Systems Engineering Needs of the DoD Architecture Framework

Report of the

Architecture Frameworks Working Group
Systems Engineering Division
National Defense Industrial Association

Co-Leads
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Joe Kuncel, Northrop Grumman
AFWG Purpose and Products

Purpose

• Recommend changes and additions to the DOD Architecture Framework (DoDAF) and related standards that will improve support for DOD systems engineering, development, and acquisition.

Products

Final report and briefing of
• Analysis of DoDAF satisfaction of SE needs
• Conclusions
• Recommendations for improvement
# AFWG Members

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* AFWG founder and sponsor
SE Needs of DoDAF

• SE Needs
  • Standard architecture modeling methodology
    for greater reuse/sharing, more efficient/standardized modeling
  • Greater definition and standardization of architecture elements
    incorporation of Services’ “architecture elements lists”
  • Executable/simulatable architecture models
    for early and inexpensive architecture verification and validation
  • Composable/decomposable architectures
    for multiple levels of abstraction for hierarchy of stakeholders
  • More reusable architecture models
    faster, more efficient, more standard architecture development
  • Standard architecture alternatives analysis method
    for continuous architecture improvement
  • Standard architecture modeling notation and symbology
    better architecture comprehension and communication
  • Auto-generation of systems engineering artifacts
    lowering costs by leveraging architecture model’s “authoritative data”
Recommendations

Standard architecture modeling methodology
• Object-Oriented, UML, SysML, UPDM implementation of DM2
Recommendations

Greater definition, standardization of architecture elements

- Integrate JFCOM’s standard architecture elements into the DM2
  - by adding elements to meta-model OR
  - by enabling user extension (profile) of meta-model
Recommendations

Executable/simulatable architecture models

• Add behavioral semantics for state-machine ...

Meta-Model:

Model Example:
Executable/simulatable architecture models (cont’d)

- And add behavioral semantics for activity definition …

**Meta-Model:**

- **Activity**
  - **Synch**
  - **Join**
  - **Fork**
  - **Action**

**Model Example:**

- **Obtain Commander's Approval**
  - **Obtain Situation Awareness**
  - **Obtain Commanders Guidance**
  - **Create/Update COAs**
  - **Evaluate COAs**
    - **Optimal?**
      - **Yes**
        - **Obtain Commander's Approval**
      - **No**
        - **Join**
          - **Obtain Commanders Guidance**
Recommendations

Composable/decomposable architectures

• Add abstraction relationship…

Note: DM2 deemed to satisfy need for structural composition/decomposition of architectures
Recommendations

More reusable architecture models

- Extend physical exchange standard (PES) to include diagrams exchange (XMI for UPDM already includes diagram exchange)
- Standardize DARS on PES (prefer XMI)
- Add patterns and frameworks support to DARS

Domain

Modeling

Model Standardization

Model Reuse/Sharing

Artifact

Model + Diagrams

translated to/from

Standard Markup

Models Repository
- federated
- standardized
- includes architecture fragments frameworks patterns

Format

UML/SysML/UPDM
<or>
Tool Specific Notation

UML/SysML/UPDM XMI
<or>
DoDAF PES XML with diagram extensions

UML/SysML/UPDM XMI Files
<or>
DoDAF PES XML Files
Recommendations

Standard architecture alternatives analysis method

- Extend meta-model with parametric analysis semantics
- Standardize on SEI’s Systems and Software ATAM

Meta-Model:

- Performance Measure
- Maintainability Measure
- Adaptability Measure
- Physical Measure

Measure Type
- units: string

Measure
- value: string

Computed Measure
- computation: string

Measure Type
- units: string

Performance Measure
- Maintainability Measure
- Adaptability Measure
- Physical Measure

Model Example:

Backup Forward Surveillance System
Mobile Surveillance System MTBF
MobileMTBF
Stationary Surveillance System MTBF
StationaryMTBF
Backup Base Surveillance System
Base Surveillance System
SystemMTBF

Computation parsed and calculated by modeling tool.

"value = 1800 computation = "value = 1/(1/MobileMTBF.value * (1 + 1/2)) + (StationaryMTBF.value * (1 + 1/2))"
Recommendations

Standard architecture modeling notation and symbology

• Establish UML/SysML/UPDM as standard notation …

Notes:
Notation is notional only; actual notation would be specified by UPDM standard. Only sampling of notation is shown.
Recommendations

Standard architecture modeling notation and symbology

• Extend meta-model with symbolic representation semantics ....

Model Example (symbology):
Recommendations

Standard architecture modeling notation and symbology

- Establish DoD Metadata Registry-like standard symbology library

Model Example (notation):

Model Example (symbology):
Recommendations

Auto-generation of systems engineering artifacts

• Extend meta-model with user-definable extensions (tagging) …
Recommendations

Auto-generation of systems engineering artifacts (cont’d)

• Establish standard model reporting capability

Detailed Architecture Model with Custom Meta-model Extension Information

Standard Model XML

Standard Reporting & Scripting Tools

Artifacts

Web-Based Model Views

Interface Specifications

Architecture Descriptions

Test Procedures

Acquisition & Program Plans

Architecture Metrics

Requirements Trace Matrices

Business Process Automation Scripts
Summary

In summary...

DoDADF v2 improves on satisfaction of SE needs, but systems engineers need greater definition and standardization of semantics and methods that are important to them.

Comments, questions, feedback are solicited. Contact… Joe.Kuncel@ngc.com, 402-682-4772