



# 2025 Federal Digital Engineering Forum

Digital Ecosystem Working Group Out brief

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# 2025 Federal Digital Engineering Forum (FED DEF) Digital Ecosystems Working Group

## Implementing a Digital Ecosystem

- The Digital Ecosystem Working Group met to gather input from various organizations to answer the following:
  - How is Digital Engineering being used in your current day-to-day work?
  - What digital ecosystems and tools are currently in use?
  - What major digital tools do you use, how are they being utilized, and what benefits can you see from them?
  - What interoperability issues do you see when working with multiple tools?
  - Have these issues led to you acquiring new tools, or customizing existing tools to become more interoperable?
  - What lessons learned regarding interoperability in a Digital Ecosystem?
  - What interop standard do you use and/or recommend to be an industry standard?
  - Do you have a structured tools roadmap, and how do you manage interoperability across platforms?
  - How do you integrate your ASOT with various tools to ensure data consistency and traceability?
  - What training is available and/or provided for educating users on how to access and use ASOT?
  - How do you ensure data integrity, consistency, and accessibility throughout your Digital Ecosystem?



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## The Past State: Where We've Been (Past)

- Digital Engineering (DE) across the US Gov. over the last couple of FED DEF's has faced significant challenges to modernize and transform. Key issues previously identified for DE Ecosystems include:
  - Inability to integrate models and work with data across diverse engineering tools to enable seamless collaboration among agencies and contractors.
  - Lack of authoritative, secure and trusted sources of truth (i.e., ASOT) for engineering data.
  - No traceability, interoperability, or data standardization across systems to support programs at scale, security requirements, and organizational complexity.
  - Inconsistent end-states, common terminology, and best practices to support training and reduce program costs and schedules.
  - Inadequate definition of roles and responsibilities to integrate business processes, share lessons learned, and build interoperable frameworks for communication and data sharing across the enterprise



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## The Current State: What We're Seeing

- Organizations are adopting DE and MBSE to enhance interoperability, accelerate development, and improve data management.
- Resistance to transitioning from traditional Engineering to Digital Engineering arises from management reluctance, cultural inertia (e.g. experienced engineers' resistance), work environment constraints (e.g. cybersecurity rules, different networks, etc.), perceived effort versus value, and differing stakeholder needs.
- Desire for common standards exists, however “but not in my backyard”.



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## The Future State: What We Need

- Organizations need to ensure data consistency and traceability through automated tools, centralized information repositories, model integration, multi-physics modeling and simulation, conceptual data models, and resulting in digital threads across the lifecycle of the program / project.
- Data integrity, consistency, and accessibility in the digital ecosystem must be maintained through best practices for ASOTs (Authoritative Source of Truth) and SSOTs (Single Source of Truth), configuration/change management, descriptive models, metamodel compliance, and central administration and thus augmenting team collaboration and advanced capabilities like digital twins.



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## Approach

- Optimizing ecosystems involves data management, tool interoperability, and clear, data-centric processes.
- Effective integration requires appropriate selection of COTS tools, ensuring metadata consistency, and maintaining scalability and data/cyber security.
- Standardized APIs, ontology-based approaches, and linking to authoritative data sources improve collaboration.
- Successful management of digital engineering transformation requires organizational adaptability, focus on data-driven decisions, and strong communication from leadership on the value to the organization.
- Training must be tailored for various roles, their usage of the tools, and how DE provides value to the user.



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## Conclusion

- **Past:** Inability to integrate models, Lack of authoritative, secure and trusted sources of truth (i.e., ASOT), interoperability issues, Inconsistent end-states, common terminology, and best practices to support training and reduce program costs and schedules.
- **Current:** Organizations are adopting DE and MBSE to enhance interoperability, accelerate development, and improve data management, resistance to transitioning from traditional Engineering to Digital Engineering, cultural inertia (e.g. experienced engineers' resistance), desire for common standards exists, however “but not in my backyard”.
- **Future:** Data-flow automation, centralized information repositories, model integration, multi-physics modeling and simulation, conceptual data models, and resulting in digital threads across the lifecycle of the program / project.



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# Back up Slides





# Question 1: What Agency/Department/Component/Company are you part of?

- Respondents represent a broad cross-section of the defense ecosystem:
- Military branches (Army, Navy, Air Force, National Geospatial-Intelligence Agency)
- Research laboratories (AFRL)
- Support organizations (MITRE)
- Testing centers (ATEC)
- Defense contractors (General Dynamics, STC, SPEC Innovations)
- Defense procurement and development centers (DEVCOM, NAVAIR, NAWCWD)



## Question 2: How is Digital Engineering being used in your current day-to-day work?

### **Themes:** Implementation varies by maturity level; focus on MBSE and standardization

- Early-stage implementation: Several organizations (like GVSC) are in early phases of DE adoption
- Tool-centric approach: Many responses focus on specific tools being used (MBSE, SysML)
- Leadership roles: Several respondents are in leadership positions directing DE implementation
- Process enhancement: DE is primarily used to enhance existing engineering processes
- Research and advancement: Some organizations (SERC/AIRC) focus on research and advancement of DE methodologies
- Program support: Multiple respondents support specific programs implementing DE



## Question 3: What role does a Digital Ecosystem play in your day-to-day work?

### **Themes:** Building infrastructure; varied maturity levels; integration challenges

- Infrastructure development: Many are actively building digital ecosystem infrastructure
- Tool integration: Focus on integrating multiple tools into coherent workflows
- Maturation efforts: Organizations describe their ecosystem as "maturing" or "developing"
- Learning from others: Several mention wanting to learn from other organizations' experiences
- Integration challenges: Limited integration across tools/platforms is a common hindrance
- Stakeholder buy-in: Multiple mentions of challenges getting stakeholder adoption



## Question 4: What major digital tools do you use, how are they being utilized, and what benefits can you see from them?

### **Themes:** Common toolsets; varying levels of integration; similar application areas

- Common tools: Widespread use of certain tools (Cameo, Atlassian, JIRA, DOORS/DNG, Teamcenter, GitHub)
- Model-Based Systems Engineering: Strong focus on MBSE tools across organizations
- Modeling & Simulation: Many organizations using M&S tools for design evaluation
- Digital thread initiatives: Several organizations implementing digital thread capabilities
- Infrastructure platforms: Some organizations have developed their own environments (like AFRL's DLE)
- Middleware solutions: Multiple mentions of integration middleware (eQube, SBE Vision)
- Benefits cited: Enhanced collaboration, traceability, and design evaluation capabilities



## Question 5: What interoperability issues do you see when working with multiple tools?

### **Themes:** Version compatibility; data consistency; tool integration

- Version compatibility: Tool version updates breaking existing interfaces
- Data consistency: Ensuring consistent metadata across systems. Building out a comprehensive digital metamodal to link data sets, meanings and normalize is a significant endeavor.
- Tool integration challenges: Difficulty connecting different tools into coherent workflows
- Vendor lock-in concerns: Organizations trying to avoid dependence on specific vendors
- Data loss during transfers: Information being lost when moving between tools
- Scale challenges: "N<sup>2</sup> problem" of connecting many tools to each other
- Proprietary formats: Challenges with proprietary data formats and models
- Stove-piped development: Tools created in isolation without considering integration



## Question 6: Have these issues led to you acquiring new tools, or customizing existing tools to become more interoperable?

### **Themes:** Mixed approaches; custom scripts; middleware adoption

- Custom scripting: Several organizations developing scripts for tool integration
- Middleware adoption: Some acquiring middleware solutions (SBE Vision, eQube)
- Custom plug-ins: Development of custom tool plugins (e.g., for Cameo and AFSIM)
- De-customization: Interestingly, some organizations are "de-customizing" to improve interoperability
- Framework development: Creation of specialized frameworks like IoIF
- Standardization efforts: Focus on standards rather than tool-specific solutions
- Minimal changes: Some organizations avoid changing tools due to migration difficulties



## Question 7: What lessons learned regarding interoperability in a Digital Ecosystem?

**Themes:** Strategic tool selection; data standards over tool integration; enterprise approach

- Strategic tool selection: Choose tools that work well together from the start
- Data standards focus: Emphasize data standards and APIs over tool-specific integration
- Enterprise perspective: Treat ecosystems as enterprise capabilities, not individual tools, requires extended leadership commitment.
- Customization caution: Excessive customization creates integration and sustainment challenges
- Open APIs: Importance of tools having open REST APIs
- Tool limitations: No "one-stop shopping" tool exists; multi-tool environments are necessary
- Manual processes: Many manual steps still required despite digital tool implementation
- Communication importance: Strong emphasis on communication between stakeholders
- Architecture planning: Creating reference architectures before implementation



## Question 8: What interop standard do you use and/or recommend to be an industry standard?

**Themes:** Diverse standards; semantic web technologies; recognition of knowledge gaps

- Knowledge gaps: Several respondents admit lack of knowledge about standards or are seeking input
- SysML adoption: SysML and future SysML 2.0 mentioned as potential standards
- Semantic technologies: RDF, OWL, SPARQL, JSON, and XML/XMI recommended
- Domain-specific standards: LML v2, OSLC for lifecycle collaboration
- Ontology approaches: Interest in INCOSE's DE Ontology WG work with BFO and CCO
- Custom architectures: Some developed their own reference architectures (DEERA)
- Pattern-based approaches: Moving beyond just standards to consider patterns and layers
- Tool agnosticism: Desire for tool-agnostic standards to avoid vendor lock-in
- Early standardization stage: General sense that interoperability standards are still emerging



# Question 9: How do you integrate your ASOT with various tools to ensure data consistency and traceability?

## General Themes:

- Wide spectrum of maturity levels - from complete lack of integration strategy to sophisticated multi-tool environments
- Multi-tool complexity - organizations juggling multiple platforms (Cameo, Jira, GitLab, Aras Innovator, Dassault 3DEXPERIENCE)
- Automation as key success factor - automated data processing reduces human error and ensures consistency
- Centralized approaches - using centralized databases and common data ontologies for interoperability
- Integration with development workflows - connecting ASOTs to DevSecOps pipelines and Agile processes

## Specific Approaches Mentioned:

- Conceptual data models using UAF
- Centralized database tools (SBE Vision)
- Automated weekly data snapshots and reformatting
- Cloud-based processing environments
- Manual "hand-walking" through systems for verification



# Question 10: What training is available and/or provided for educating users on how to access and use ASOT?

## General Themes:

- Inconsistent training approaches - ranging from formal contractor-delivered training to completely ad-hoc methods
- Resource-dependent solutions - leveraging external opportunities (like DAU) when available
- Role-based training initiatives - creating specialized positions like "Digital Thread Specialists"
- Documentation-heavy approaches - heavy reliance on guides, presentations, and wiki-style resources
- Gap between tool training and data quality - adequate access training but poor data context understanding

## Training Methods Mentioned:

- Contractor-delivered dashboard training
- Integration guides for major ASOTs
- Digital Transformer coaching teams
- PowerPoint presentations and videos
- Confluence pages and walkthroughs



# Question 11: How do you ensure data integrity, consistency, and accessibility throughout your Digital Ecosystem?

## General Themes:

- Metadata standardization advocacy - emphasis on Dublin Core filtering and structured metadata
- Persistent data quality issues - particularly in maintenance descriptions and narratives
- Critical impact on analysis - data quality problems affecting failure analysis and reliability modeling
- Manual verification requirements - need for human oversight despite automated systems
- Agile environment challenges - constantly changing requirements making consistency difficult

## Key Issues Identified:

- Inconsistent maintenance descriptions affecting failure mode analysis
- Impact on parametric values needed for RCM-based software
- Need for embedded team members to maintain accuracy
- Ever-changing requirements in Agile environments requiring constant model updates

### Overall Organizational Maturity Spectrum:

The responses reveal organizations at vastly different stages of digital transformation - from those with no coherent strategy to others implementing sophisticated multi-tool integrated environments with specialized roles and automated processes.