AI4SE & SE4AI Workshop 2022

Keynote

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DoD is a Data Centric Organization

- Unleashing data to advance the National Defense Strategy

- Guiding Principle #6 – Data for Artificial Intelligence Training – Data sets for A.I. training and algorithmic models will increasingly become the DoD’s most valuable digital assets

- As DoD modernizes and integrates AI technologies into joint warfighting, generating DoD-wide visibility of and access to these digital assets will be vital in an era of algorithmic warfare
Increasing Complexity and Challenges

Source: 2022 PSM Workshop, RDML Dion English, SC, USN
Contested Environment – All Domain

Open Source A2/AD Map

- A2/AD fuses “Sea Denial,” the “Fortress Fleet,” and Maoist “Active Defense” with asymmetric capabilities
- A2/AD is both a conventional threat and a psychological competition

Attributed to The Stanford Project Agrippa 2021

Source: 2022 PSM Workshop, RDML Dion English, SC, USN
“Bake In” Sustainment Attributes into the System Design

The Time To Act is Here

By the start of Procurement, ~90% of O&S Costs are decided based on design and programmatic decisions.

Sustainment Attributes
- Quantity in Service
- Operational Usage (Hours, miles, etc.)
- Maintainer/Operator manpower costs
- Fuel Costs

Procurement
- Funding (Depot Activation, Provisioning, Pubs/Manuals)
- Program Trades (Prioritization of acquisition cost, schedule, performance over sustainment over CBM+)
- Reliability/maintainability improvements

Development
- Sustainment Requirements (RAM)
- Cost Baselining
- Sustainment Planning (Who, What, Where, When)

The Time to Effect O&S Costs and Performance is During Development

Source: 2022 PSM Workshop, Principal Deputy Assistant Secretary of Defense (Sustainment)
Engineering Data in a DE Ecosystem

Design and Development
- DFMEA
- Specification
- Analyses: R&M, Safety, HSI, MFG
- Subsystem Analysis (Reliability)
- Testing (Contractor Test)
- System Test (Contractor – Government Test)
- DT&E Test Results (Verification)
- OT&E Test Results (Validation)
- Field Observed (IOC, FOC)

“LRIP” Updates
“FRP” Updates

Manufacturing and Quality
- Supportability FMEA – LORA – MTA – RCM – CBM+
- R&M Assessment (Data Analytics)
- MAFs
- Maintenance Data Collection System
- TIRs
- Mishap Data

Digital Twin Planning
- DFMEA Safety and HA
- HSI and HF
- Initial KPPs, KSA Verified
- Capability Needs
- Draft CDD
- RAM-C Analysis (Valid and Feasible)
- Translation (R&M Thresholds)
- Specification
- SOW
- CDD

Digital Twin(s)
- R&M Data Libraries
- Failure Data
- Maintenance Data
- Demand Planning
- PLM (CM, BOMs)
- PHM
- LPD

Contractor IDE*
- R&M Data Libraries
- Failure Data
- Maintenance Data
- Demand Planning
- PLM (CM, BOMs)
- PHM
- LPD

Government IDE*
- R&M Data Libraries
- Failure Data
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- PLM (CM, BOMs)
- PHM
- LPD

Legend
- Data
- Activity
- All blue lines represent the digital thread

*Contractually agreed to content, views, access, and delivery of data.
Early AI4SE Application in Engineering Data

**Legend**

- **Data**
- **Activity**

- To Data Library (IDE)
- To & From Data Library (IDE)

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**Distribution Statement A:** Approved for public release. Distribution is unlimited.
CBM+

Source: The Office of the Under Secretary of Defense for Acquisition and Sustainment

Photo By: R. Nial Bradshaw

Distribution Statement A: Approved for public release. Distribution is unlimited.
Guiding Principle #6: Data for AI Training
“Warfighters at all echelons require tested, secure, seamless access to data across networks, supporting infrastructure, and weapon systems out to the tactical edge.”

DoD Data Strategy, 2020
AI4SE Application in FRACAS Data

Analyses: R&M, Safety, HSI, MFG

Design and Development

“LRIP”
“FRP”

Manufacturing and Quality

FRACAS

R&M Assessment (Data Analytics)

System Design

Sensor Design (PHM, CBM+)

Contractor IDE*
Government IDE*

Sustainment

Analytical Reviews
Review Boards R&M, Safety, HFAC

Modern Analytics
Network

Network

Sustainment

Real – Time Sensor Data

Decision (To Stakeholder)

To Data Library (IDE)

To & From Data Library (IDE)

Legend

Data
Activity

Legend

Data
Activity

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AI4SE Application in FRACAS Data

AI enables:
- Alerts
- Trends
- Optimized Scheduled Maintenance
- Updates to RCM
- Design Changes
- Digital Twin Updates
- Spares Optimization
- Sustainment
- Metrics
- R&M Estimates

Analyses: R&M, Safety, HSI, MFG

Subsystem (Reliability) Testing (Contractor Test)

Reliability Growth M-DEMO System Test (Contractor – Government Test)

DT&E Test Results (Verification)

OT&E Test Results (Validation)

Field Observed (IOC, FOC)

FRACAS

R&M Assessment (Data Analytics)

Review Boards R&M, Safety, HFAC

AI Data Analytics

Mishap Data

TIRs

MAFs

Maintenance Data Collection System

Onboard and Off Board Sensors Telemetry (Environmental Context)

Sensor Design (PHM, CBM+)

System Design

H - Human
M - Machine

Other Stakeholders

Decision (To Stakeholder)

Modern Analytics

Network

Real – Time Sensor Data

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Enhancing Predictive Maintenance

SE4AI Responsible, Effective, Safe and Reliable

Photo By: Marine Corps Staff Sgt. Jacob Osborne
“DOD Incorporating AI Ethics Into Systems Engineering, Official Says” January 21, 2021
Defense.gov/News
Its All About the Data – Enhanced by AI

Photo By: Army Spc. Kayla Anstey
“Digital Transformation, AI Important in Keeping Battlefield Edge, Leaders Say” June 9, 2022
960cyber.afrc.af.mil/News
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