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# Digital Engineering Standards

April 4, 2024

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Prepared for:

General Manager, Corporate Chief Engineer's Office

Authorized by: Corporate Chief Engineer's Office

Developed in conjunction with Government and Industry contributors as part of the U.S. Space Programs Mission Success Improvement Workshop



## Acknowledgments

This document has been produced as a collaborative effort of the Mission Success Improvements Workshop (MSIW). The MSIW forum was organized to enhance mission assurance processes and supporting disciplines through collaboration between industry and government across the U.S. space program community utilizing an issue-based approach. The process is to engage the appropriate subject matter experts to share best practices across the community in order to produce value-added mission assurance guidance documentation.

The document was created by multiple authors throughout the government and the space industry. For their content contributions, the following contributing authors are acknowledged for making this collaborative effort possible:

| | |
|---|---|
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## Abstract

Mission Success Improvement Workshops (MSIWs) bring together partners from Aerospace, industry, and government organizations to address challenges that affect the entire space industry. MSIW participation is often voluntary and funded by willing participants whose goal is to improve success of the national space enterprise. The Digital Engineering (DE) Standards MSIW is focusing on helping the U.S. space industry realize the promised benefits of moving to digital methods of systems architecture and systems engineering (SE), including model-based systems engineering (MBSE) and digital twins. While traditional "artifact-based" methods have been the standard for decades, DE promises to bridge gaps between programs, between government and contractor partners, and between developers and operators.

Aerospace is co-hosting the DE Standards MSIW with industry partners. DE functional leaders from several major defense contractor organizations are participating alongside a broad Aerospace team, with government officials from Space Systems Command (SSC) representing the interests of the government. The workshops have featured discussions of stakeholder perspectives on the problem, as well as exercises to identify key aspects of the DE-based business model, value proposition, and key capabilities required to achieve the end goal of DE-driven acquisitions, development, and operations. The MSIW additionally performed a strengths, weaknesses, opportunities, and threats (SWOT) analysis to help identify transformation priorities and created capability threads to see the order of activities to accomplish these capabilities for transformation and to identify where any commonalities may lie between the threads. The team voted on the first projects to achieve high-priority capabilities and are beginning those projects in FY24. The end goal of the DE Standards MSIW is to define a roadmap for describing and implementing DE methods and practices across the industry and realizing the activities on the roadmap, whether through the MSIW or through an external organization's efforts.

This ATR includes products that the MSIW developed over the last 18 months to determine the root of the issues the industry is facing and make recommendations on what steps need to be taken (either by the MSIW or external groups) to realize a good future end-state for the industry. They can be revisited and updated as the MSIW and other external organizations progress.

# Digital Engineering (DE) Standards
# Mission Success Improvement Workshop (MSIW)

Dean Bucher
Digital Engineering Integration Office

Ron Squires
Northrop Grumman

March 2024

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# DE Standards

## MSIW

- **Open engagement and partnership between Aerospace and industry to enable DE success across the space enterprise**
  - Conducted via both in-person events and virtual 2-hour workshops
  - Exploring a multi-org strategy development and a project-planning effort

- **MSIW objectives**
  - Investigate and define standards that enable DE to be applied consistently across the enterprise, particularly between government and industry, and that enable interoperability between data, models, and tools
  - Investigate using DE to define and manage design and interface standards across the complex space enterprise

- **Participants include DE leads from**


NORTHROP GRUMMAN

MAXAR

SAIC

ULA

BAE SYSTEMS

BOEING

Raytheon
An RTX Business

LOCKHEED MARTIN

STRATOSPHERE

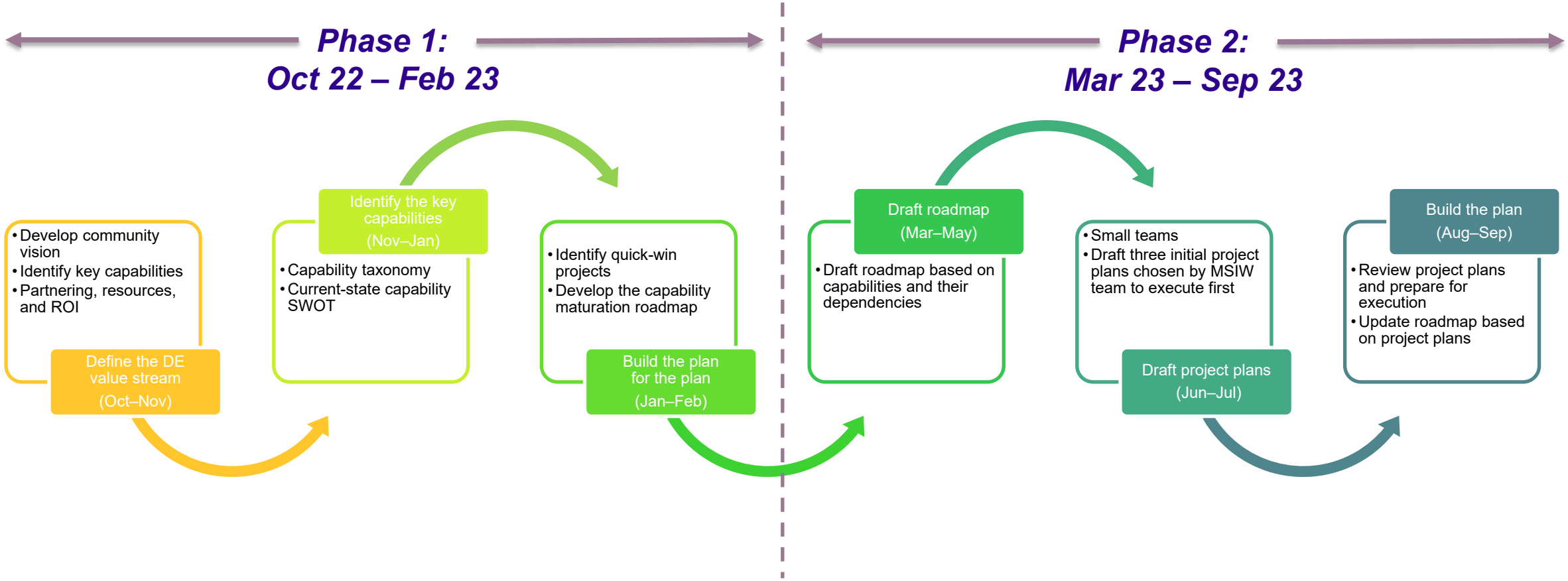
# Themes and Focus Areas

## Speed and Interoperability

- Industry-wide culture shift to enable DE adoption
  - Building trust in the model and data
  - Sharing to minimize duplication, enable collaboration, and protect proprietary, classified, and sensitive information
- Standardizing DE workflows and processes across the industry
  - Modeling languages, style guides, taxonomies/ontologies
  - Defining common interfaces, tool-to-tool translation, sharing environments
- Educating, hiring, and training the DE workforce
  - Standardized training for modelers
  - Training by role for those who need to interpret the models—growing systems thinkers
- Making the business case for profit-and-loss organizations
  - Protecting proprietary information and prior technical investments
- Contracting and acquisitions in a DE-centric environment
  - Standard CDRLs and contract language
  - Identifying modeling and analysis needs at each lifecycle stage
- Model VV&A
  - Tracing models to requirements, informing potential failure modes, standard levels of fidelity

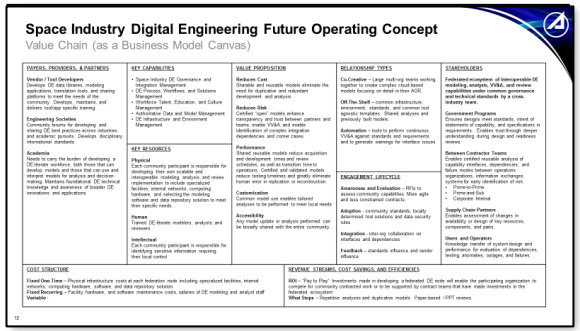
# MSIW Method: Phases 1 and 2

## Assessing Required Capabilities and Maturation Priorities, Creating Executable Way Forward




**Phase 3 "Execute the Plan" Is Ongoing**

# MSIW Process and Products

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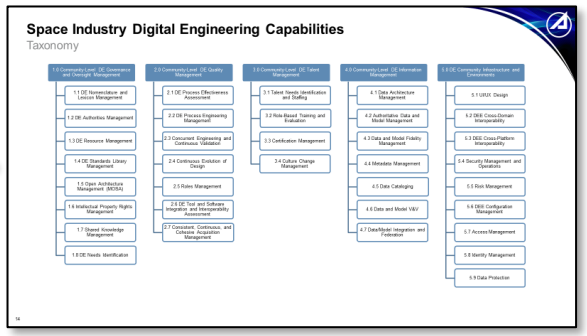


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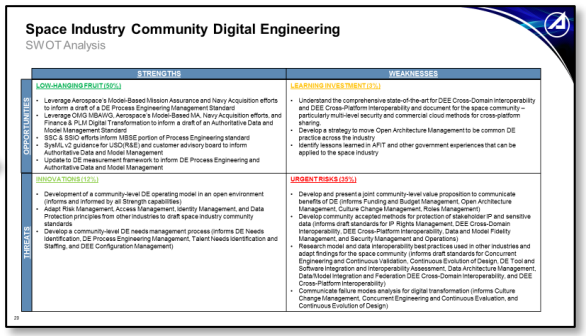


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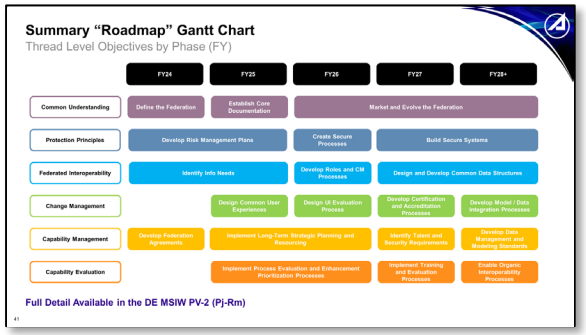


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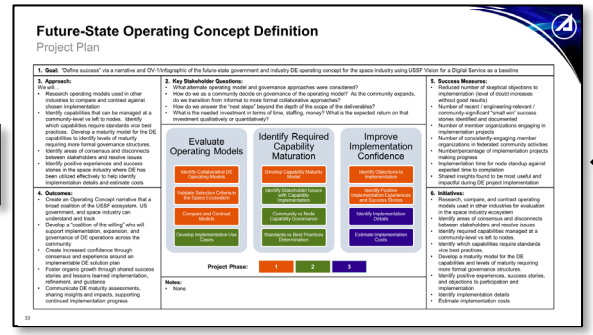
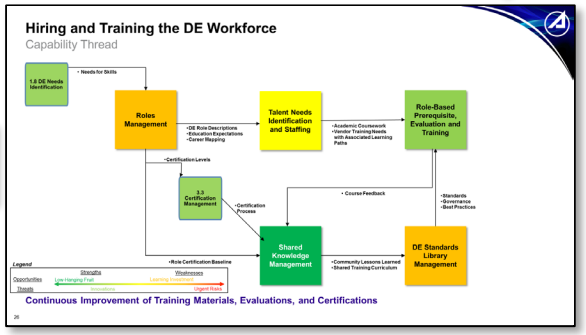



Transformation Project Plans




Transformation Capability Threads

**Culmination of Efforts Is a Plan for Community Action**

# MSIW Spring 2024 Status

- Post-MSIW work continues
  - Air Force Materiel Command (AFMC) initiating the Digital Acceleration Task Force (DATF)
    - Interested in leveraging the model and roadmap of the DE Standards MSIW as a framework for their effort
    - Inviting membership of the MSIW to join their larger effort
  - Existing MSIW team will continue supporting project plans that were developed in 2023
    - Developing a common lexicon
    - Defining the future operational state in deeper detail
    - Developing principles of model and data interoperability
  - Existing MSIW team will continue to meet bi-monthly to provide status on project plans, review DATF progress, and act as a focus group for pertinent community topics

# Table of Contents

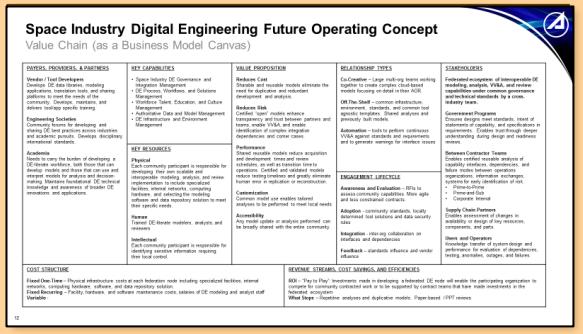
# ATR Layout and Products Generated

- This ATR walks through the products generated by the DE Standards MSIW. Since October 2022, this team has:
  - Captured the vision of the **future operating concept**[1] we'd like to see as an industry
  - Defined the **required end-state capabilities**[1] to achieve that future concept
  - Performed a **SWOT analysis**[1] to help us identify our transformation priorities
  - Created **transformation capability threads**[1] to see the order of activities to accomplish these capabilities for transformation and where any commonality might lie between the threads
  - Created **project plans**[1] for three projects that the MSIW voted on to address first
  - Developed a **draft community-adopted roadmap**[2] to illustrate an actual executable path forward

[1] Final WG product

[2] Draft WG product

# MSIW Process and Products

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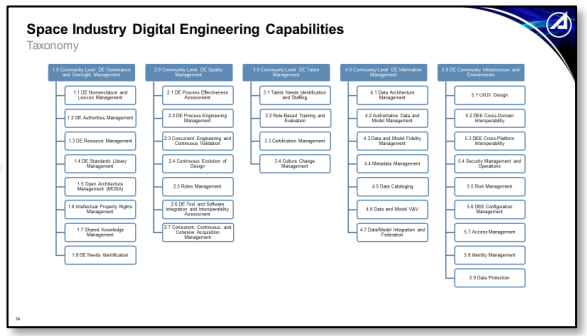


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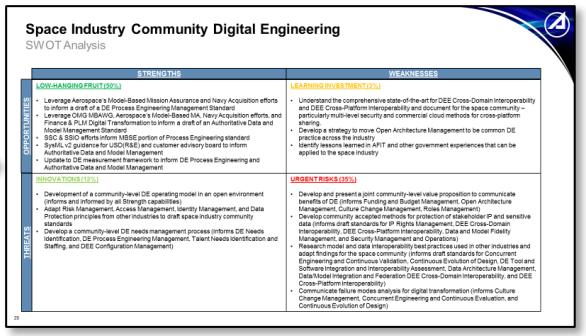


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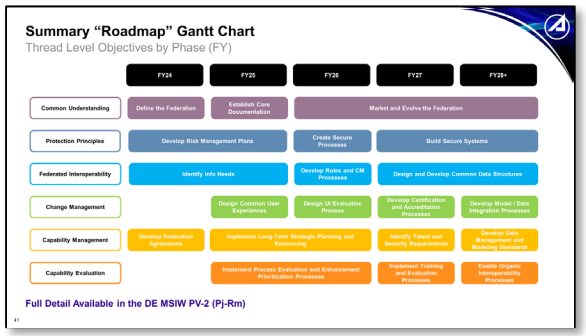


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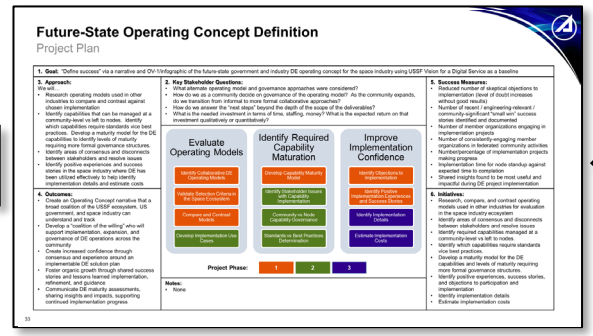


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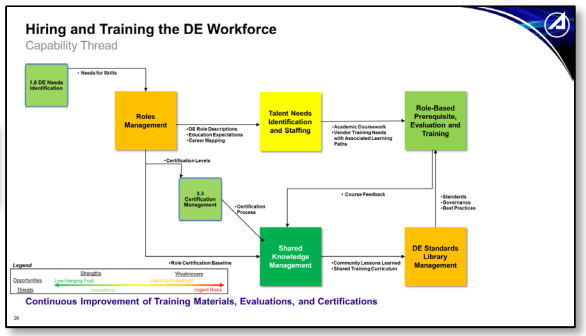



Transformation Capability Threads

## Culmination of Efforts Is a Plan for Community Action

# Space Industry DE Future Operating Concept

## Value Chain (as a Business Model Canvas)

**PAYERS, PROVIDERS, & PARTNERS**

**Vendor / Tool Developers**
Develops DE data libraries, modeling applications, translation tools, and sharing platforms to meet the needs of the community. Develops, maintains, and delivers tool/app specific training.

**Engineering Societies**
Community forums for developing and sharing DE best practices across industries and academic pursuits. Develops disciplinary international standards.

**Academia**
Needs to carry the burden of developing a DE-literate workforce, both those that can develop models and those that can use and interpret models for analysis and decision-making. Maintains foundational DE technical knowledge and awareness of broader DE innovations and applications.

**KEY CAPABILITIES**

- Space Industry DE Governance and Integration Management
- DE Process, Workflows, and Solutions Management
- Workforce Talent, Education, and Culture Management
- Authoritative Data and Model Management
- DE Infrastructure and Environment Management

**KEY RESOURCES**

**Physical**
Each community participant is responsible for developing their own scalable and interoperable modeling, analysis, and review implementation to include specialized facilities, internal networks, computing hardware, and selecting the modeling software and data repository solution to meet their specific needs.

**Human**
Trained DE-literate modelers, analysts, and reviewers

**Intellectual**
Each community participant is responsible for identifying sensitive information requiring their local control.

**VALUE PROPOSITION**

**Reduces Cost**
Sharable and reusable models eliminate the need for duplicative and redundant development and analysis.

**Reduces Risk**
Certified "open" models enhance transparency and trust between partners and teams, enable VV&A, and enable identification of complex integration dependencies and corner cases.

**Performance**
Shared reusable models reduce acquisition and development times and review schedules, as well as transition time to operations. Certified and validated models reduce testing timelines and greatly eliminate human error in replication or reconstruction.

**Customization**
Common model use enables tailored analyses to be performed to meet local needs

**Accessibility**
Any model update or analysis performed can be broadly shared with the entire community.

**RELATIONSHIP TYPES**

**Co-Creative** – Large multi-org teams working together to create complex cloud-based models focusing on detail in their AOR.

**Off-The-Shelf** – common infrastructure, environment, standards, and common tool agnostic templates. Shared analyses and previously built models.

**Automation** – tools to perform continuous VV&A against standards and requirements and to generate warnings for interface issues

**ENGAGEMENT LIFECYCLE**

**Awareness and Evaluation** – RFIs to assess community capabilities. More agile and less constrained contracts.

**Adoption** - community standards, locally determined tool solutions and data security rules

**Integration** - inter-org collaboration on interfaces and dependencies

**Feedback** – standards influence and vendor influence

**STAKEHOLDERS**

**Federated ecosystem of interoperable DE modeling, analysis, VV&A, and review capabilities under common governance and technical standards by a cross-industry team.**

**Government Programs**
Ensures designs meet standards, intent of statements of capability, and specifications in requirements. Enables trust through deeper understanding during design and readiness reviews.

**Between Contractor Teams**
Enables certified reusable analysis of capability interfaces, dependencies, and failure modes between operations organizations, information exchanges, systems for early identification of risk.

- Prime-to-Prime
- Prime-and-Sub
- Corporate Internal

**Supply Chain Partners**
Enables assessment of changes in availability or design of key resources, components, and parts.

**Users and Operators**
Knowledge transfer of system design and performance for evaluation of dependencies, testing, anomalies, outages, and failures.

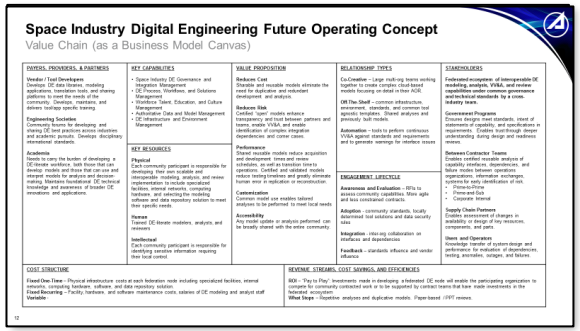
**COST STRUCTURE**

**Fixed One-Time** – Physical infrastructure costs at each federation node including specialized facilities, internal networks, computing hardware, software, and data repository solution.
**Fixed Recurring** – Facility, hardware, and software maintenance costs, salaries of DE modeling and analyst staff
**Variable** -

**REVENUE STREAMS, COST SAVINGS, AND EFFICIENCIES**

**ROI** – "Pay to Play": Investments made in developing a federated DE node will enable the participating organization to compete for community contracted work or to be supported by contract teams that have made investments in the federated ecosystem
**What Stops** – Repetitive analyses and duplicative models. Paper-based / PPT reviews.

# MSIW Process and Products

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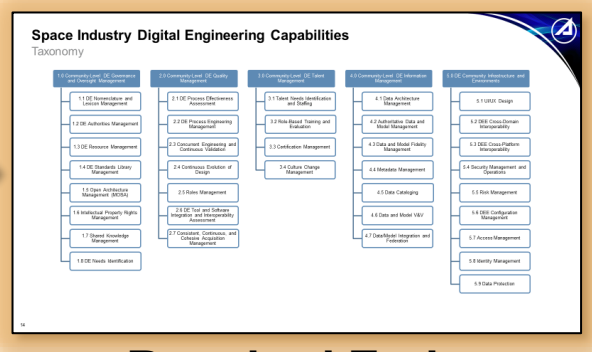


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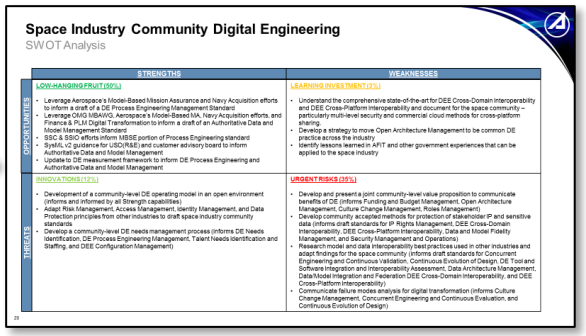


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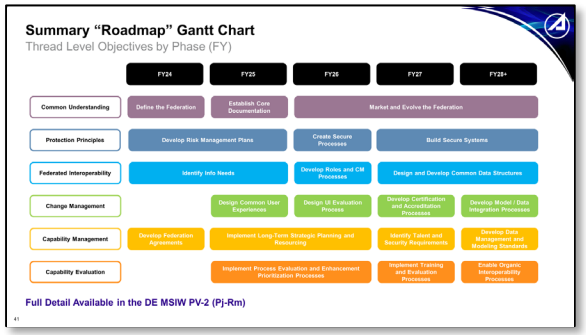


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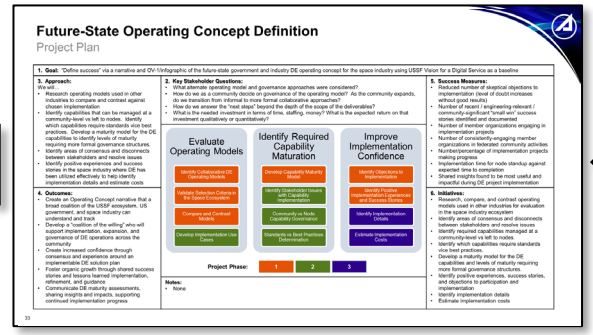
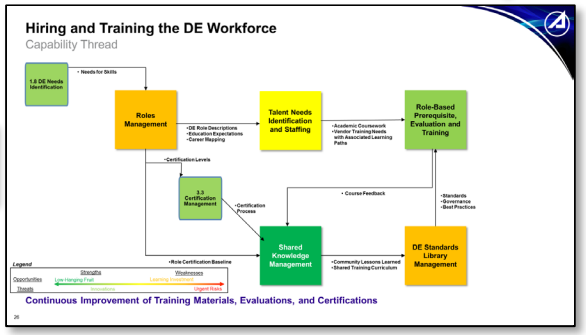



Transformation Project Plans




Transformation Capability Threads

**Culmination of Efforts Is a Plan for Community Action**

# DE Community-Level Capabilities

## Defined

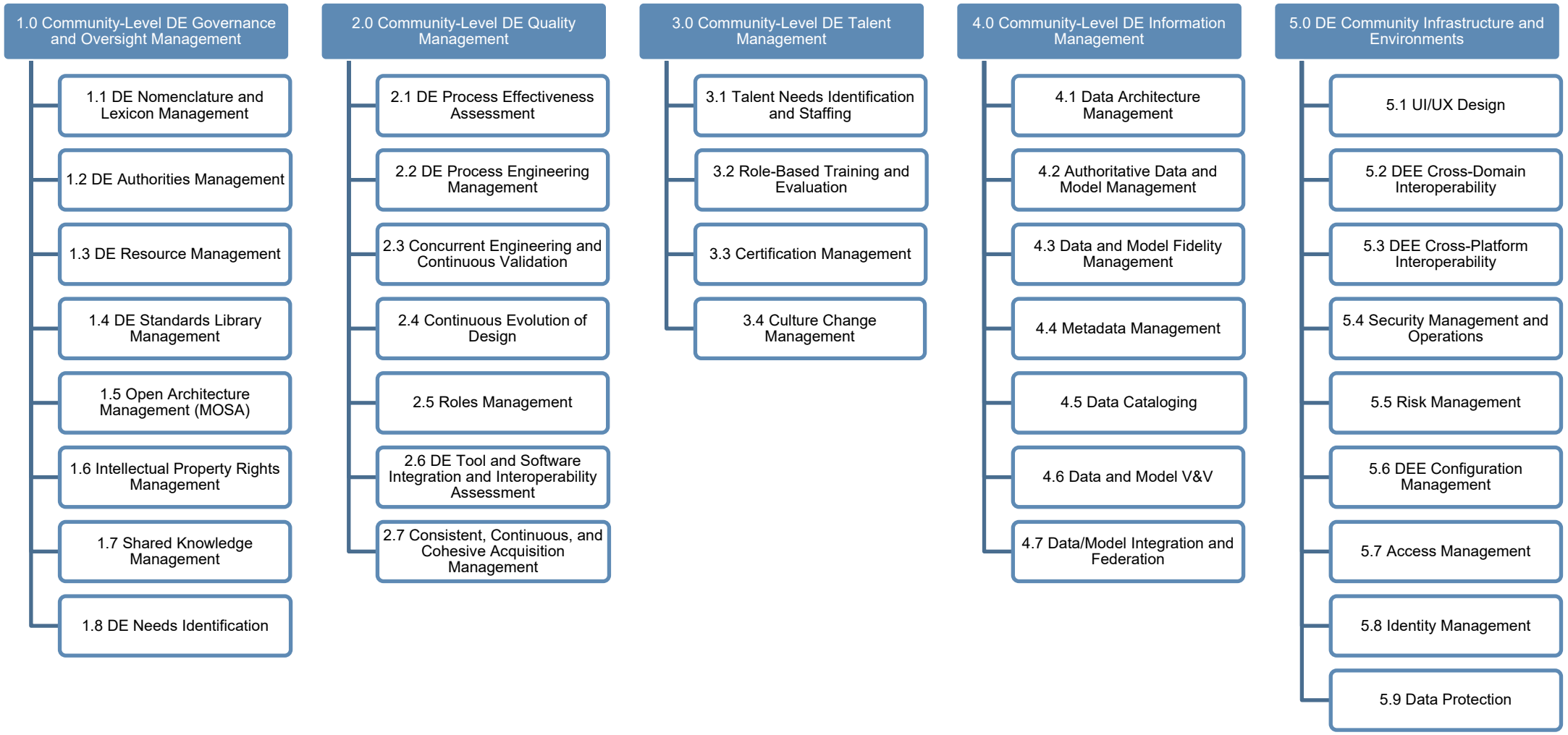
- DE community-level capabilities are those things that enable the widespread adoption of interoperable DE practices that the U.S. space community must perform competently (or seek to perform competently) to deliver DE-driven products and services that increase analysis and acquisition speed

- DE community-level capabilities comprise:
  - Measures of success (outcomes, satisfaction, progress, and performance metrics)
  - Rules (standards, governance, policies, procedures, and training)
  - Process (activity flow, interfaces, and resources)
  - Personnel (skillsets and expertise in workgroups and teams)
  - Data and information flows
  - Tools and software application functions
  - Service platforms and environments
  - Computing and storage system, device, and network hardware
  - Facilities, utilities, and physical infrastructure

- Successful DE implementation is about more than the standards and involves:
  - Defining the to-be state of each capability (usually shifting from manual toward system-centric)
  - Building a roadmap of initiatives to develop, transform, or maintain/sustain the capabilities
  - Ensuring the right team is responsible for executing the initiative and synchronizing with dependent initiatives and teams

# Space Industry DE Capabilities

## Taxonomy



# Capability Definitions

## 1.0 Community-Level DE Governance and Oversight Management

- 1.1 DE Nomenclature and Lexicon Management: managing the vocabulary and naming rules for DE activities
- 1.2 DE Authorities Management: managing the governance, authorities, and accountabilities for DE activities
- 1.3 DE Resource Management: managing the projected cost and allocation of funds for community-level DE activities
- 1.4 DE Standards Library Management: managing the DE standards and specifications that are used community-wide
- 1.5 Open Architecture Management: managing the guidelines for design, specifications, quality, and performance metrics of the DE community-wide modular open architecture via a standard way to describe, manage, and measure modularity and openness
- 1.6 Intellectual Property Rights Management: managing the policies and practices that govern intellectual property rights as they relate to DE
- 1.7 Shared Knowledge Management: managing the DE information available at a community level
- 1.8 DE Needs Identification: identifying the community's requirements, constraints, and issues in the execution of DE activities

# Capability Definitions

## 2.0 Community-Level DE Quality Management

- 2.1 DE Process Effectiveness Assessment: assessing the measure of DE processes' ability to produce desired results
- 2.2 DE Process Engineering and Management: developing and managing the processes at a community level to enable DE execution within organizations
- 2.3 Concurrent Engineering and Continuous Validation: evaluating the quality of the design; e.g., how do stakeholders know what aspects of the design to assess and provide feedback/review (model change management)
- 2.4 Continuous Evolution of Design: changing the design without breaking it—accepting/rejecting proposed changes
- 2.5 Roles Management: defining industry-level roles for DE professionals that set typical responsibilities of each role in processes and driving expectations of competencies, education, training, and certification standards
- 2.6 DE Tool and Software Integration and Interoperability Assessment: assessing and confirming the ability of DE tools and other developed software to function together as a unified whole and/or incorporate content from multiple disparate or independent software or tools
- 2.7 Consistent, Continuous, and Cohesive Acquisition Management: managing acquisition programs as they progress through their lifecycle in a manner that is conducted in the same manner over time, unceasing, well-structured, and organized

# Capability Definitions

## 3.0 Community-Level DE Talent Management

- 3.1 Talent Needs Identification and Staffing: assessing the community's current capabilities of critical DE skills and identifying the capabilities still needed
- 3.2 Role-Based Training and Evaluation: identifying the DE training content required based on different program or organizational roles and the evaluation processes required to ensure competency
- 3.3 Certification Management: managing the processing and execution of community-level DE training certifications
- 3.4 Culture Change Management: managing the acceptance of DE and modification of the community perception of DE

# Capability Definitions

## 4.0 Community-Level DE Information Management

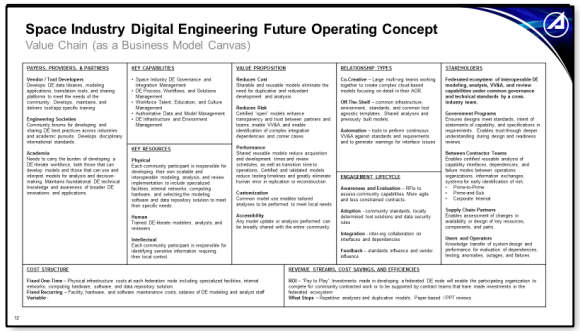
- 4.1 Data Architecture Management: managing the data chain that connects the IT/infrastructure/environment and design; e.g., data flowing from RFP has a pathway to requirements and design (standard approaches for data interoperability)
- 4.2 Authoritative Data and Model Management: managing the key elements of model and data baselines and ensuring stakeholders are apprised of the correct ways to collect and share the models and data
- 4.3 Data and Model Fidelity Management: managing the appropriate level of detail and/or completeness required at different program points or for different stakeholders
- 4.4 Metadata Management: managing processes and technologies that help manage and understand metadata to effectively use underlying data
- 4.5 Data Cataloging: creating an organized inventory of enterprise data
- 4.6 Data and Model V&V: ensuring the current data and/or model is acceptable, accurate, and consistent and reflects its intended purpose
- 4.7 Data/Model Integration and Federation: ensuring the ability of DE data and models to be integrated such that they function together as a unified whole

# Capability Definitions

## 5.0 DE Community Infrastructure and Environments

- 5.1 UI/UX Design: designing DE user experience/user interfaces that enable positive interactions with DE infrastructure and environments
- 5.2 DEE Cross-Domain Interoperability: ensuring that systems from different security domains can interact and exchange information with the DEE (federating security enclaves → guards → data interface needs) while moving between security levels (defining “zero trust”)
- 5.3 DEE Cross-Platform Interoperability: ensuring that systems from different platforms can interact and exchange information with the DEE
- 5.4 Security Management and Operations: managing protocols to ensure DE infrastructure and environment security and enabling the interaction with the DE infrastructure and environment at the appropriate security level (moving toward “zero trust” in operating within a security level)
- 5.5 Risk Management: identifying, analyzing, and responding to risk factors to the DE infrastructure and environments; resilience, including fault tolerance and disaster recovery
- 5.6 DEE Configuration Management: managing OS/app/tool baseline versions, freeze control, including cross-platform
- 5.7 Access Management: identifying, tracking, controlling, and managing authorized or specified users’ access to the DE infrastructure or environments, including cross-platform
- 5.8 Identity Management: managing attributes related to the user within the DE infrastructure and environments, including cross-platform
- 5.9 Data Protection: protecting data and ensuring proper dissemination to appropriate users

# MSIW Process and Products

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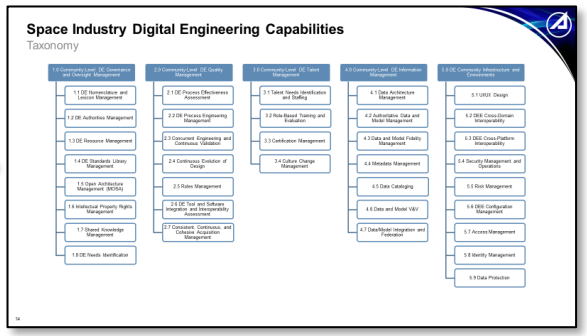


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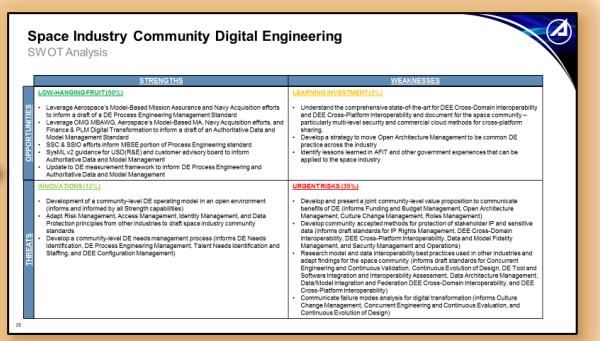


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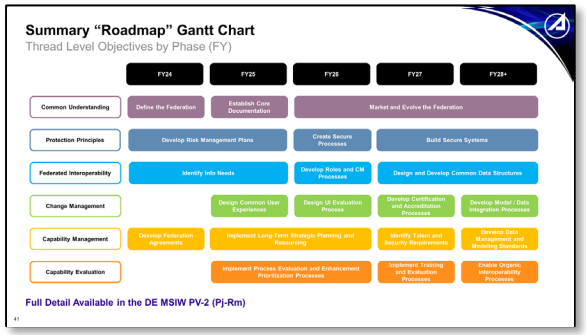


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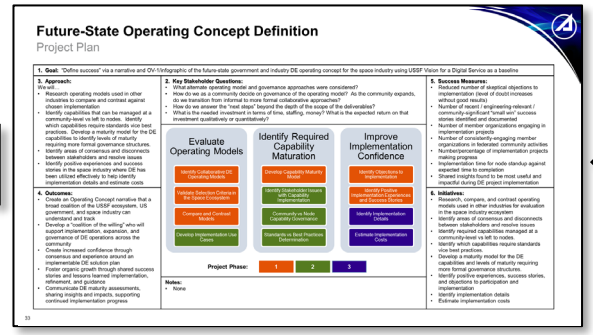
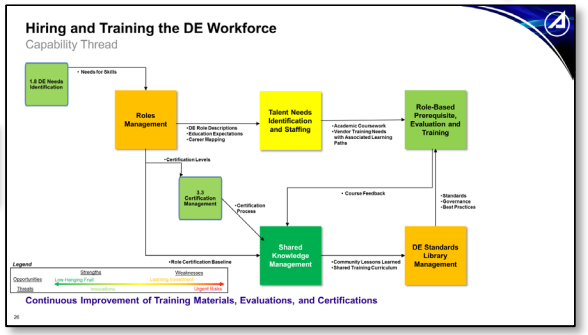



Transformation Project Plans




Transformation Capability Threads

**Culmination of Efforts Is a Plan for Community Action**

# Space Industry Community DE

## SWOT Analysis

| | STRENGTHS | WEAKNESSES |
|---|---|---|
| OPPORTUNITIES | **LOW-HANGING FRUIT**<br>• Leverage Aerospace's Model-Based Mission Assurance (MA) and Navy Acquisition efforts to inform a draft of a DE Process Engineering Management Standard<br>• Leverage OMG Model-Based Acquisition User Group, Aerospace's Model-Based MA, Navy Acquisition efforts, and Finance & PLM Digital Transformation to inform a draft of an Authoritative Data and Model Management Standard<br>• SSC & SSIO efforts inform MBSE portion of Process Engineering Management Standard<br>• SysML v2 guidance for USD(R&E) and customer advisory board to inform Authoritative Data and Model Management Standard<br>• Update to DE measurement framework to inform DE Process Engineering Management Standard and Authoritative Data and Model Management Standard | **LEARNING INVESTMENT**<br>• Understand the comprehensive state-of-the-art for DEE Cross-Domain Interoperability and DEE Cross-Platform Interoperability and document for the space community—particularly multi-level security and commercial cloud methods for cross-platform sharing.<br>• Develop a strategy to move open-architecture management to be common DE practice across the industry<br>• Identify lessons learned in AFIT and other government experiences that can be applied to the space industry |
| THREATS | **INNOVATIONS**<br>• Development of a community-level DE operating model in an open environment (informs and informed by all Strength capabilities)<br>• Adapt risk management, access management, identity management, and data protection principles from other industries to draft space industry community standards<br>• Develop a community-level DE needs management process (informs DE needs identification, DE process engineering management, talent needs identification and staffing, and DEE configuration management) | **URGENT RISKS**<br>• Develop and present a joint community-level value proposition to communicate benefits of DE (informs funding and budget management, open-architecture management, culture change management, roles management)<br>• Develop community-accepted methods for protection of stakeholder IP and sensitive data (informs draft standards for IP rights management, DEE cross-domain interoperability, DEE cross-platform interoperability, data and model fidelity management, and security management and operations)<br>• Research model and data interoperability best practices used in other industries and adapt findings for the space community (informs draft standards for concurrent engineering and continuous validation, continuous evolution of design, DE tool and software integration and interoperability assessment, data architecture management, data/model integration and federation DEE cross-domain interoperability, and DEE cross-platform interoperability)<br>• Communicate failure modes analysis for digital transformation (informs culture change management, concurrent engineering and continuous evaluation, and continuous evolution of design) |

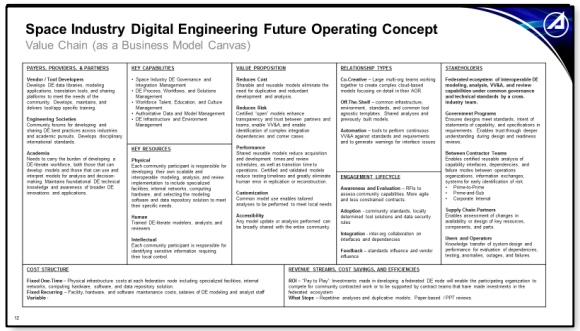
# Space Industry Community DE

## SWOT-Indexed Capability Taxonomy

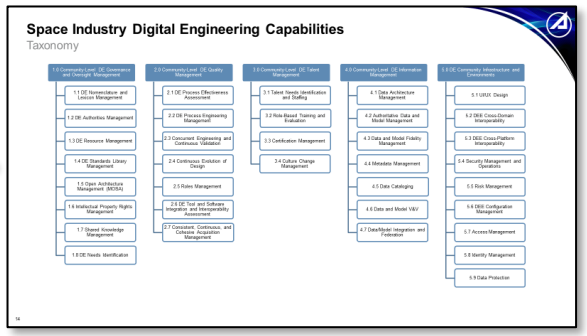
- 1.0 Community-Level DE Governance and Oversight Management
  - 1.1 DE Nomenclature and Lexicon Management
  - 1.2 DE Authorities Management
  - 1.3 DE Resource Management
  - 1.4 DE Standards Library Management
  - 1.5 Open Architecture Management (MOSA)
  - 1.6 Intellectual Property Rights Management
  - 1.7 Shared Knowledge Management
  - 1.8 DE Needs Identification
- 2.0 Community-Level DE Quality Management
  - 2.1 DE Process Effectiveness Assessment
  - 2.2 DE Process Engineering Management
  - 2.3 Concurrent Engineering and Continuous Validation
  - 2.4 Continuous Evolution of Design
  - 2.5 Roles Management
  - 2.6 DE Tool and Software Integration and Interoperability Assessment
  - 2.7 Consistent, Continuous, and Cohesive Acquisition Management
- 3.0 Community-Level DE Talent Management
  - 3.1 Talent Needs Identification and Staffing
  - 3.2 Role-Based Training and Evaluation
  - 3.3 Certification Management
  - 3.4 Culture Change Management
- 4.0 Community-Level DE Information Management
  - 4.1 Data Architecture Management
  - 4.2 Authoritative Data and Model Management
  - 4.3 Data and Model Fidelity Management
  - 4.4 Metadata Management
  - 4.5 Data Cataloging
  - 4.6 Data and Model V&V
  - 4.7 Data/Model Integration and Federation
- 5.0 DE Community Infrastructure and Environments
  - 5.1 UI/UX Design
  - 5.2 DEE Cross-Domain Interoperability
  - 5.3 DEE Cross-Platform Interoperability
  - 5.4 Security Management and Operations
  - 5.5 Risk Management
  - 5.6 DEE Configuration Management
  - 5.7 Access Management
  - 5.8 Identity Management
  - 5.9 Data Protection

***Legend***

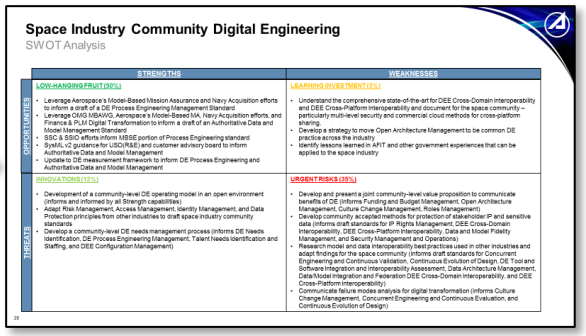
# MSIW Process and Products



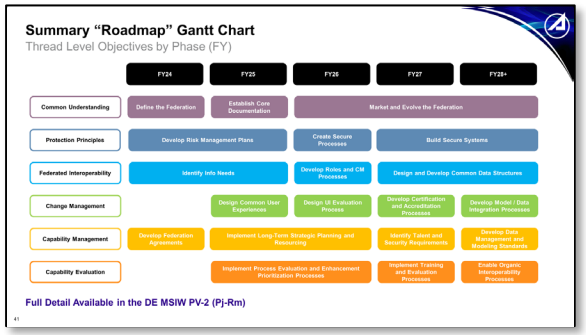

Future Operating Concept



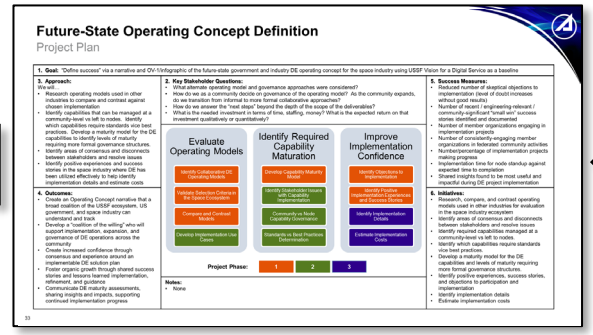

Required End-State Capabilities



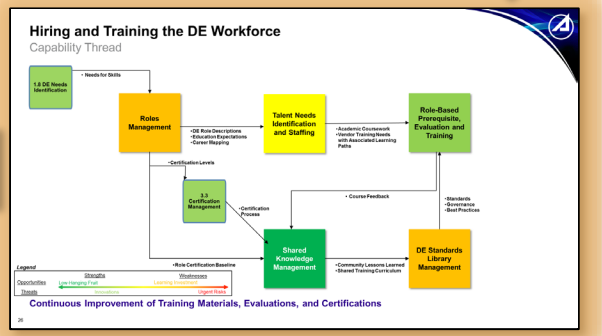

SWOT Analysis




Community Adopted Plan/Roadmap




Transformation Project Plans

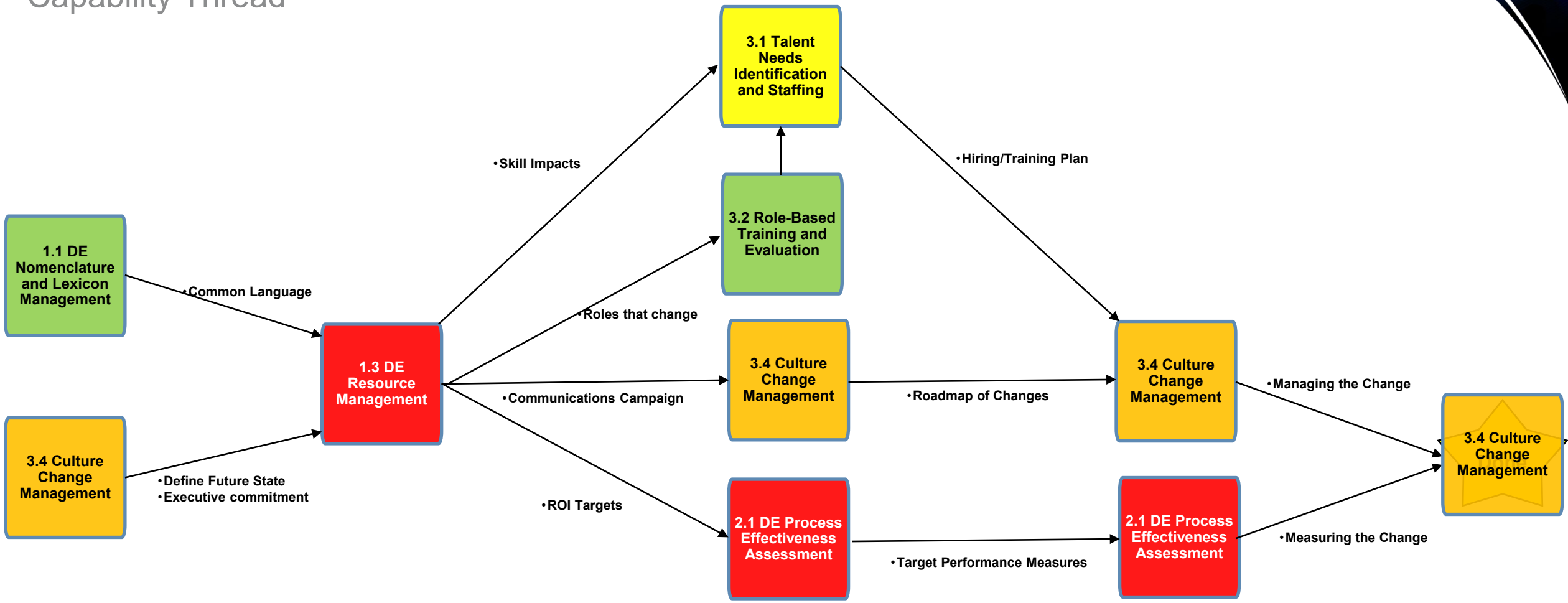



Transformation Capability Threads

## Culmination of Efforts Is a Plan for Community Action

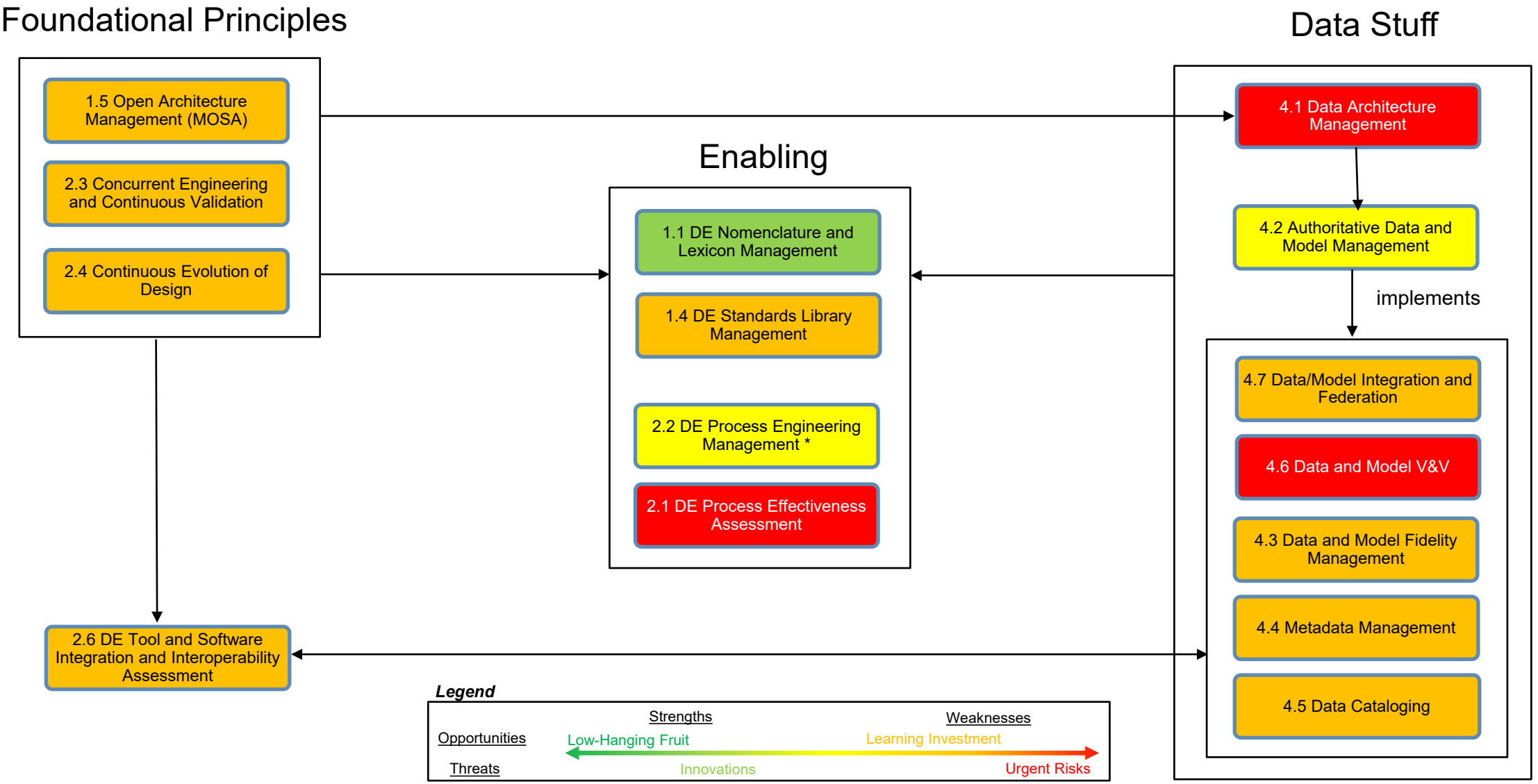
# Industry-Wide Culture Shift to Enable DE Adoption

## Capability Thread



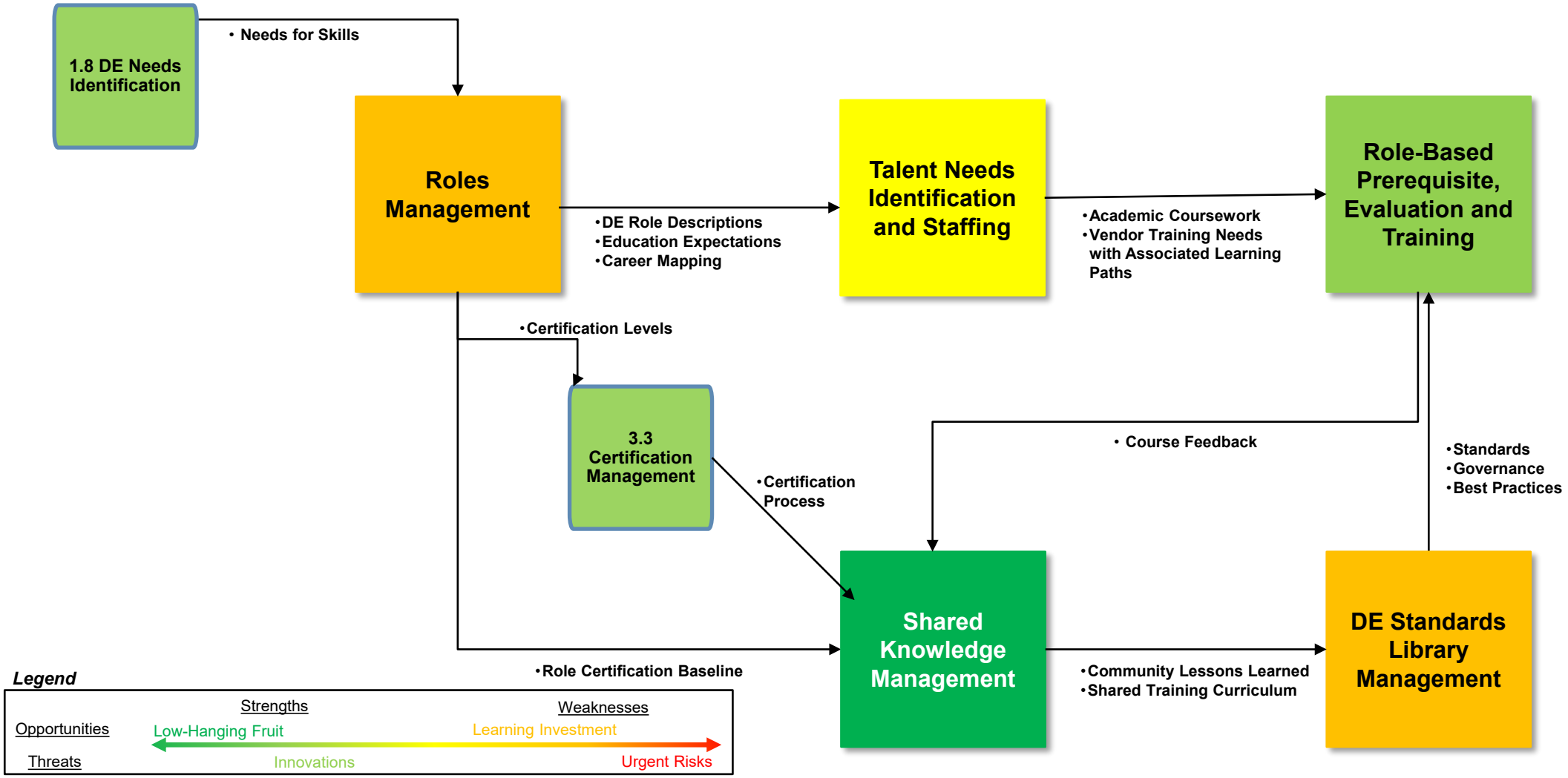
# Standardizing DE Workflows and Processes Across the Industry

## Capability Thread



# Hiring and Training the DE Workforce

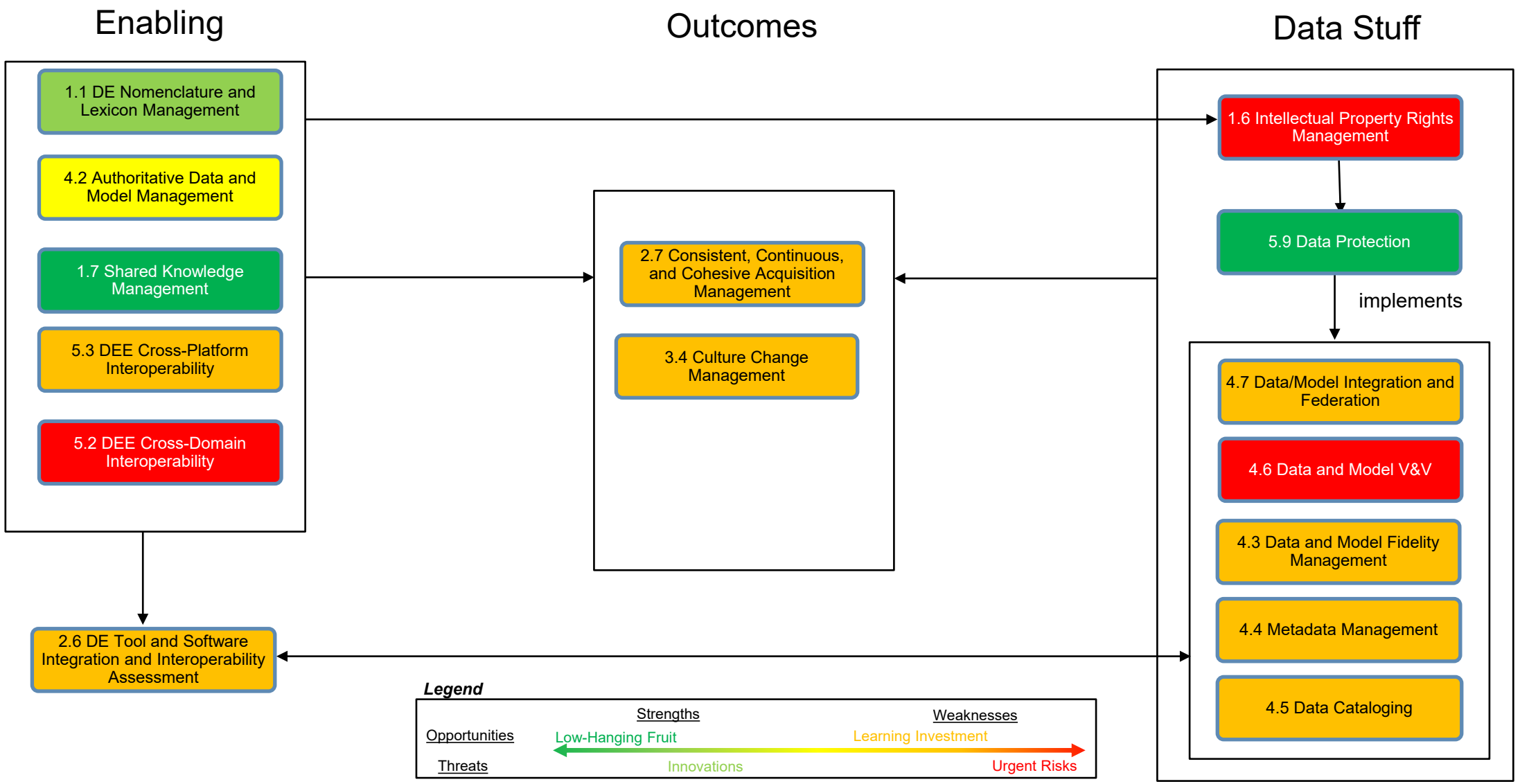
## Capability Thread




**Continuous Improvement of Training Materials, Evaluations, and Certifications**

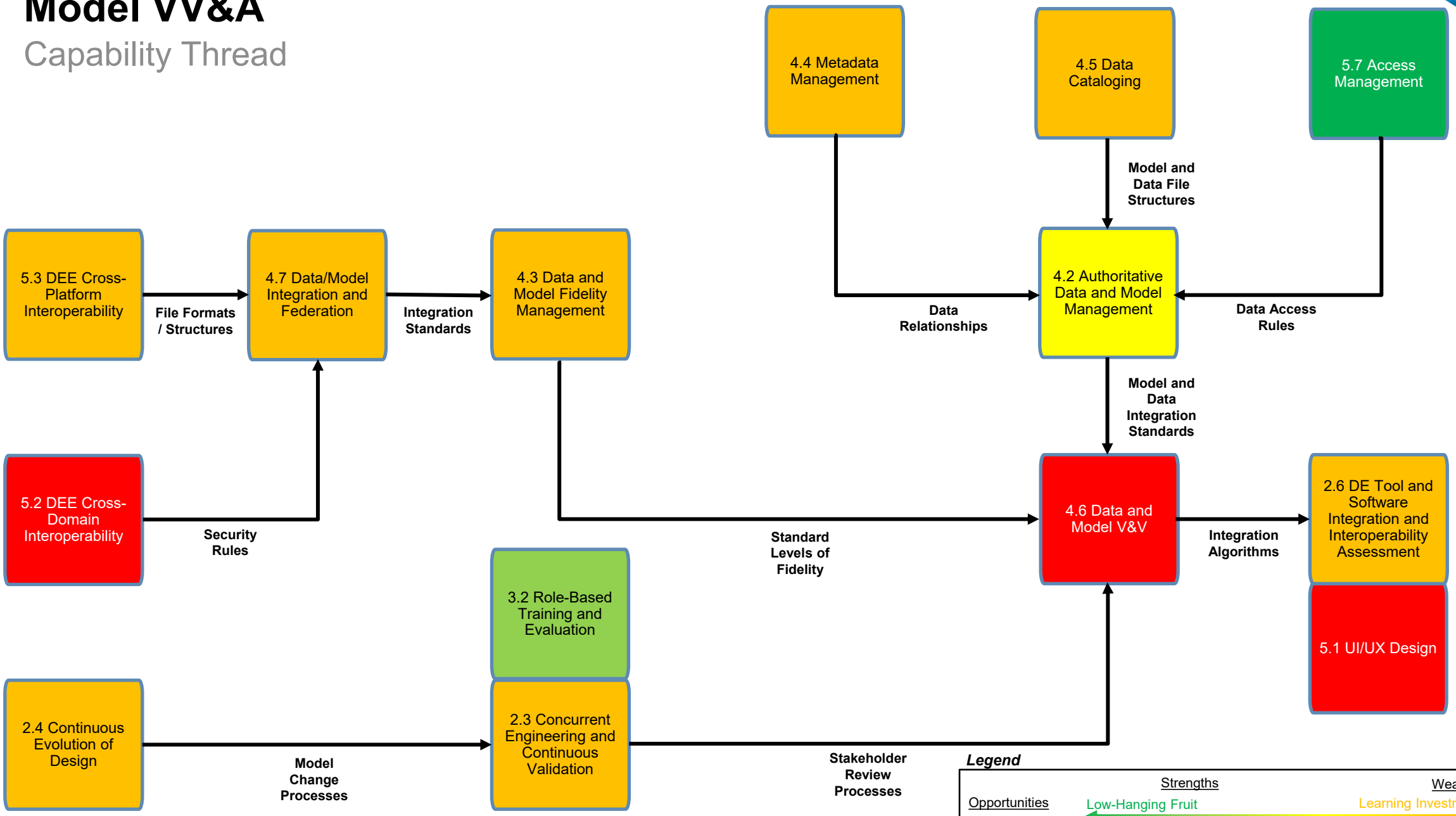
# Contracting and Acquisition in a DE-Centric Environment

## Capability Thread



# Model VV&A

## Capability Thread



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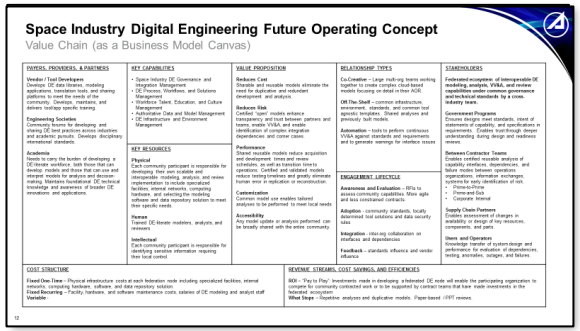
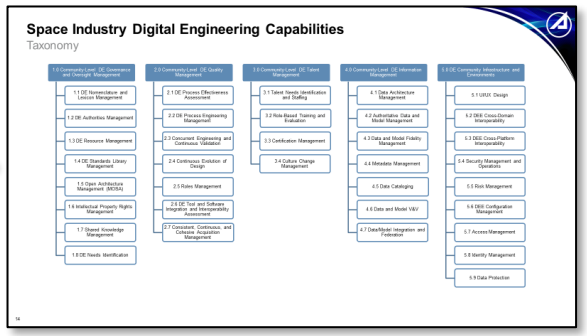



Future Operating Concept

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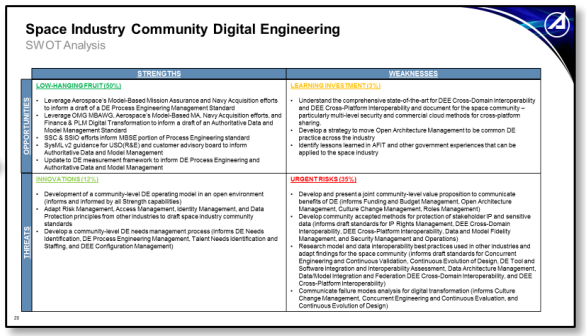
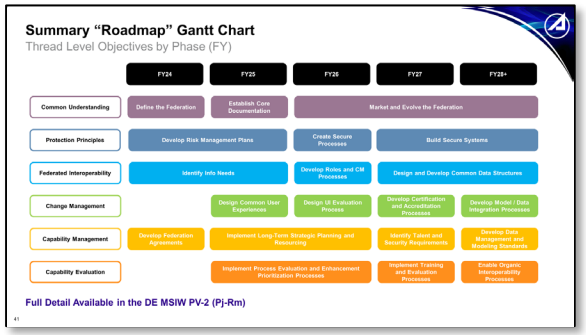



SWOT Analysis

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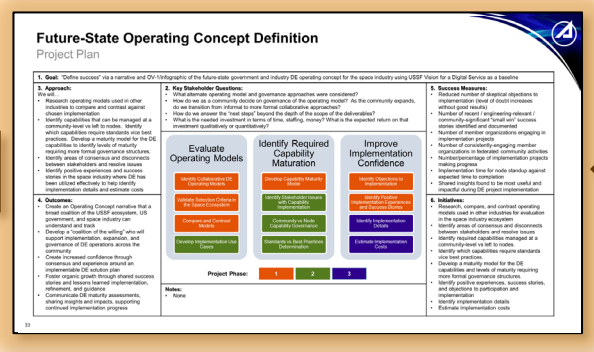
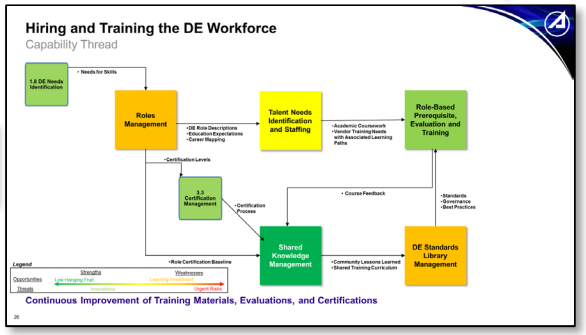



Transformation Project Plans




Transformation Capability Threads

**Culmination of Efforts Is a Plan for Community Action**

# Best Practices for Managing and Communicating DE Lexicon

## Project Placemat

**1. Goal:** Develop best practices for managing and communicating DE lexicon, nomenclature, and shared knowledge to gain consensus among government and industry

**3. Approach:**

We will…

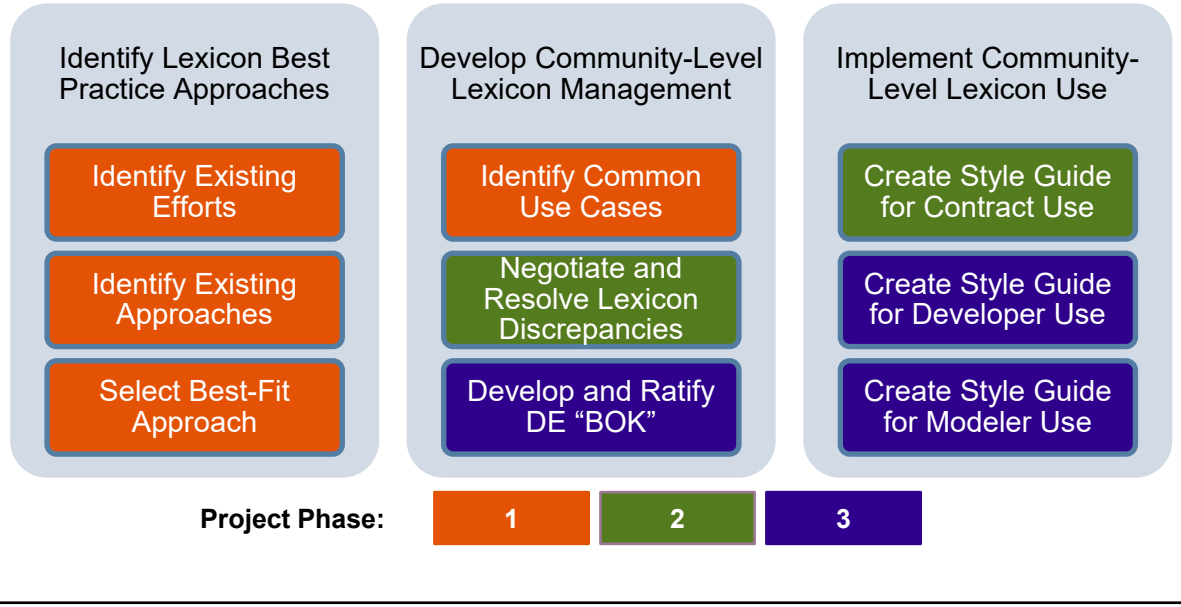
- Understand existing standards efforts
- Identify best practice approaches
- Identify common challenges, community-level gaps, and proposed solutions
- Identify, negotiate, and resolve discrepancies between existing and proposed solutions and stakeholder constraints
- Make community-level recommendations
- Incorporate findings and recommendations into new and updated documents / whitepapers / standards

**4. Outcomes:**

- Reduced rework and duplication of effort
- Maturation of DE capabilities at the community level (INCOSE MBSE capability matrix / USAF DE maturity assessment)
- Engaged stakeholders in the DE transformation process and stakeholders more prepared to tackle harder problems
- Agreement on a basic common DE lexicon
- Dissemination of knowledge of common lexicon
- Community-level education in and use of common lexicon and nomenclature

**2. Key Stakeholder Questions:**

- How does this help government agencies who currently have differing concepts of digital twin, ecosystem, digital thread, etc., communicate with one another?
- How will we ensure that RFPs / RFIs clearly articulate the government's needs for CDRLs and use a common lexicon in contract language?
- How do the best practices for the space industry adopt / adapt what's already been developed in other industries and lifecycle phases and align with SysML 2.0?
- How will this project's products eventually support the formalization of data-level semantic constructs?




**Notes:**

- AIAA DEIC & INCOSE DEIXWG, OMG Model-Based Acquisition User Group
- MBSE tool vendors and standards bodies that need to be compliant (FMI, DCP, LOTAR)

**5. Success Measures:**

- Reduced number of errors
- Zero "no bids" due to DE requirements
- Reduced number of DE CDRL-related questions asked at a bidders conference
- Community alignment of definitions of DE terms
- Increased number of organizations sponsoring DE efforts
- Increased DE capability resourcing
- Broader sharing of success stories
- Increased consensus for DE glossary
- Increased number of defined DE terms
- Published definitions in a DE "BOK"
- BOK page hits / access metrics
- References to DE standards and use of lexicon across contract Section L

**6. Initiatives:**

- Identify the best-fit approach for lexicon management in the DE space community
- Develop a group and process for managing lexicon for the DE space community
- Create a Space Community DE Book of Knowledge (BOK)
- Create style guides for various community segments to implement lexicon use

# Best Practices for Managing and Communicating DE Lexicon

## Project Summary

- Government agencies procuring material for space applications do not yet have a common DE lexicon
- Without a common DE lexicon, procurement requirements (e.g., RFIs, RFPs, CDRLs) will not clearly articulate the government's needs and DE deliverables will not be compatible and will not drive the formalization of data-level semantic constructs

- Final deliverable: **DE Book of Knowledge for Space Applications**

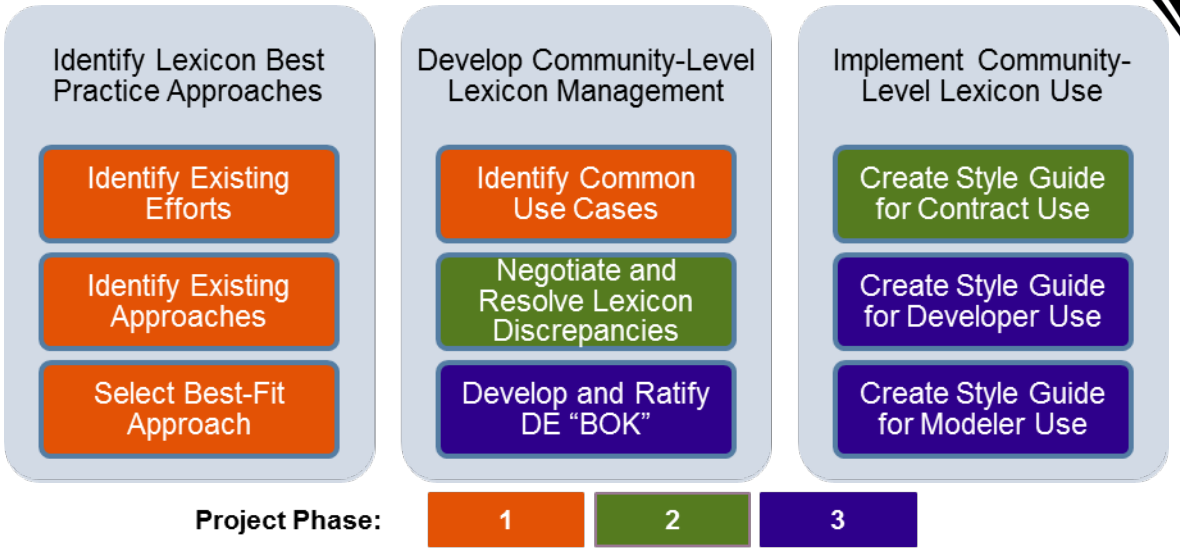
- This project will:
  - Develop a **DE book of knowledge for space applications** to improve model and data interoperability, facilitating DE within the space domain
  - **Prioritize and research definitions** and select a best-fit approach
  - Identify **use cases**
  - **Build out the lexicon**
  - Productize the lexicon via a **"style guide"**
  - **Leverage best practices** for the space industry to adopt/adapt what's already been developed in other industries and lifecycle phases

# Best Practices for Managing and Communicating DE Lexicon

## Project Summary

### MSIW team tasks for Phase 1 (in progress)

- Baseline lexicon pilot terms
- Task 1: Identification of lexicon use cases
- Task 2: Research existing efforts and resources for lexicon pilot terms
- Task 3: Research existing approaches
- Task 4: Select best-fit approach
- Task 5: Develop Phase 2 plan




### Phase 2 activities—support defined during Phase 1

- Reconciliation of lexicon pilot term discrepancies
- Documentation of pilot reconciliation approach
- Identify follow-on lexicon scope (i.e., other terms beyond pilot)
- Definition planning for content and format of DE BoK
- Engagement with stakeholders for initial product reviews
- Development of Phase 3 plan

### Phase 3 activities—support defined during Phase 2

- Assume to be contracted/sponsored work
- Development of DE BoK and remaining style guide and standardize guidance content
- Apply complete approach to follow-on lexicon scope
- Engagement with stakeholders for final product reviews
- Stakeholder communication of result

**Phase 1 in progress**

# Future-State Operating Concept Definition

## Project Plan

**1. Goal:** "Define success" via a narrative and OV-1/infographic of the future-state government and industry DE operating concept for the space industry using USSF Vision for a Digital Service as a baseline

**3. Approach:**

We will…

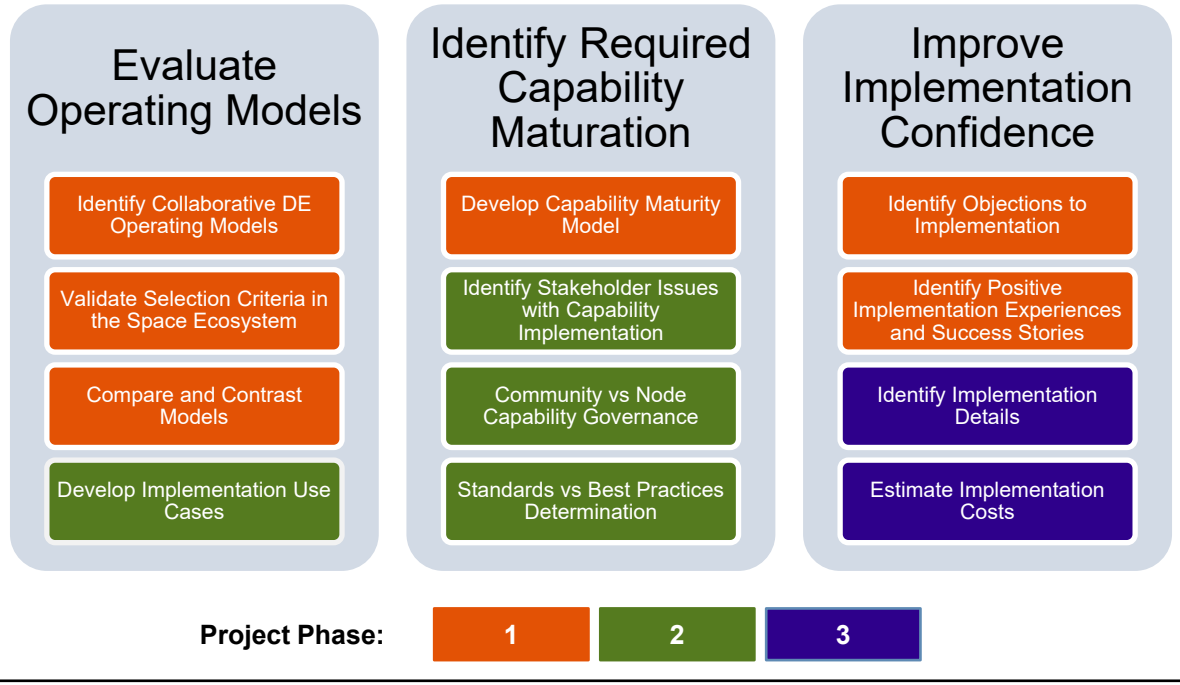
- Research operating models used in other industries to compare and contrast against chosen implementation
- Identify capabilities that can be managed at a community-level vs left to nodes. Identify which capabilities require standards vice best practices. Develop a maturity model for the DE capabilities to identify levels of maturity requiring more formal governance structures.
- Identify areas of consensus and disconnects between stakeholders and resolve issues
- Identify positive experiences and success stories in the space industry where DE has been utilized effectively to help identify implementation details and estimate costs

**4. Outcomes:**

- Create an Operating Concept narrative that a broad coalition of the USSF ecosystem, US government, and space industry can understand and track
- Develop a "coalition of the willing" who will support implementation, expansion, and governance of DE operations across the community
- Create increased confidence through consensus and experience around an implementable DE solution plan
- Foster organic growth through shared success stories and lessons learned implementation, refinement, and guidance
- Communicate DE maturity assessments, sharing insights and impacts, supporting continued implementation progress

**2. Key Stakeholder Questions:**

- What alternate operating model and governance approaches were considered?
- How do we as a community decide on governance of the operating model? As the community expands, do we transition from informal to more formal collaborative approaches?
- How do we answer the "next steps" beyond the depth of the scope of the deliverables?
- What is the needed investment in terms of time, staffing, money? What is the expected return on that investment qualitatively or quantitatively?




**Notes:**

- None

**5. Success Measures:**

- Reduced number of skeptical objections to implementation (level of doubt increases without good results)
- Number of recent / engineering-relevant / community-significant "small win" success stories identified and documented
- Number of member organizations engaging in implementation projects
- Number of consistently-engaging member organizations in federated community activities
- Number/percentage of implementation projects making progress
- Implementation time for node standup against expected time to completion
- Shared insights found to be most useful and impactful during DE project implementation

**6. Initiatives:**

- Research, compare, and contrast operating models used in other industries for evaluation in the space industry ecosystem
- Identify areas of consensus and disconnects between stakeholders and resolve issues
- Identify required capabilities managed at a community-level vs left to nodes.
- Identify which capabilities require standards vice best practices.
- Develop a maturity model for the DE capabilities and levels of maturity requiring more formal governance structures.
- Identify positive experiences, success stories, and objections to participation and implementation
- Identify implementation details
- Estimate implementation costs

# Future Operating Concept Project Summary

- Space Force released its “Vision for a Digital Service” in May 2021 to spur digital transformation as part of its objective to be “born digital” but has struggled to implement this vision
- A foundational step to achieving this vision is to create an OV-1/infographic with an accompanying narrative to illustrate and explain how the USSF will accomplish its mission across its enterprise and with its partners within a fully digital paradigm
- The scope of this project does not include how to realize the OV-1, but is expected to anticipate and address known challenges and risks associated with implementation

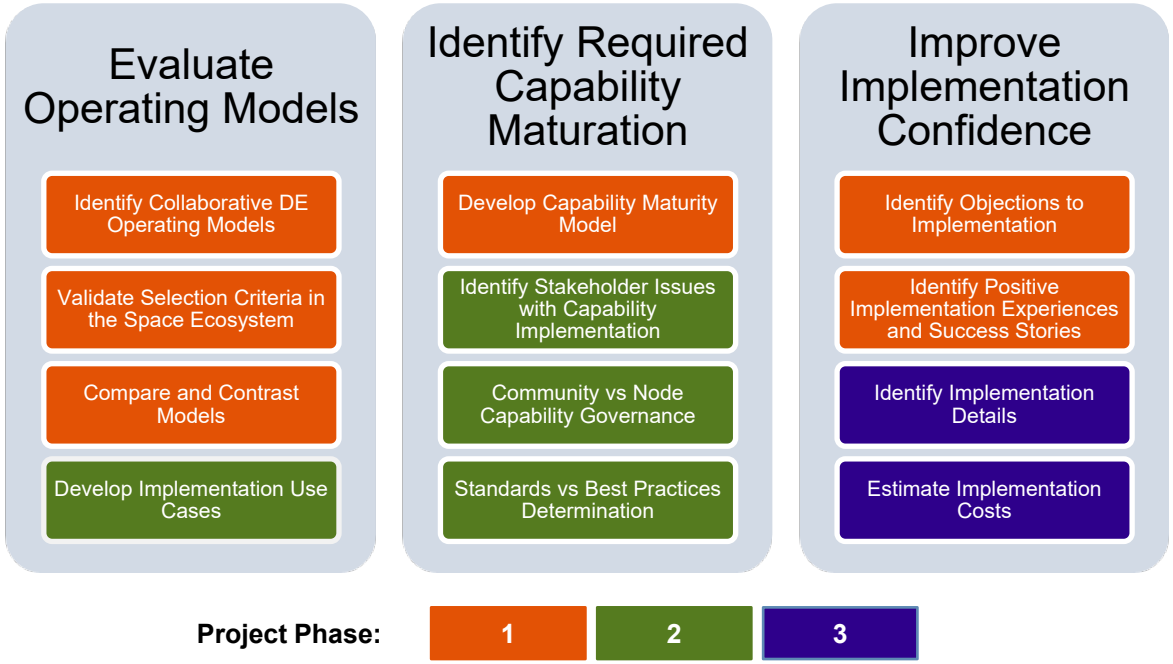
- Final deliverable: **OV-1/Infographic with an Accompanying Narrative**

- This project will:
  - Create an **operating concept narrative** that a broad coalition of the USSF ecosystem, U.S. government, and space industry can understand and track
  - Develop a **“coalition of the willing”** who will support implementation, expansion, and governance of DE operations across the community
  - Create **increased confidence** through consensus and experience around an implementable DE solution path
  - Foster organic growth through **shared success stories and lessons learned implementation, refinement, and guidance**
  - Communicate **DE maturity assessments**, sharing insights and impacts, supporting continued implementation progress

# Future Operating Concept Project Summary

**MSIW team tasks**

- Task 1: Identify collaborative DE operating model
- Task 2: Validate selection criteria in the space ecosystem
- Task 3: Compare and contrast models
- Task 4: Develop implementation use cases
- Task 5: Develop capability maturity model
- Task 6: Identify stakeholder issues with capability implementation
- Task 7: Align community versus instance capability governance
- Task 8: Identify process for standards versus best practices determination
- Task 9: Identify objections to implementation
- Task 10: Identify positive implementation experiences
- Task 11: Identify implementation details
- Task 12: Estimate implementation costs




**Phase 1 in progress**

# Model and Data Interoperability Best Practices

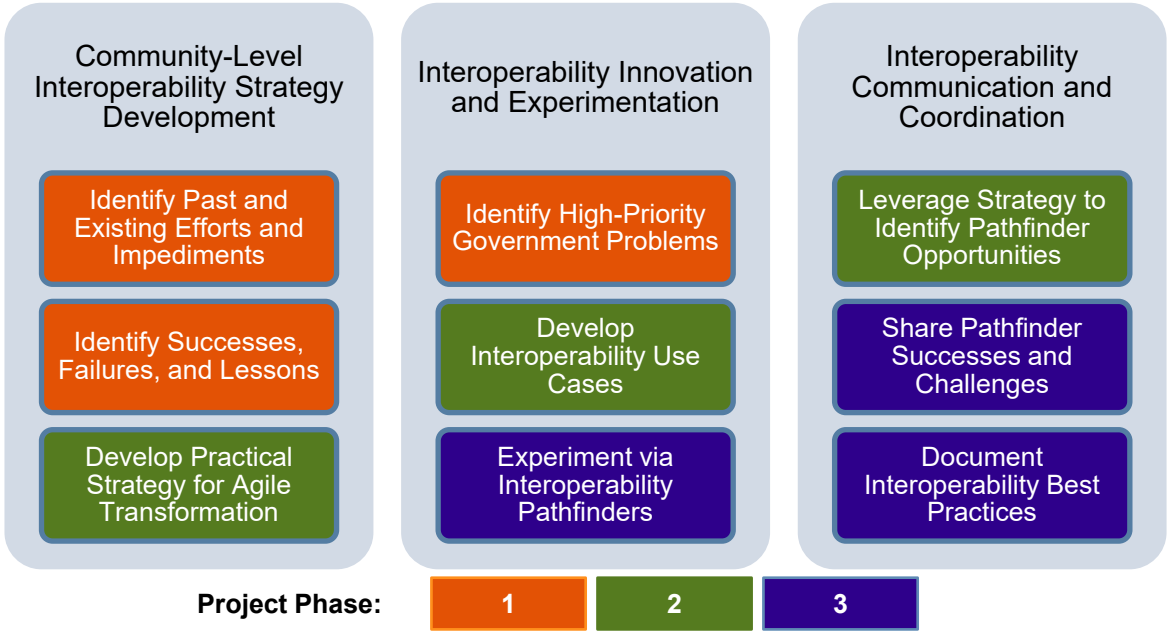
## Project Plan

**1. Goal:** Develop model and data interoperability best practices for the space community

**2. Key Stakeholder Questions:**
- Will using these best practices ensure interoperability to achieve good outcomes?
- How do we define interoperability?
- What is the scope of the interoperability standards that are chosen?
- How much can we agree on to standardize?
- How much do we dive into ontologies, metamodels, data sets, and tools in terms of common formats, ontologies, approaches, etc.?
- What does the framework of follow-on activities look like?

**3. Approach:**

We will…
- Identify existing standards, efforts, and pain points
- Identify failed efforts to obtain consensus, impediments to adoption, and lessons learned
- Determine strategy that leverages practical realities to use standards as they evolve
- Develop top-level use cases for most-critical government needs and pathfinder context and scoping
- "Try" interoperability via self-funded pathfinders – research to identify methods and techniques that can scale
- Use awareness and sharing / exchange forums and efforts to communicate progress




**4. Outcomes:**
- Avoid repeating previous failures
- Execution of important pathfinders
- Interoperability sweet spot identified
- Scalable interoperability methods and techniques
- Accessible shared models, data, tools, code, and documentation
- More participants in federated community
- Increased number of pathfinder efforts
- Increased awareness of DE capability developments across the community

**Notes:**
- Various standards groups across the community; e.g., INCOSE DEIXWG

**5. Success Measures:**
- Increased number of lessons learned
- Decreased published number of "duplicate" failures
- Increased number of pathfinder efforts
- Consensus on the sweet-spot of interoperability standards / best practices
- Increased investments in sweet-spot development
- Execution and completion of a pathfinder effort resulting in good lessons (defined standard, exchanged model, etc.)
- Increased number of organizations that can / have accessed information files (at least one non-provider access)
- Information accessed more frequently
- Increase in how often is information ready for use (no need to tailor it)

**6. Initiatives:**
- Develop a community-level interoperability strategy
- Experiment and innovate with interoperability through self-funded pathfinder efforts that support the strategy
- Foster creation and promotion of forums supporting the communication and coordination of successes, failures, and lessons learned about interoperability

# Model and Data Interoperability Best Practices Project Summary

- Space Force has identified the need to field space systems at a much faster rate to improve U.S. competitive position in space
- The foundational step to achieving this goal is the creation of a digital ecosystem that enables secure collaboration between the Space Force and industry partners
- This ecosystem is the mechanism for sharing models and data across partners in near-realtime, accelerating development. Model and data interoperability are fundamental to achieving success

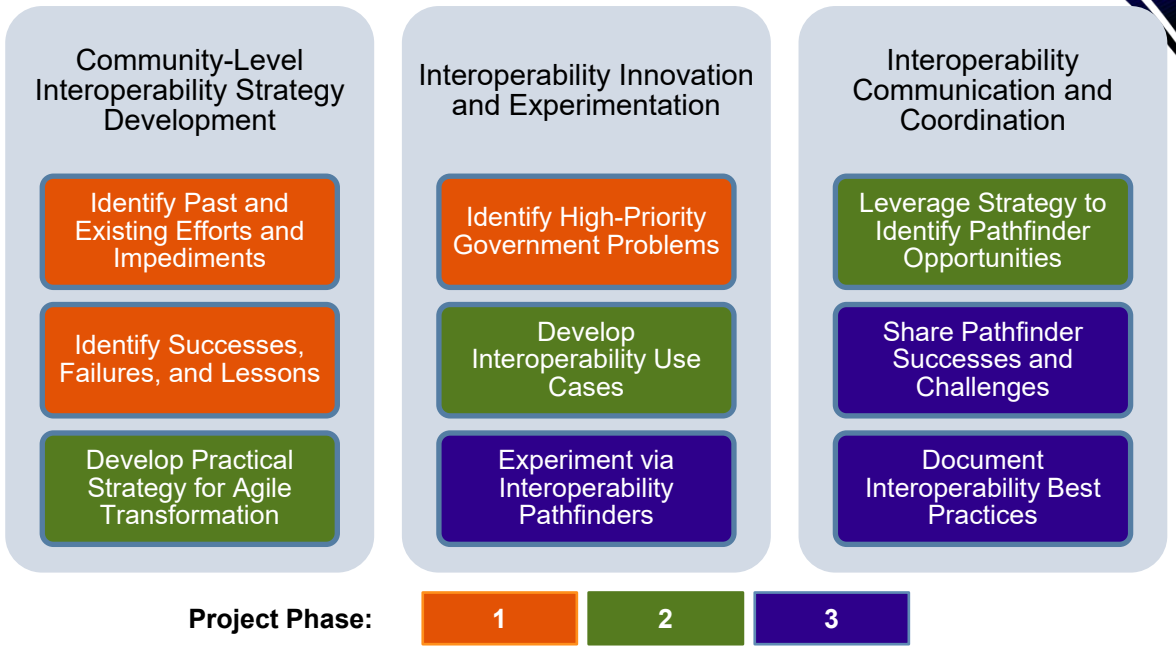
- Final deliverable: **Interoperability Pilot/Working Model**

- This project will:
  - Develop **stakeholder alignment and standards** to improve model and data interoperability, facilitating DE within the space domain
  - **Leverage work** from other DE working groups within the aerospace industry as well as other industries
  - Define what the **digital ecosystem** could be along with associated capabilities and stakeholder interactions
  - Capture the **digital lifecycle management** process and information flow at the government level in association with industry partners
  - Deliver reports on recommendations for **community prioritization and governance** of standards
  - Deliver **draft standards** to jumpstart formal consensus standard development activities

# Model and Data Interoperability Best Practices Project Summary

## MSIW Team Tasks

- Task 1: Stakeholder questions
- Task 2: Interoperability domains and focus areas
- Task 3: Leverage existing and propose new standards efforts
- Task 4: Use cases for interoperability standards
- Task 5: Define standards strategy and governance approach
- Task 6: Define digital ecosystem capabilities, interactions, and process flows; deliver pilot program/working model of ecosystem; share lessons learned from pilot
- Task 7: Engage DE tools vendors




## Leveraging Existing Standards Efforts (Task 3)

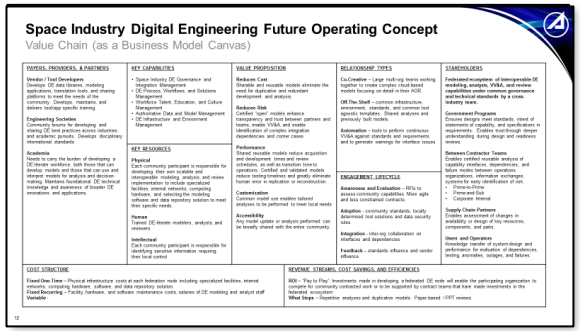
- Task A0: Support, influence, and accelerate SSC efforts
- Task A1: OMG Model-Based Acquisition User Group
- Task A2: INCOSE DE Information Exchange WG
- Task A3: DE Measurement Framework v2.0
- Task A4: AIAA DE Integration Committee (DEIC)
- Task A5: Digital Twin Consortium
- Task A6: DE standardization efforts in other industries

## New Standards Efforts (Task 3)

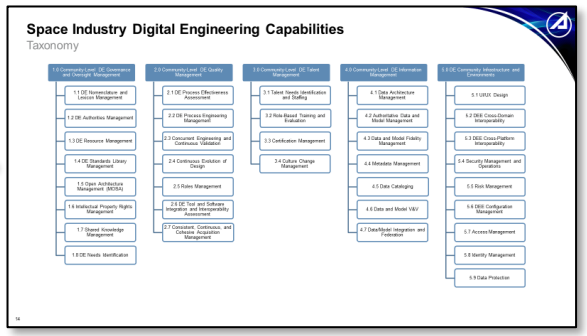
- Task B1: Standard categories of digital twins and standard expectations of scope for deliverable digital twins
- Task B2: Standard expectations for MBSE efforts and model content for key technical review success criteria, distinguished by mission risk class
- Task B3: Standard definition of key SE concepts needed for model interoperability (lexicon/ontology/metamodel)

**Phase 1 in progress**

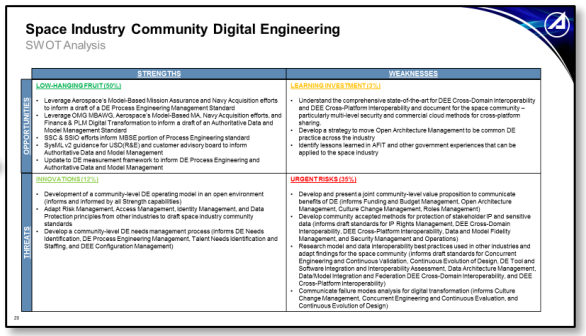
# MSIW Process and Products



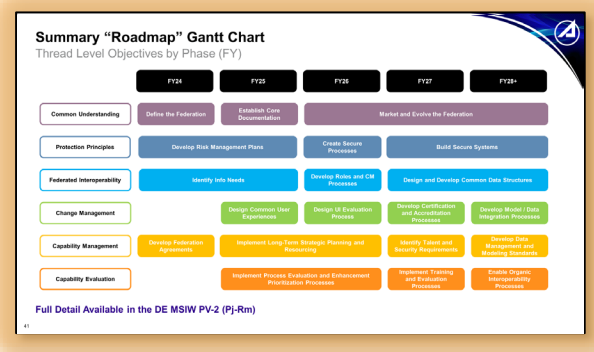

Future Operating Concept



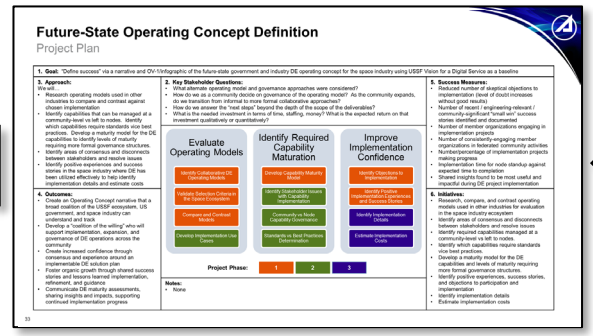

Required End-State Capabilities



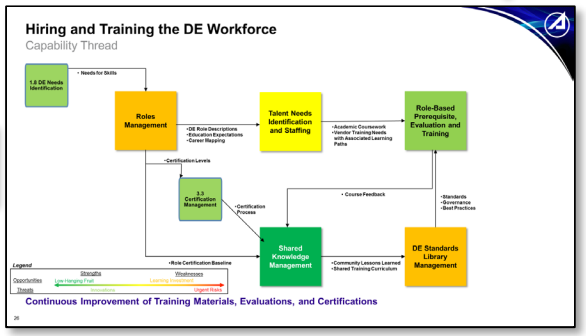

SWOT Analysis




Community Adopted Plan/Roadmap




Transformation Project Plans




Transformation Capability Threads

**Culmination of Efforts Is a Plan for Community Action**

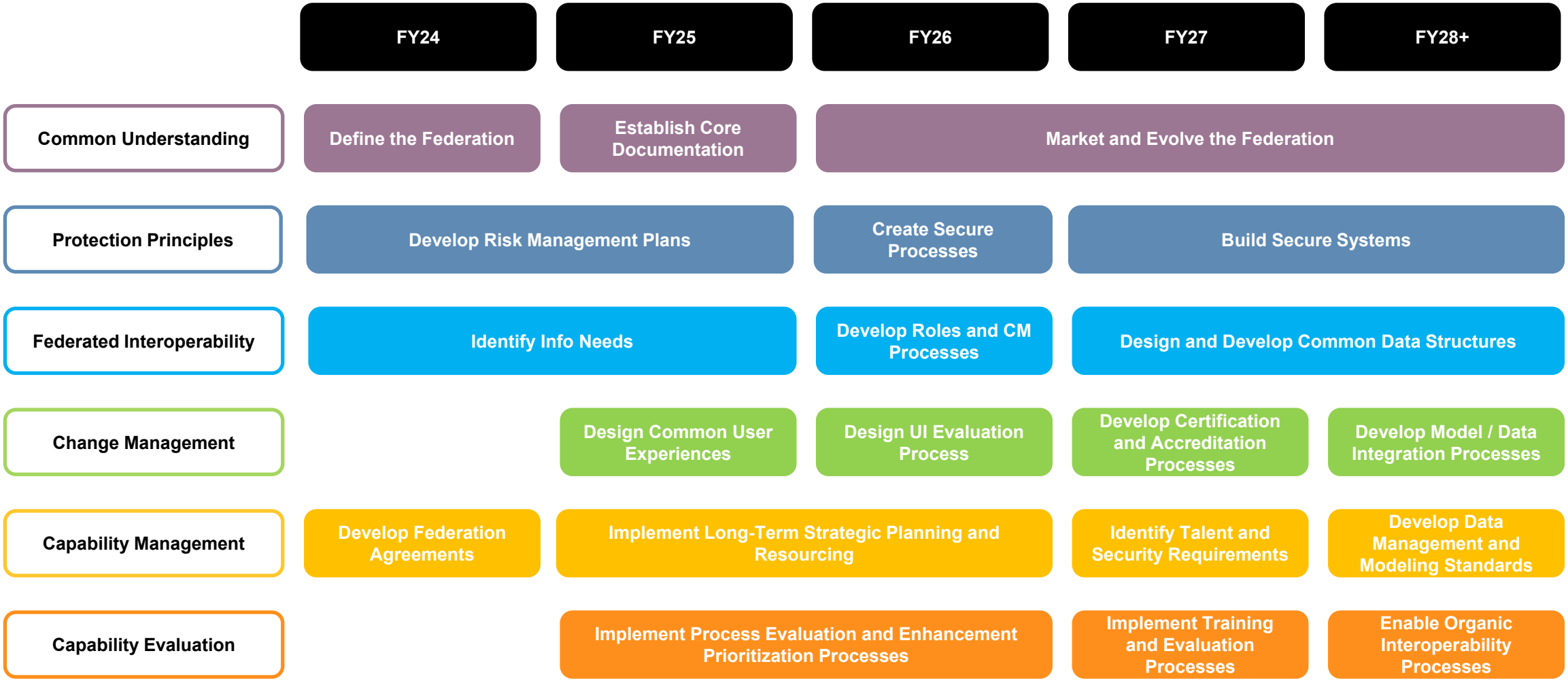
# Federated DE Capabilities

## Transformation Objectives

| Common Understanding | Protection Principles | Federated Interoperability | Change Management | Capability Management | Capability Evaluation |
|---|---|---|---|---|---|
| Develop the overall concept for a federated DE community | Identify sensitive information and data that requires protection, the risks to its exposure, and the means to protect it | Identify information sharing needs and means that enforce protection principles and maximize speed and accessibility | Plan the evolution of federated DE capabilities | Implement the evolving federated DE capabilities | Determine effectiveness and efficiency of DE federated capabilities to inform transformation and innovation priorities |

# Summary “Roadmap” Gantt Chart

## Thread-Level Objectives by Phase (FY)




**Full Detail Available in the DE MSIW PV-2 (Pj-Rm)**

# Key Near-Term Project Priorities

## As Suggested by the Roadmap

**In-progress projects in the DE Standards MSIW**

- Establish a common community DE lexicon **(Common Understanding)**
- Develop a detailed DE federated future-state operating concept **(Common Understanding)**
- Research parallel model and data interoperability best practices **(Common Understanding)**

**Next 10 things to do (in the DE Standards MSIW or other external groups)**

- Develop and communicate value proposition **(Common Understanding)**
- Identify and form DE oversight body **(Common Understanding)**
- Develop community-level strategic planning process **(Capability Management)**
- Establish community-level staffing and resource planning cycle **(Capability Management)**
- Develop a high-level open architecture design **(Common Understanding)**
- Establish repository for DE governance, best practices, and tech standards **(Common Understanding)**
- Establish process for developing DE governance, best practices, and tech standards **(Common Understanding)**
- Develop community-level process effectiveness measures and metrics **(Federated Interoperability)**
- Identify types of protected information, exposure risks, exposure impacts, and associated legal and technical protections **(Protection Principles)**
- Develop community-level divergent, convergent, and fault tree risk assessments **(Protection Principles)**

# Common Understanding

## Roadmap

**Objective:** Develop the overall concept for a Federated DE community

| Capability | Dependencies | Barriers | Projects | Roles / Interfaces |
|---|---|---|---|---|
| Authorities Management | N/A | Trust to commit resources (funding, staff, and time) to federation-level development | Identify and form oversight body from MSIW team | Aerospace: Organize & facilitate oversight body, develop MOA/MOU community: steering committee |
| Nomenclature and Lexicon Management | DE capability oversight from *Authorities Management* | Adoption of existing lexicon from other standards bodies and industries where appropriate | 1. Establish a common community DE language<br>2. Establish means to manage and distribute language updates | MSIW: Develop project |
| Culture Change Management | Common DE language from *Nomenclature and Lexicon Management* | Trust to commit resources (funding, staff, and time) to node-level development | 1. Develop detailed federated operating concept<br>2. Develop and communicate value proposition | MSIW: Develop project |
| Open Architecture Management (MOSA) | Shared DE vision from *Culture Change Management* | N/A | 1. Develop high-level open-architecture design<br>2. Develop open-architecture specifications, standards, and performance thresholds | MOSA Enabling Environment WG: input |
| Standards Library Management (DE Governance, Best Practices, and Tech Standards) | N/A | Trust to commit resources (funding, staff, and time) to node-level development | 1. Establish repository<br>2. Establish process for publishing and updating | |
| Shared Knowledge Management | N/A | | 1. Research parallel interoperability best practices<br>2. Establish processes and procedures for information sharing | DE BOK Governance Team: input and lessons learned<br>MSIW: Develop project |

| FY24 | FY25 | FY26 | FY27 | FY28+ |
|---|---|---|---|---|

# Protection Principles

## Roadmap

**Objective:** Identify sensitive information and data that requires protection, the risks to its exposure, and the means to protect it

| Capability | Dependencies | Barriers | Projects | Roles / Interfaces |
|---|---|---|---|---|
| Risk Management | DE leadership team core values from *DE Authorities Management* | Identify common understanding of "protection needs, threats, and risks" across stakeholder group—what are we protecting? | 1. Community-level divergent, convergent, and fault tree risk assessments<br>2. Community-level risk prioritization | MSIW/prospective mbrs: Risk stakeholders<br>MSIW: Leads risk ID and assessment<br>OMG: Lessons learned from previous risk management efforts as applicable |
| IP Rights Management | Information security risk management from *Risk Management* | 1. Investigate potential for obfuscation through reduced order models<br>2. Potential for obfuscation through black box approaches<br>3. Ways to quickly ID & remediate spills | 1. Identify protected information, risks, impacts<br>2. Develop remediations for spills | Vendor community: Approaches to obfuscation |
| Identity Management | Information ownership and rights from *IP Rights Management* | 1. Transient nature of need—dynamic management of access<br>2. Understand implications of roles and permissions in context of access mgmt | 1. Identify identity-verification techniques<br>2. Document identity-verification principles | 1. Cross-domain conversations on identity / relationships (access and permissions vary based on domain).<br>2. Should be related to product vice where the data is stored |
| DEE Cross-Domain Interoperability | 1. Identity verification standards from *Identity Management*<br>2. Federated architecture operating model from *Open Architecture Mgmt* | Vendor-developed interoperability standards—government not willing to bear the cost of standardizing data structures | 1. Determine and document federation- vs node-level info mgmt needs, controls, and procedures<br>2. Develop control governance<br>3. Move toward standards w/ vendors | 1. Information systems security rules for classified programs<br>2. Extract/transform/load (ETL) techniques and processes |
| Data Protection | Federated- vs node-level control governance from *DEE Cross-Domain Interoperability* | 1. Identify and prevent misuse of shared data (wrong application / extraction of information not intended for audience)<br>2. "Data marking" analogous to "document marking" | 1. Develop standardized data structures/role-based security rules<br>2. Develop data protection and security standards | Potential cyber-related efforts |
| Access Management | Data security standards from *Data Protection* | 1. Role-based access principles<br>2. "Exceptions" handling | Develop data access standards | |
| | | | | |
| FY24 | FY25 | FY26 | FY27 | FY28+ |

# Federated Interoperability

## Roadmap

**Objective:** Identify information sharing needs and means that enforce protection principles and maximize speed and accessibility

| Capability | Dependencies | Barriers | Projects | Roles / Interfaces |
|---|---|---|---|---|
| DE Needs Identification | Capability gap risk management process from *Risk Management* | 1. Close gaps in gov't understanding of certification / supervision responsibilities and operations roles<br>2. Evolving nature of DE artifacts | 1. Develop contract-level guidance for information needs and replacements for "PDF" CDRLs<br>2. Develop community needs ID, prioritization, and mgmt processes | Make inroads to USSPACECOM as well as USSF, FAA, Dept of Commerce to support acquisitions as well as ops (gov't and commercial services) |
| DE Process Engineering Management | 1. Federation process change effectivity from *DE Needs Identification*<br>2. Information protection standards from *IP Rights Management* | Acquisition asynchronicity—modifications to processes that impact programs "in progress" | 1. Establish community-level process mgmt and documentation forum<br>2. Develop community-level processes, modification process, & implementation effectivity rhythm | Lessons learned from cyber realm where threat changes and adaptations force continuous process change |
| Roles Management | Process-driven role needs from *DE Process Engineering Management* | Adoption of role terminology by the community | 1. Develop and publish definitions for community-level and common node-level process roles<br>2. Detail responsibilities, req'd quals, and typical career paths for roles | SERC developed a framework for roles and skills (Digital Engineering Competency Framework), may need evaluation for roles beyond DOD scope |
| DEE Cross-Platform Interoperability | Federated- vs node-level control governance from *DEE Cross-Domain Interoperability* | 1. Cannot mandate use of a specific vendor at the program level<br>2. Defining a common data layer between platforms | 1. Identify community IT configuration, sharing, and storage challenges<br>2. Determine acceptable IT configurations, storage, and version-control processes | Interact with vendor community as a federation to "push" our desired interface standards across platforms and vendors<br>*FMI Standards*<br>*DCP* |
| Data Architecture Management | 1. Operating system and software data storage standards from *DEE Cross-Platform Interoperability*<br>2. Data protection stds from *Data Protection* | 1. Environment interconnectivity authorities<br>2. Authentication from external connections<br>3. Disconnect between descriptive modeling ecosystem and others | Develop common and acquisition-specific data set structure standards | SSC: LOE1<br>SysML v2 |
| Authoritative Data and Model Management | 1. Data paths from requirements to design from *Data Architecture Management*<br>2. Data access standards from *Access Management* | Common definition of ASOT (e.g., single vs group sourced, Boolean vs gradient/relative/subjective) to reduce misinterpretation and misapplication | 1. Develop model & analysis baseline stds<br>2. Document standards for collecting and sharing models and data<br>3. Data model to identify ASOT for various datasets | Examples of ASOT mechanisms from other communities<br>Formats and standards for ASOT datasets |
| | | | | |
| **FY24** | **FY25** | **FY26** | **FY27** | **FY28+** |

# Change Management

## Roadmap

**Objective:** Planning the evolution of federated DE capabilities

| Capability | Dependencies | Barriers | Projects | Roles / Interfaces |
|---|---|---|---|---|
| Continuous Evolution (as related to DE capabilities) | Capability enhancement needs process from *DE Needs Identification* | Configuration management<br>Asynchronous application of evolutionary changes<br>Procurement—contractual changes<br>Testing of continuously evolving tools<br>Lack of established or automated workflow | Develop process for community-level capability and associated UI/UX design modification and use cases | Need a governance board to manage the rollout and timing<br>Collective/shared responsibility for testing and assessment |
| UI/UX | 1. Process workflow best practices from *DE Process Engineering Mgmt*<br>2. Capability UI/UX requirements/use cases from *Continuous Evolution of Design* | Lack of inputs from actual users<br>Current or evolving differing opinions/experience of users/operators<br>Resource scarcity | 1. Identify & tailor accepted standards and associated performance measures and metrics for UX<br>2. Develop design evaluation process for UI/UX | Users and operators<br>User advisory group? |
| Certification Management | 1. Human/machine process interface standards from *UI/UX Design*<br>2. Role activities and competency expectations from *Roles Mgmt* | Competing certification options that might not be compatible with each other (e.g., Agile, Cloud)<br>Tailored business operations vary | Develop certification standards for defined roles | OMG, Agile, and Cloud certifications<br>Other certifications (e.g., CISSP, data security, environment security) |
| DEE Configuration Management | 1. Sys admin certification reqt's from *Configuration Mgmt*<br>2. Supported platform version control process from *DEE Cross-Platform Interoperability*<br>3. Process for community-level capability from *Continuous Evolution* | Lack of established/automated workflow<br>Lack of organizational authority and funding<br>Continuously evolving tools/infrastructure<br>Scalability at global/enterprise level<br>Need baselines for discipline-specific variations | 1. Develop global baseline configuration mgmt processes<br>2. Develop best practices for local baseline config mgmt processes | Interagency DevSecOps system needed |
| Metadata Management | 1. OS/App/Data compatibility test processes from *DEE Configuration Mgmt*<br>2. Requirements-driven data mgmt from *Data Architecture Management* | Standard ontology/DE lexicon needed<br>Evolving structure | Develop structure, processes, and rules for metadata management | USSF/CTIO?<br>JFAC? JFAC Portal (dso.mil) |
| Data and Model Fidelity Management | 1. Metadata structure from *Metadata Mgmt*<br>2. Model and analysis baseline standards from *Authoritative Data and Model Management* | Automated reduced order of modeling (security/proprietary layers, speed-of-need) | Develop standard model and analysis levels of fidelity | |
| | | | | |
| **FY24** | **FY25** | **FY26** | **FY27** | **FY28+** |

# Capability Management

## Roadmap

**Objective:** Implementing the evolving federated DE capabilities

| Capability | Dependencies | Barriers | Projects | Roles / Interfaces |
|---|---|---|---|---|
| Consistent, Continuous, and Cohesive Acquisition Management | Capability Design Change Process from *Continuous Evolution of Design* | Funding line for development and maintenance of centrally-curated org-agnostic information about federated architecture | Develop community-level strategic planning process | Existing examples of curated info databases from industry (SHREC, NASA efforts) |
| Resource Management | 1. Community-level implementation plan from *Acquisition Management*<br>2. Process changes from automation from *UI/UX Design* | 1. Organization mindsets to use "tool-implemented" solutions<br>2. Level of enterprise investment maturity tool suite adoption by each org | 1. Value proposition connection to long-term resourcing<br>2. Establish community-level resource and staffing planning cycle | 1. Interface with tool vendors to change tools to needs<br>2. Representation in federated community by DE leaders in participant orgs connected to internal solution decision-makers |
| Talent Needs Identification and Staffing | 1. Staffing needs changes from process improvements from *Resource Management*<br>2. Certification requirements standards from *Certification Management* | Common lexicon across tools enables talent to flow between programs, roles, project efforts, etc.<br>Academia teaching and influencing tool use—professors incentivized to teach with specific tools by vendors | Identify sources of talent for roles | 1. Training and deeper dives into interfaces between tools over demonstration of specific tool knowledge<br>2. Industry / government sponsorship of BOK-development and specific certifications and degree programs |
| Security Management and Operations | 1. Global and local security eligibility requirements from *Talent Needs Identification and Staffing*<br>2. Global and local baseline management standards from *DEE Configuration Mgmt*<br>3. *Resource Management*<br>4. *Data Access Management* | 1. Security rules impeding installation and use of tools on global and local systems<br>2. Access controls on security-tagged models and data | Develop global security management and operations processes | Security workflows based on data-tagging<br>Government support in providing data-access tools for tagged data |
| Data Cataloguing | 1. Global and local data storage standards and best practices from *Security Mgmt and Operations*<br>2. Model and data organization standards from *Metadata Mgmt* | Contractual CDRL delivery requirements aligned to the modeling environment and capabilities<br>Data tagging (class marking) in DE environments | Develop and document data storage and inventory technical standards | |
| Data and Model Integration and Federation | 1. Data inventory standards from *Data Cataloging*<br>2. Standard model and analysis levels of fidelity from *Data and Model Fidelity Management* | Configuration control issues on model versions maintained "on" and "off" network (e.g., high side/low side)—hinders re-use<br>Persistence of security tagging when it moves across environments | Develop and document model and data integrity standards | |
| FY24 | FY25 | FY26 | FY27 | FY28+ |

# Capability Evaluation

## Roadmap

**Objective:** Determining effectiveness and efficiency of DE federated capabilities to inform transformation and innovation priorities

| Capability | Dependencies | Barriers | Projects | Roles / Interfaces |
|---|---|---|---|---|
| Concurrent Engineering and Continuous Validation | Improved capability satisfaction measures from *Acquisition Management* | Software bill of materials (SBOM): Management of IP in context of models in a digital ecosystem—info covered in NDAs | Implement community-level resource evaluation and enhancement prioritization process | SAE/G32 looking to generate standards for cyber physical systems (auto, medical, etc.) |
| DE Process Effectiveness Assessment | Capability performance metrics from *Concurrent Engineering and Continuous Validation* | | 1. Develop common environment mgmt & operations process use cases<br>2. Develop community-level process effectiveness measures and metrics | INCOSE Model-Based Capabilities Assessment (AF version—"Digital Maturity Assessment") |
| Role-Based Training and Evaluation | 1. Process training and evaluation performance metrics from *DE Process Effectiveness Assessment*<br>2. Role-based education and skillset standards from *Talent Needs Identification and Staffing* | Most certs are "tool specific" vice skill-based—university context vice vendor / corporate / organizational / SDO context | 1. Develop training & evaluation methods to meet role cert standards<br>2. Develop documentation to convey user feedback for DE tool/software integration | 1. Leverage models such as "PMP" & "QMS" that teach industry/tool-agnostic skills and concepts<br>2. DOD DE Competency Framework |
| DE Tool/Software Integration and Interoperability Assessment | 1. DE tool/software usability metrics from *Role-Based Training and Evaluation*<br>2. Global and local security standards from *Security Management and Operations* | Lack of SLAs or processes / tools / interfaces not meeting SLA requirements (SLAs for various use cases) | Develop and document tool/software integration and interoperability rules | 1. SSC LOE 2 as a possible connected effort<br>2. Banking industry or air traffic management as examples |
| Data and Model V&V | Model and data integrity standards from *Data/Model Integration and Federation* | We can "verify" against a set of requirements, but complexity of the model increasing will make it more difficult for all parties to agree on "validation." | Develop processes and standards for data and model V&V | SSC LOE 2 as a possible connected effort |
| | | | | |
| **FY24** | **FY25** | **FY26** | **FY27** | **FY28+** |

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# Digital Engineering Standards

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# Digital Engineering Standards

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