

Practical Software and Systems Measurement

Objective Information for Decision Makers



***Impact of Digital Engineering
on Measurement***

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Impact of Digital Engineering on Measurement

- ***DoD has released a Digital Engineering (DE) Strategy***
- ***DoD Services are developing DE Implementation Plans***
- ***PSM has developed an Information Category-Measurable Concept Measurement (ICM) table which reflects measurement best practices***

What impact does the move towards Digital Engineering have on measurement?

Objectives of the Workshop

- ***Assess the impact digital engineering may have on measurement***
- ***In particular, review the ICM table to assess how does measurement change as projects implement digital engineering approaches***

Workshop Format

1:30 Introductions, Review of Objectives, Agenda, and Review of DE Strategy

2:00 Review of each information category in ICM to identify any areas which may be affected by DE

- ***Schedule & Progress***
- ***Resources & Cost***
- ***Size & Stability***
- ***Product Quality***
- ***Process Performance***
- ***Technology Effectiveness***
- ***Customer Satisfaction***

4:00 Review of impacts and implications

Intended Output

- ***Review of the current ICM table with identification of areas impacted by DE, with possible recommended updates***

**OUR REVIEW WAS ONLY ABLE TO
LOOK AT PROGRAM. UNABLE TO
GET TO ENTERPRISE**

Participants

Participant	Organization
Judith Dahmann (Lead)	Mitre
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Project – Schedule and Progress

Information Categories	Measurable Concepts	Questions Addressed	Measures		Notes
			Prospective Indicators	Sample Base Measures	
Schedule and Progress	Milestone Completion	Is the project or service meeting scheduled milestones? Are critical tasks or delivery dates	- Milestone Progress	- Number of milestones started and completed versus plan	- Completion should be based on achieving specific quantifiable milestone completion criteria - Include updates as schedules change - Milestones may include inch stones, or
	Work Unit Progress	Are specific activities and products completed as scheduled?	- Requirements Progress - Problem Reports Progress - Reviews Progress - Change Requests Progress - System Elements (Units) Progress - Test Cases Progress - Action Items Progress	- Requirements defined, traced, verified, validated - Problem reports discovered, closed - Reviews completed - Change requests opened, resolved - System elements designed, implemented, integrated, approved, qualified, accepted - Test cases developed, attempted, passed - Action items opened, completed	- Other work unit progress measures may be defined based on the work in progress - Other schedule performance indicators are included with financial performance indicators (e.g. earned value measures)
	Work Backlog	Is the backlog of work units growing? Has the backlog of work units been adequately addressed?	- Work Unit Backlog Trends - Burndown Rates	- Work units in backlog, work units in backlog resolved	- Measure/categorize by priority level and age - Work units may be: -- actions, assignments -- service requests
	Incremental Capability	Is capability being delivered as scheduled in incremental builds, releases, or service provisions?	- System Elements Integrated - Functionality Integrated	- Systems elements integrated (planned versus actual) - Functions integrated (planned versus actual)	

Project – Resources and Cost

Information Categories	Measurable Concepts	Questions Addressed	Measures		Notes
			Prospective Indicators	Sample Base Measures	
Resources and Cost	Financial Performance	Is the project or service meeting budget and schedule objectives? Is the project or service at risk of exceeding established cost and schedule objectives?	<ul style="list-style-type: none">- CPI, SPI Trends- Earned Value Cost and Schedule Variance- Budget Adequacy and Trends- Cost Trends- Cost and Schedule Impact Risk Trends	Earned Value: <ul style="list-style-type: none">- Budgeted Cost of Work Scheduled (BCWS)- Budgeted Cost of Work Performed (BCWP)- Actual Cost of Work Performed (ACWP)- Budget at Completion (BAC)- Latest Revised Estimate (LRE)- Estimate at Completion (EAC)- Budget, planned, and actual costs- Cost and schedule risk	<ul style="list-style-type: none">- For deployed systems, costs include those to operate, maintain (resolve problems), and enhance system- Include updates as funding changes- For risks, develop a range of cost values with associated probabilities, not just a single "cost" value, to facilitate improved awareness of potential cost exposure. Note that this should be related to both cost and schedule risk.
	Personnel Effort	Is effort being expended according to plan? Is there enough staff with the required skills?	<ul style="list-style-type: none">- Staff Level Sufficiency- Effort Distribution and Trends- Skill Profiles- Staff Turnover Rates	<ul style="list-style-type: none">- Number of staff on project and projected- Number of staff by skill level- Number of staff by activity- Staff added, removed, quit	<ul style="list-style-type: none">- Can also focus on key staff- Effort distribution and trends by activity provides a more detailed profile- Look at these measures for the current state and future projection- Skills include expertise, experience, training, education, and domain knowledge
	Facilities and Support Resources	Are needed facilities, equipment, tools, and materials available as needed to meet milestones?	<ul style="list-style-type: none">- Resource availability- Resource utilization	<ul style="list-style-type: none">- Quantity needed, available- Time required, available, used	

INSIGHTS FROM THE REVIEW

- ***MEASUREMENTS DON'T CHANGE***
 - ***INFORMATION CATEGORIES AND MEASUREMENT CONCEPTS STILL VALID***
- ***MANY MEASURES MAY BE EASIER TO COLLECT***
 - ***AUTOMATE COLLECTION/VALIDATION (PRODUCT QUALITY)***
 - ***SIZE/STABILITY AROUND CHANGE SCOPE***
- ***SOME POSSIBILITY FOR NEW MEASURES***
 - ***"INTEGRATABILITY" OF MODEL WITH OTHER MODELS***
 - ***SUITABILITY OF MODEL REUSE***
 - ***EARLIER DELIVERY OF MODEL ELEMENTS FOR REVIEW/VERIFICATION***

Future Work

- ***Complete the ICM review for Digital Engineering impacts for the “Enterprise Measures”***
- ***Follow up with validation of suggested additions/modifications***
- ***Propose revised ICM***

BACKUP

Workshop Background

- ***PSM has provided a effective forum for addressing best practices in measurement***
- ***With the advent of digital engineering, approaches to systems engineering are changing***
- ***The question is whether these changes will effect the measurement approaches***



Digital Engineering Overview

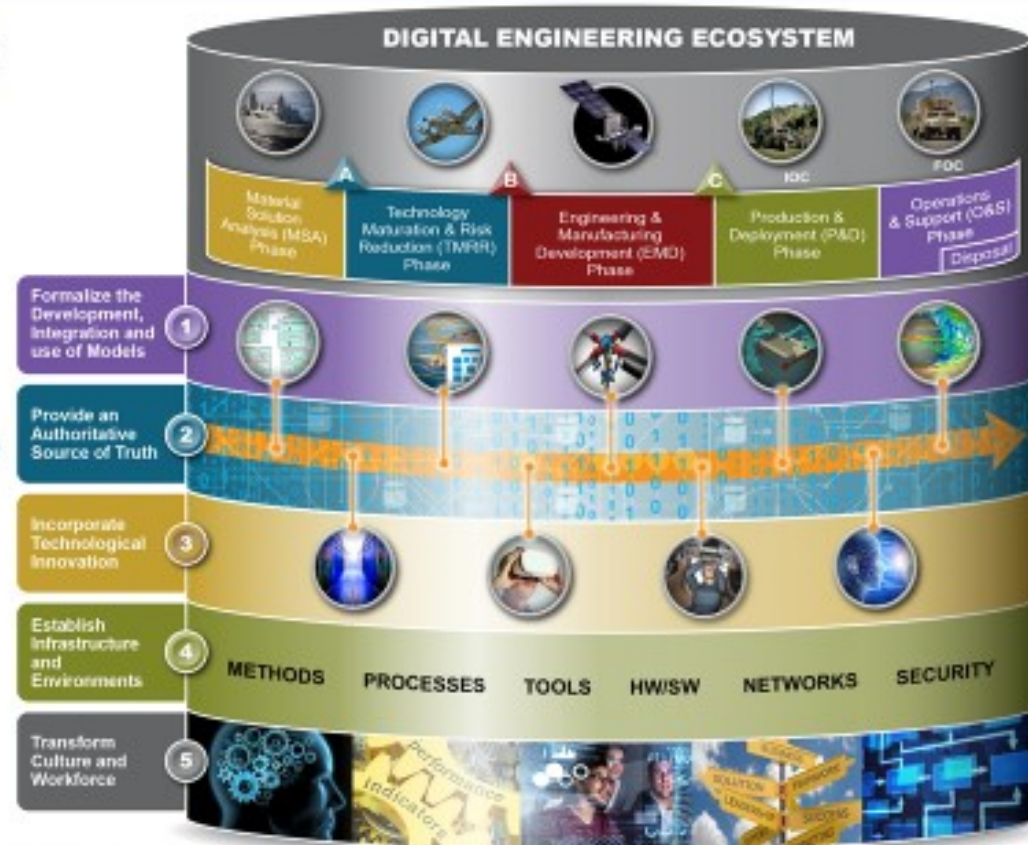


- **What is Digital Engineering?**

- Combines model-based techniques, digital practices, and computing infrastructure
- Enables Delivery of high pay off solutions to the warfighter at the speed of relevance

- **Reforms Business Practices**

- Digital enterprise connects people, processes, data, and capabilities
- Improves technical, contract, and business practices through an authoritative source of truth and digital artifacts



Modernizes how we design, operate, and sustain capabilities to outpace our adversaries



Digital Engineering Strategy



- **Digital Engineering Strategy**
 - Basic capabilities needed by Services and Agencies to begin use of digital engineering practices
- **Objective**
 - Guide the planning, development, and implementation of digital engineering across the services and agencies
- **Expected Impact**
 - Increase technical cohesion and awareness of system in lifecycle activities
 - Reform the Department's business practices for greater performance and agility
- **Coordination**
 - Approved by USD(R&E), DASD(SE), and each Service

<https://www.acq.osd.mil/se/docs/2018-DES.pdf>



Digital Engineering Strategy: Five Goals



Modernizes how we design, operate, and sustain capabilities to outpace our adversaries