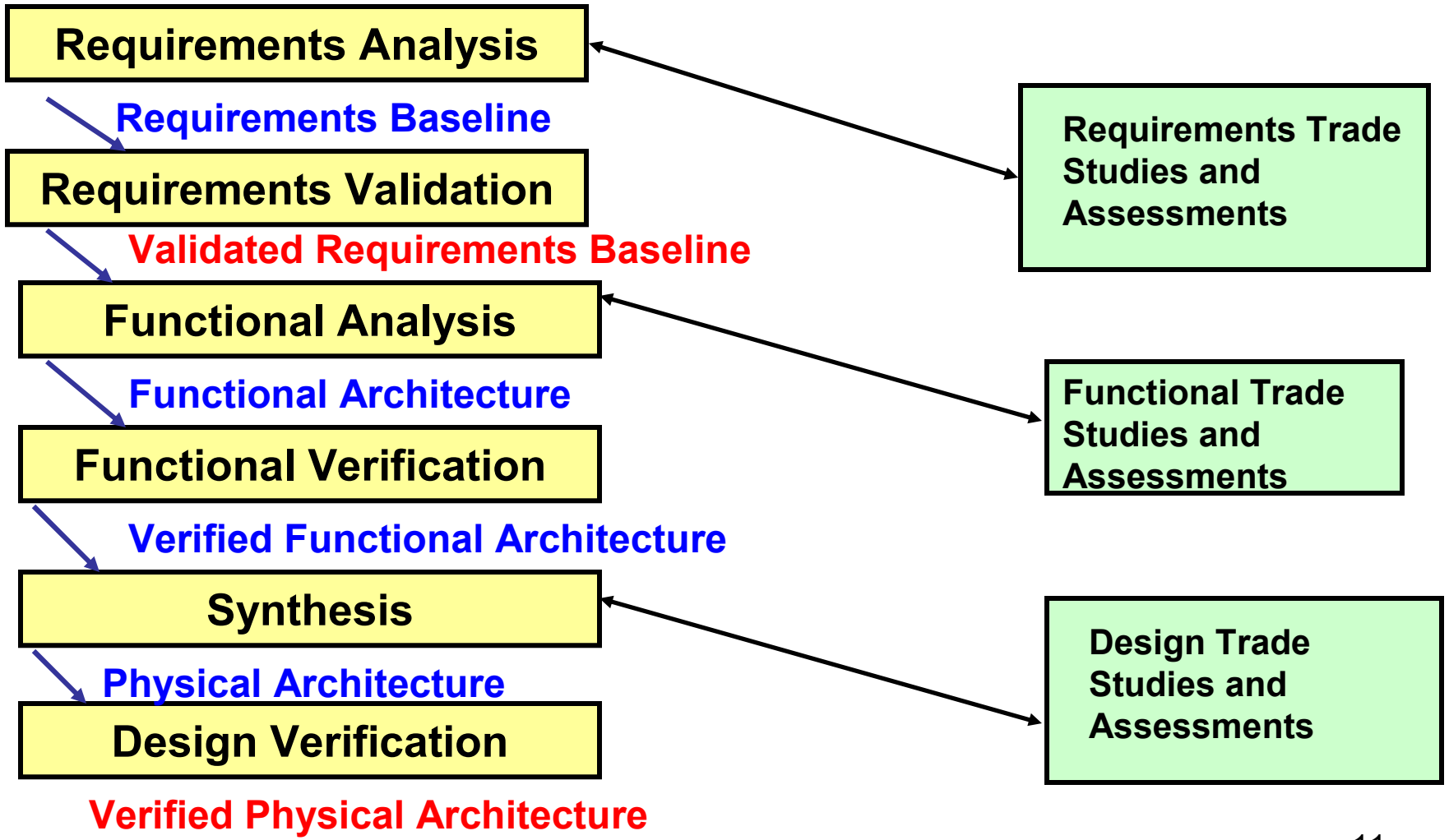
Define the functional requirements

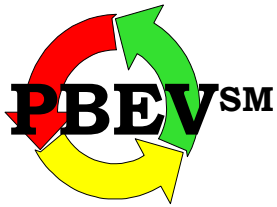
- ***What* the system must *do* (6.1.10)**

For each function, define the performance requirements

- ***How well* the functional requirements must be *performed* to satisfy the Measures of Effectiveness (MOE) (6.1.11)**

SE Life Cycle Work Products
IEEE 1220



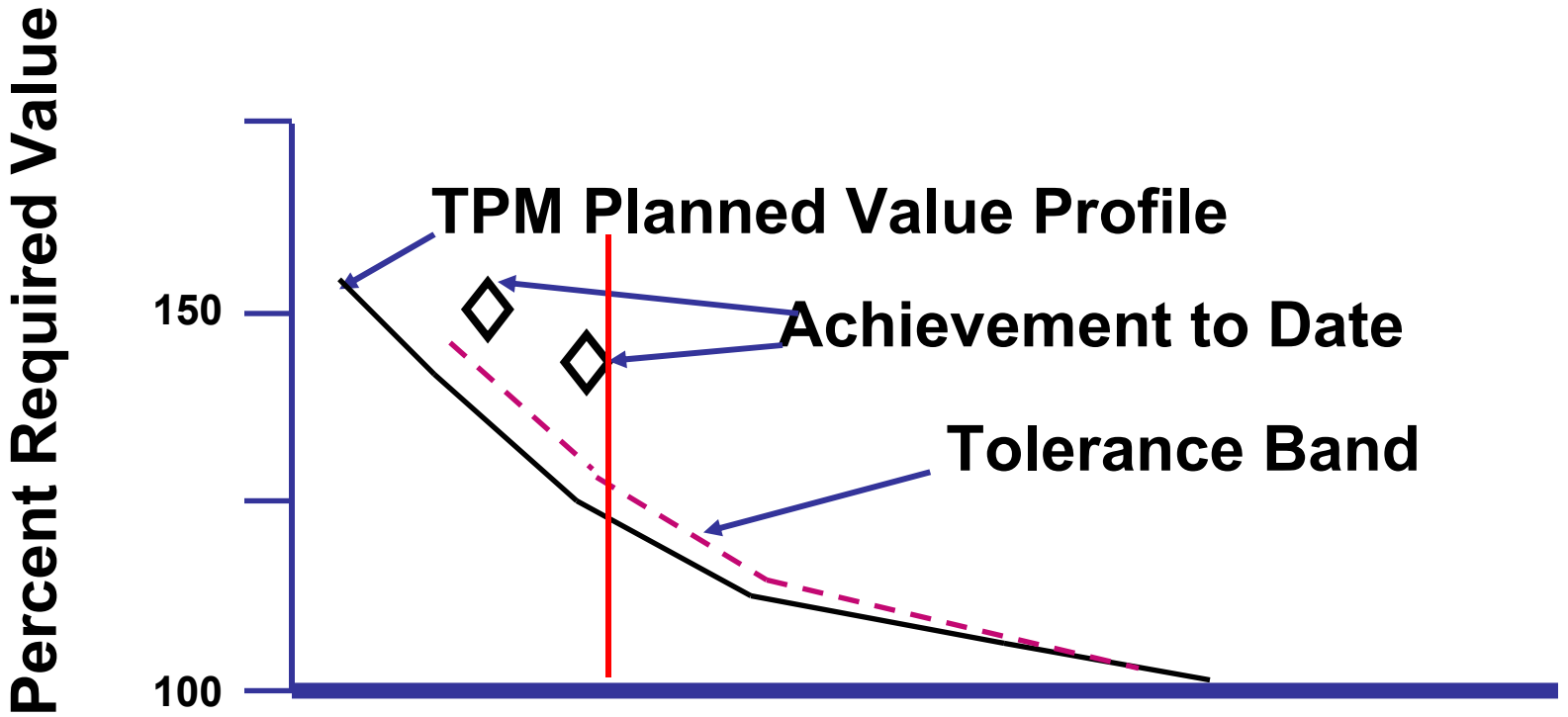


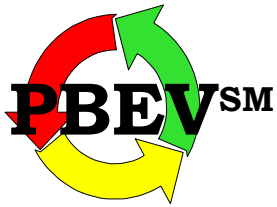
Requirements Progress

Performance-Based Progress Measurement	IEEE 1220	EIA 632
Product metrics:	☑	☑
• Ability to satisfy requirements	☑	☑
• Quality of product	☑	☑
• Development maturity	☑	
• TPMs	☑	☑

TPM

Use TPMs as a Base Measure of Earned Value



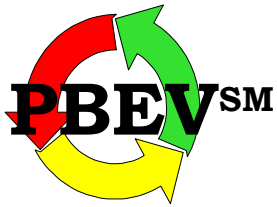


Success Criteria of Technical Reviews

IEEE 1220: Detailed design stage

System review

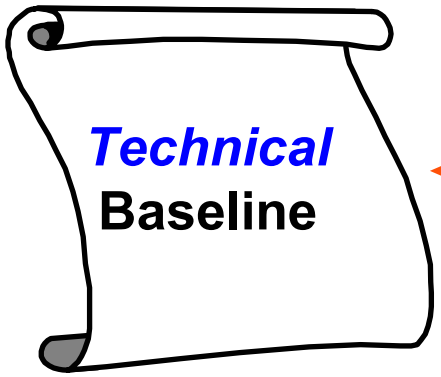
- Detailed design satisfies system baseline (5.3.4.3)
- Design solution meets (6.5.11)
  - Allocated functional and performance requirements
  - Interface requirements
  - Constraints
- Design verification complete (6.6)
  - Each requirement and constraint is traceable to the verified physical architecture (6.6.2)
  - Design element solutions satisfy the validated requirements baseline (6.6.2)



Product Requirements

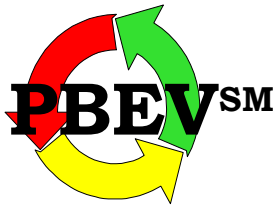
- CMMI: Traceability and Consistency

Requirements



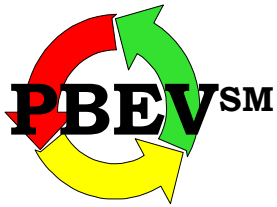
Work

- Project Plans
  - Task 1
  - Task 2
  - Task 3
- Activities
- Work Products



PBEV

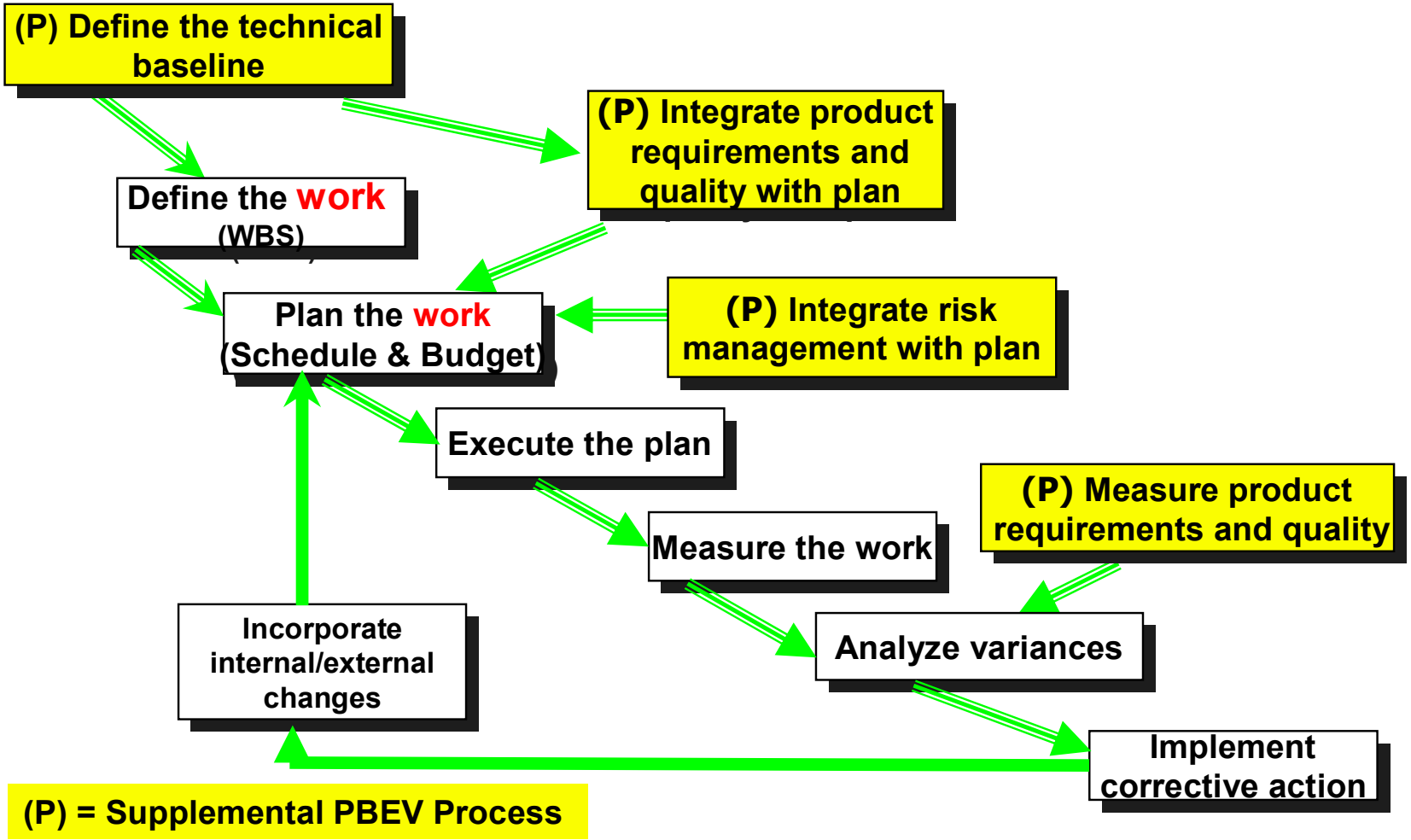
- 4 Principles
  - 16 Guidelines
- Requirements-driven plan
- Measures technical performance
- Consistent with standards and models
- Tailorable according to risk
- Lean

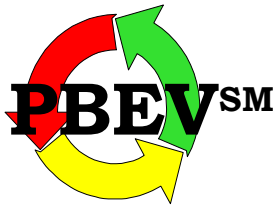


Principles of PBEV

1. Integrate product requirements and quality into the project plan.
2. Specify performance towards meeting product requirements, including planned quality, as a base measure of earned value.
3. Integrate risk management with Earned Value Management.
4. Tailor the application of PBEV according to the risk.

EVMS and PBEV Process Flows



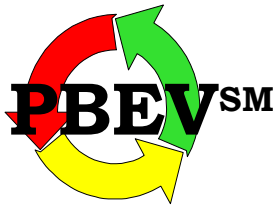


PBEV Guidelines

1.1 Establish the *technical* and *product baselines* and *allocate* the *product requirements* to the product components.

1.2 Maintain *bidirectional traceability* of *product* and product component *requirements among:*

- Project plans
- Work packages
- Planning packages
- Work products.



PBEV Guidelines

2.2 Specify *work products* and performance-based *measures* of progress for meeting *product requirements* as *base measures of earned value*.

2.4 Identify *event-based success criteria* for technical reviews (entry and exit criteria):

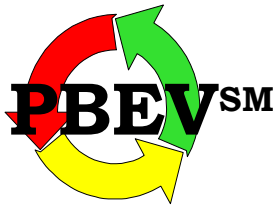
- ***Development maturity to date***
- **Product's *ability to meet product requirements*.**

PBEV Guidelines

2.5 Establish:

- **Time-phased, planned values for measures of progress towards meeting product requirements**
- **Dates or frequency for checking progress**
- **Dates when full conformance will be met.**

2.6 Allocate budget in discrete work packages to measures of progress towards meeting product requirements.



TPM Example

- Work Package Statement of Work and Budget
  - 100 drawings over 5 months
  - TPM constraint: 300 pound limit
  - TPM measurable by analytical model when drawings are 80 % complete (4th month)
  - Budget at Completion (BAC): 5000 hours
  - TPM Achievement worth 10% (500 hours)
- EV Method and Values
  - Take EV @ 50 hours / drawing
  - Negative EV of 500 hours if 300 pounds not achieved when planned

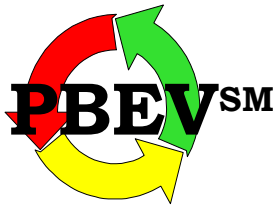
PBEV℠ Requirements Met Example

EV based on drawings and requirements

- **50 drawings @ 36 hours = 1800**
- **2 structural requirements met @ 25 = 50**
- **15 other requirements met @ 10 = 150**

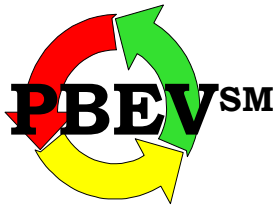
Time-phased BCWS based on schedule

Total design BCWS	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Total
Drawings	288	360	432	360	360			1800
Requirements			30	30	40	70	30	200
Total BCWS	288	360	462	390	400	70	30	2000



Trade Study Example

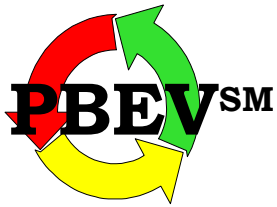
Trade Study Base Measures: Evaluate Alternatives	Time Period
Initial evaluation of each of 5 candidates has three milestones: • Start test set up • Tests executed to completion • Analyze and document	 1 2 3
Down select from 5 candidates to 2 candidates	3
Document recommendation	4



Supplier Acquisition Management

How to Get Contractors to Integrate SE with EVM?

- SE standards and SEP in solicitation, contract
- Integrated Baseline Review (IBR):
  - Review SEP
    - Entry and success criteria for technical reviews
    - Requirements management and traceability process
    - TPMs
  - Review IMS
    - Event-driven technical reviews
    - Milestone success criteria
    - SE life cycle work products
    - Control points for product metrics, including TPMs



Supplier Acquisition Management

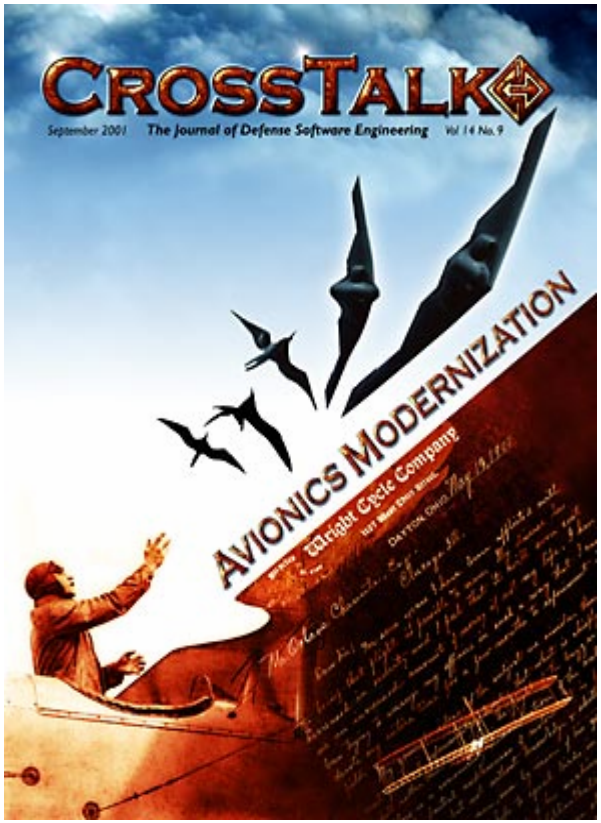
How to get contractors to integrate SE with EVM?

- **IBR continued:**
  - **Confirm integration with EVM**
  - **Review product requirement measures**
  - **Review approach for requirements traceability**
- **Monitor progress and process**
- **Incentives to meet success criteria and planned TPM values**
- **Perform independent assessments**

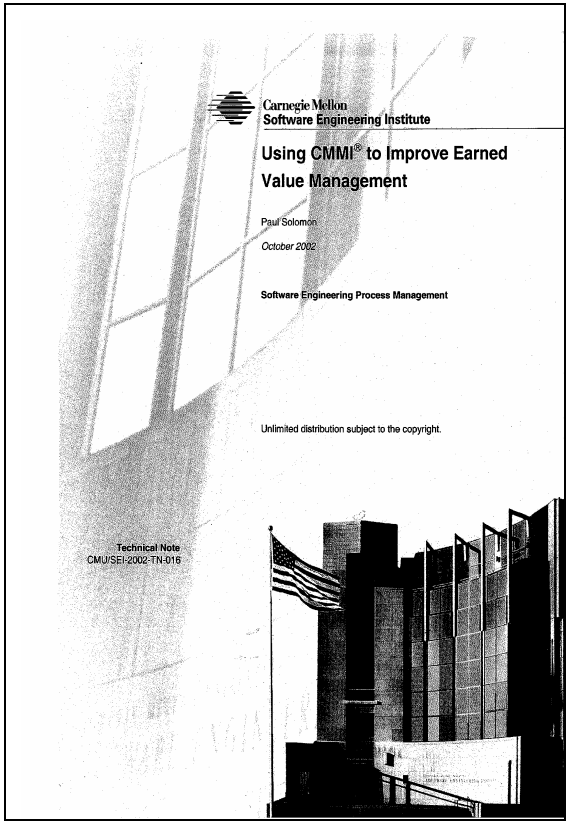
PBEV Benefits

- Integrate
  - Systems Engineering with EVM
    - Product requirements and quality baseline
    - SE life cycle work products
    - Technical performance measures
    - Success criteria of technical reviews
  - Technical>schedule>cost performance
- Lean process
  - Less work packages with right base measures
- Agile

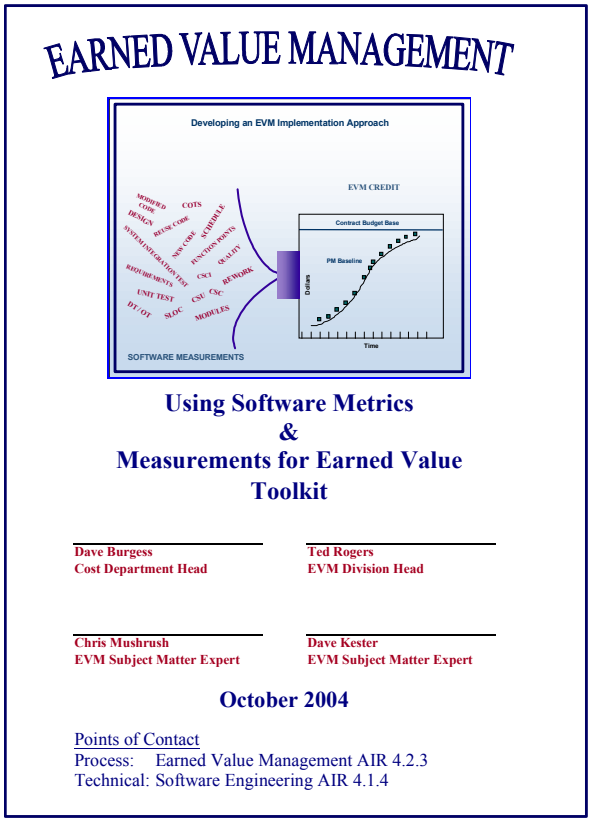
Process Improvement



DoD



SEI / CMMI



NAVAIR

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By Paul Solomon & Ralph Young

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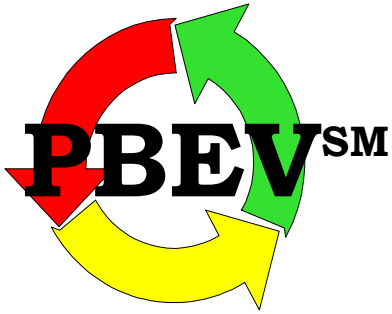

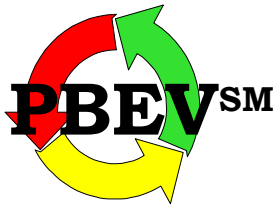

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