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Controlling the Digital Engineering Ecosystem: An Elastic Model Governance Guide for the Digital Thread

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Executive Summary

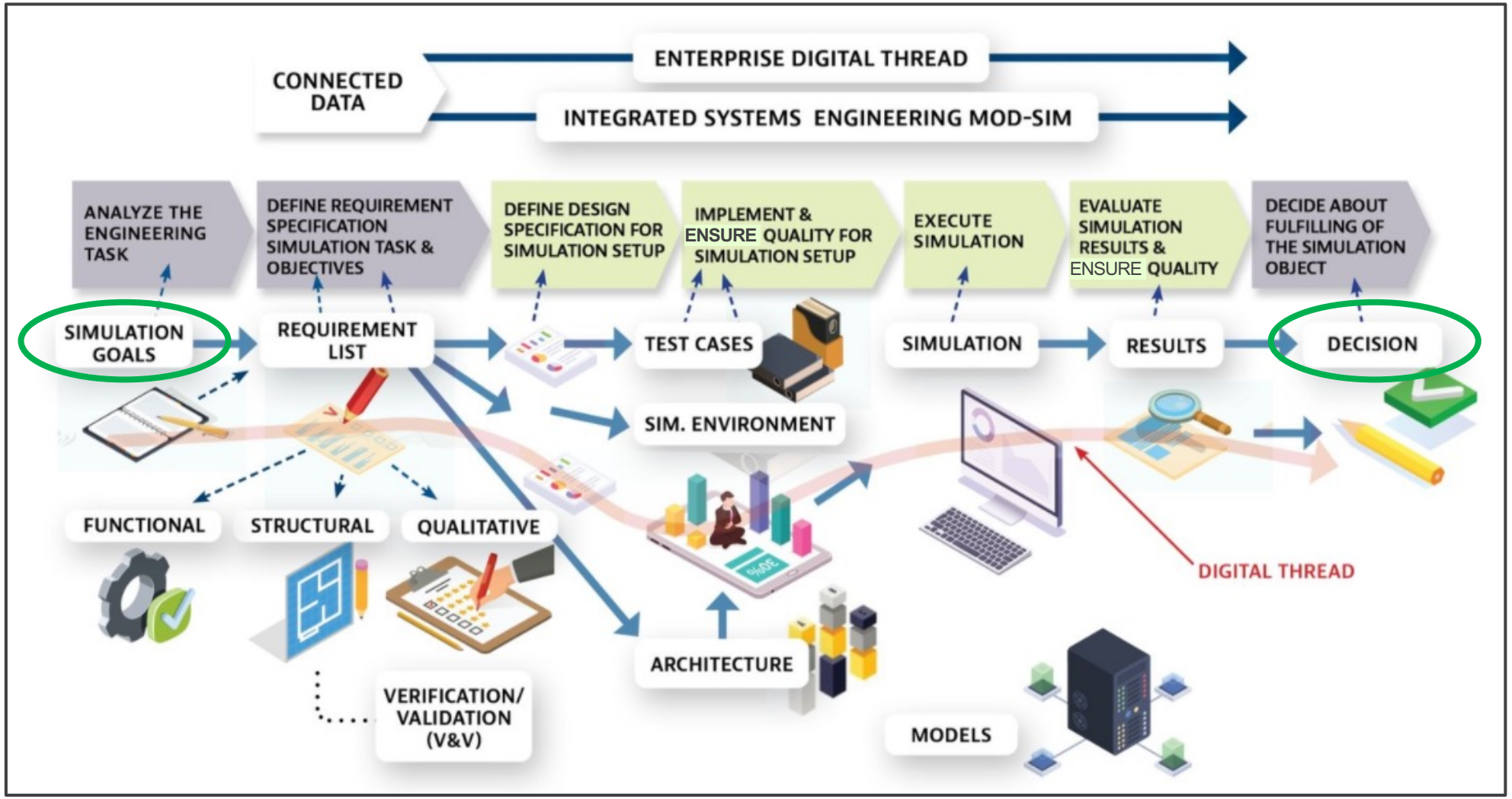
As Digital Engineering (DE) ecosystems proliferate, there is a need to robustly manage heterogeneous linked models and data across disciplines, cultures, and contractual boundaries. The Elastic Model Governance Guide includes:

- **GUIDANCE** – Model-based guidance with in-model work instructions
- **INTEGRATION** – Integration of the overall model governance system, DE Ecosystem (DEE) infrastructure, individual models, and composite models
- **PURPOSE** – Traceability of model purpose and resolution of technical debt
- **VALIDATION** – Automated validation for insight on compliance
- **FLEXIBILITY** – Customization for flexibility and tailoring (fleX-engineering™)

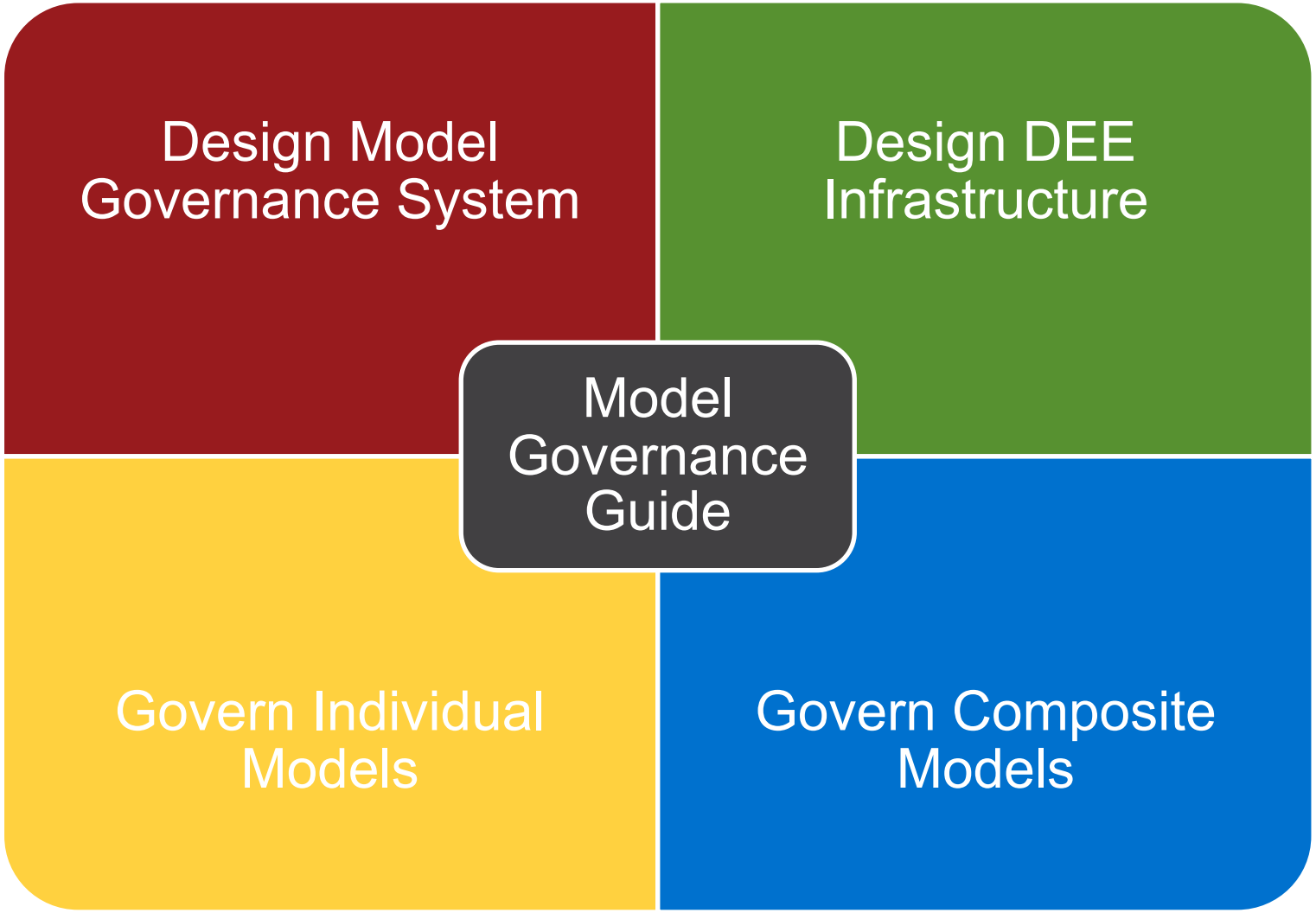
Adaptation from graphic[1]

Model Governance Enhances Value Delivered to Customers

Model Goal Ties to Decision Informed²



Key Sections



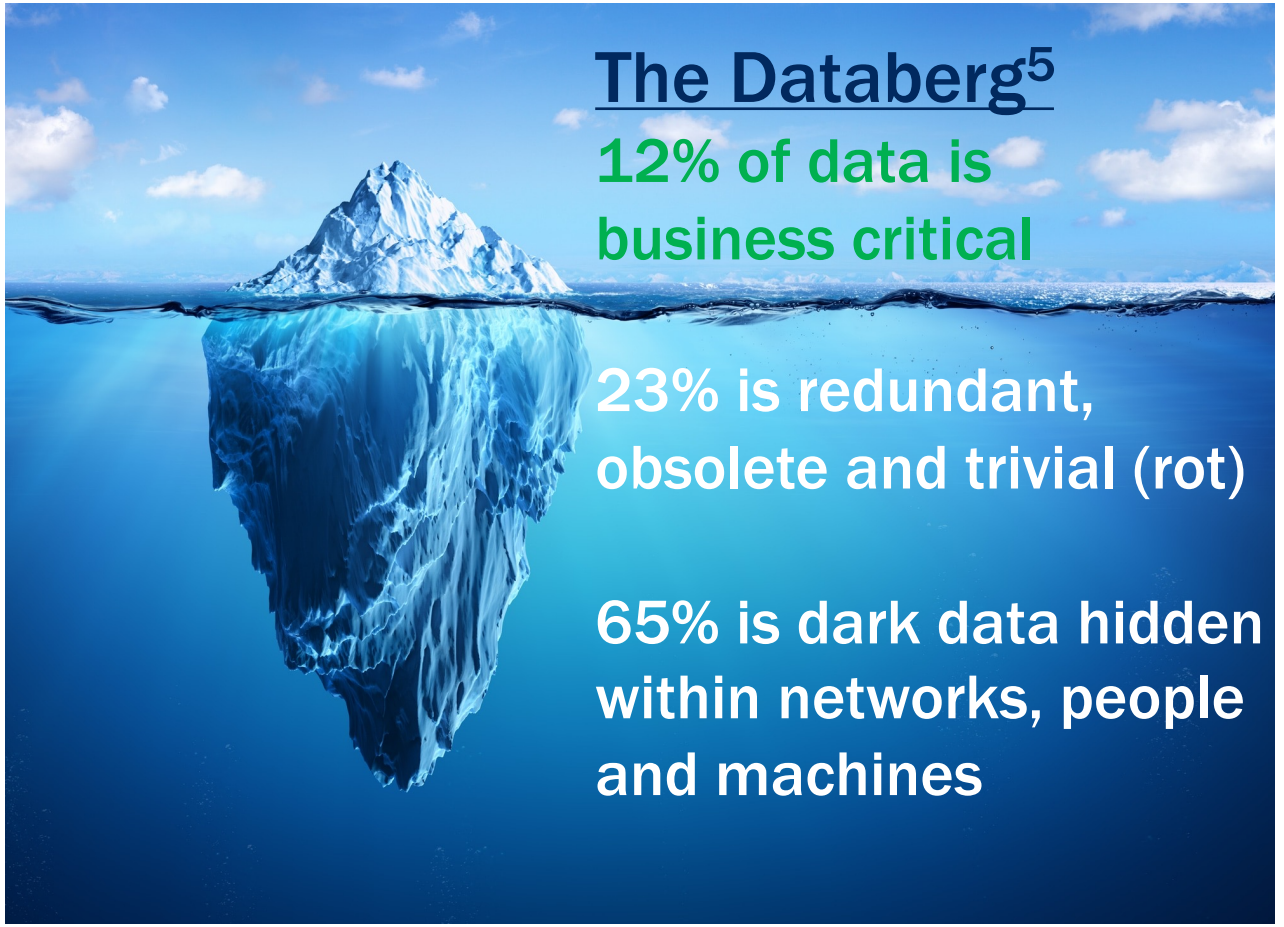
Agenda

Model Governance Challenges

Governance Challenges

Quantifying Need

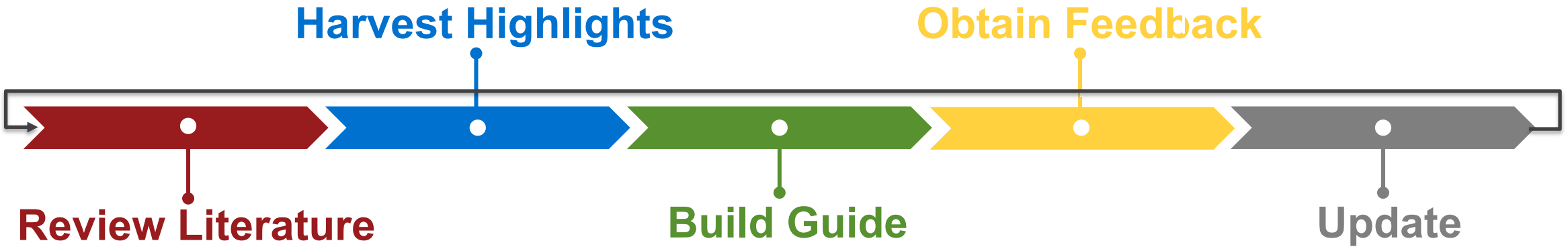
- Scale of data and model generation with petabytes of data generated by low-cost, high-throughput technologies[3]
- Organizations score low on "Model Management" capabilities when assessed by the INCOSE Model-Based Capabilities matrix[4]
- SERC SE Survey cited "Model Management" as a significant area of improvement[4]



Model Governance is a Recognized Need

ManTech Approach

Methodology

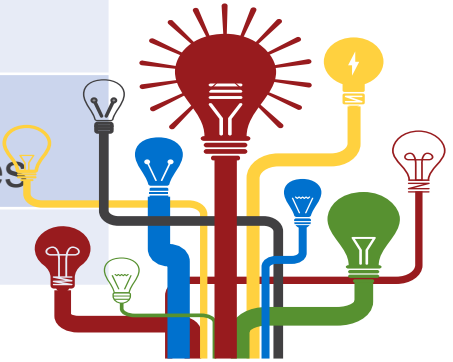


- Data management
- Model management
- Knowledge management
- Configuration management
- Data governance
- Dark data
- Digital curation
- Model curation
- Standards
- Elasticity
- Model validation

- Use model lifecycle and guidelines from NASA-STD-7009[6,7]
- Use considerations from International Council on Systems Engineering (INCOSE) model lifecycle management[8], OpenMBEE[9,10], Model Portfolio Management Guide[11], Model-Based Capabilities Matrix[12]
- Include INCOSE configuration management insights[13]
- Involve ManTech Data Governance expertise[14]
- Incorporate digital curation[15]
- Include recommendations from model curation[16,17]
- Structure process to be flexible per DoDI 5000.0216 “Operation of the Adaptive Acquisition Framework”[18], ManTech fleX-engineering™ [19]
- Utilize established SysML model validation practices[20]

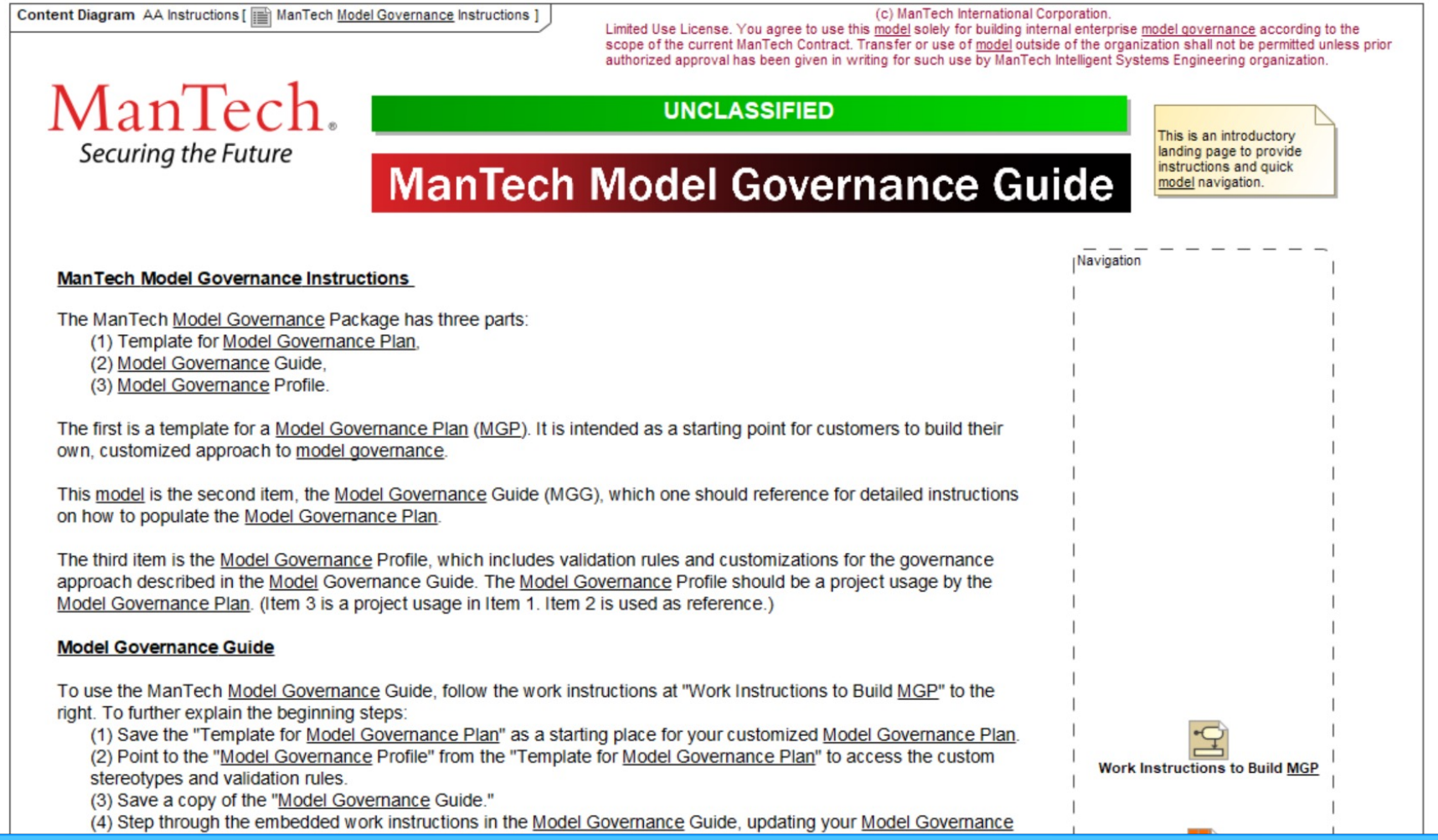
Solution Features with Corresponding Value

Features	Value
Provide model-based guidance with in-model work instructions	Enhance usability and demonstrate model-based methods promoted
Establish explicit governance system	Ensure veracity of authoritative source of truth
Include interacting elements -- model governance system, DEE infrastructure, individual models, composite models	Improve integration, since elements can be referenced, linked, checked
Trace model purpose through needs addressed, questions answered, technical debt resolved	Establish transparency into system development status
Automate validation for insight on compliance	Enable synchronized data structuring for analytics applications to enhance outcomes
Structure for customization	Provides flexibility and tailoring for context



Model Governance Guide Profile and Model

Welcome and Navigation



Content Diagram AA Instructions [ManTech Model Governance Instructions]

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Limited Use License. You agree to use this model solely for building internal enterprise model governance according to the scope of the current ManTech Contract. Transfer or use of model outside of the organization shall not be permitted unless prior authorized approval has been given in writing for such use by ManTech Intelligent Systems Engineering organization.

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ManTech Model Governance Guide

This is an introductory landing page to provide instructions and quick model navigation.

Navigation

ManTech Model Governance Instructions

The ManTech Model Governance Package has three parts:
(1) Template for Model Governance Plan,
(2) Model Governance Guide,
(3) Model Governance Profile.

The first is a template for a Model Governance Plan (MGP). It is intended as a starting point for customers to build their own, customized approach to model governance.

This model is the second item, the Model Governance Guide (MGG), which one should reference for detailed instructions on how to populate the Model Governance Plan.

The third item is the Model Governance Profile, which includes validation rules and customizations for the governance approach described in the Model Governance Guide. The Model Governance Profile should be a project usage by the Model Governance Plan. (Item 3 is a project usage in Item 1. Item 2 is used as reference.)

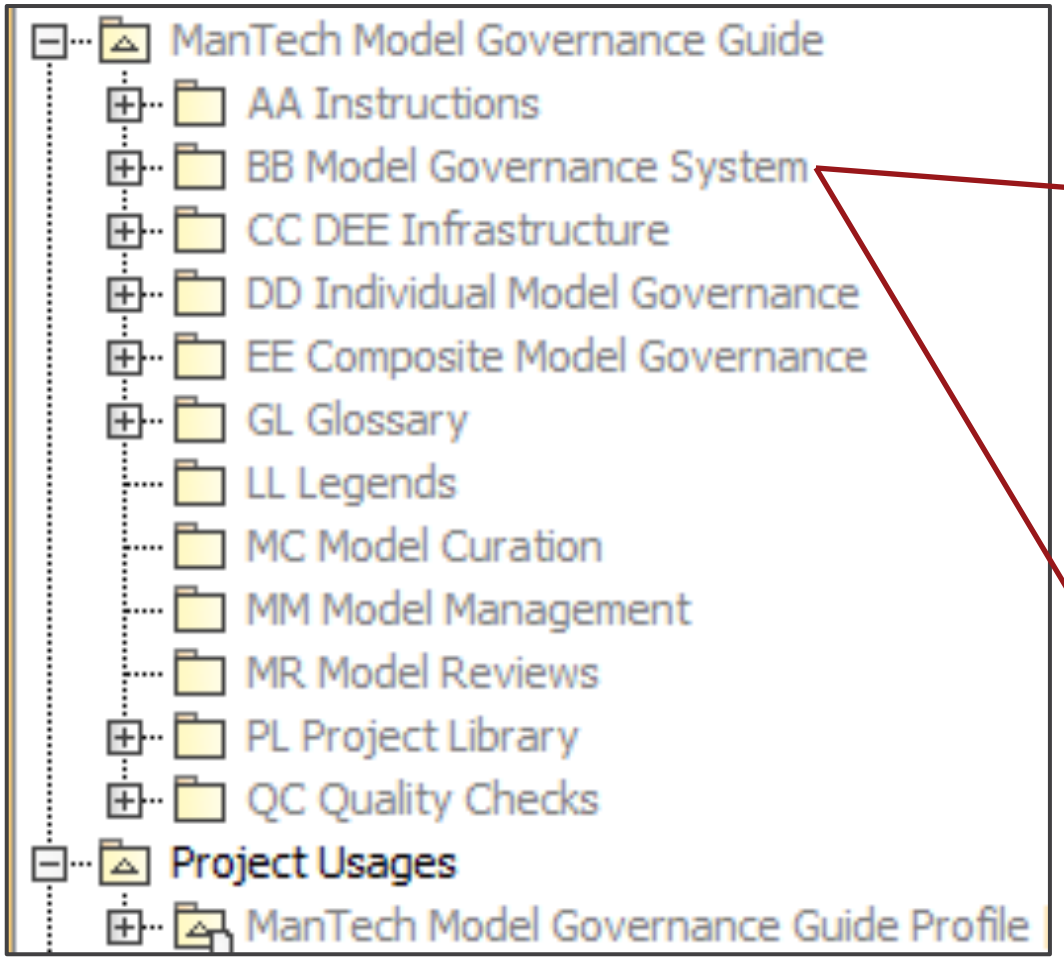
Model Governance Guide

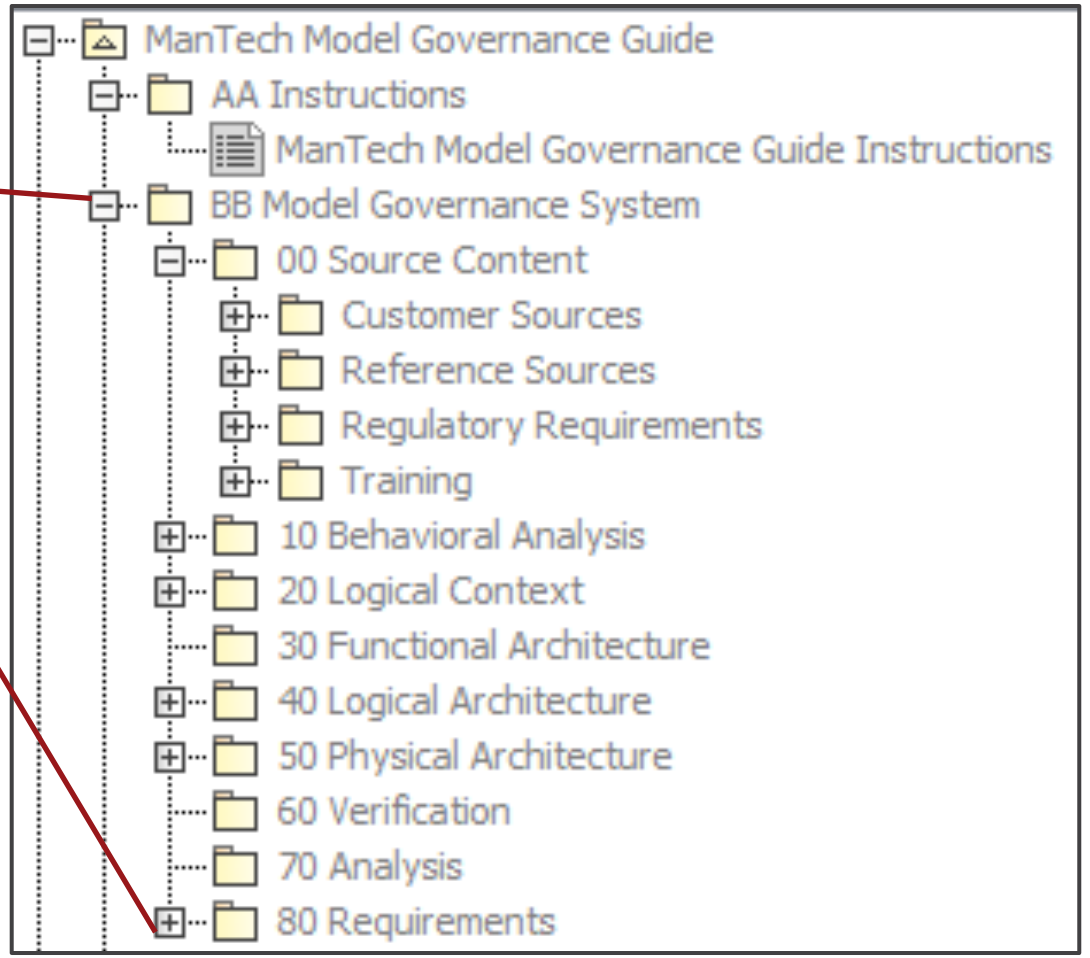
To use the ManTech Model Governance Guide, follow the work instructions at "Work Instructions to Build MGP" to the right. To further explain the beginning steps:
(1) Save the "Template for Model Governance Plan" as a starting place for your customized Model Governance Plan.
(2) Point to the "Model Governance Profile" from the "Template for Model Governance Plan" to access the custom stereotypes and validation rules.
(3) Save a copy of the "Model Governance Guide."
(4) Step through the embedded work instructions in the Model Governance Guide, updating your Model Governance

Work Instructions to Build MGP

Navigation Aids and Embedded Explanation Provided

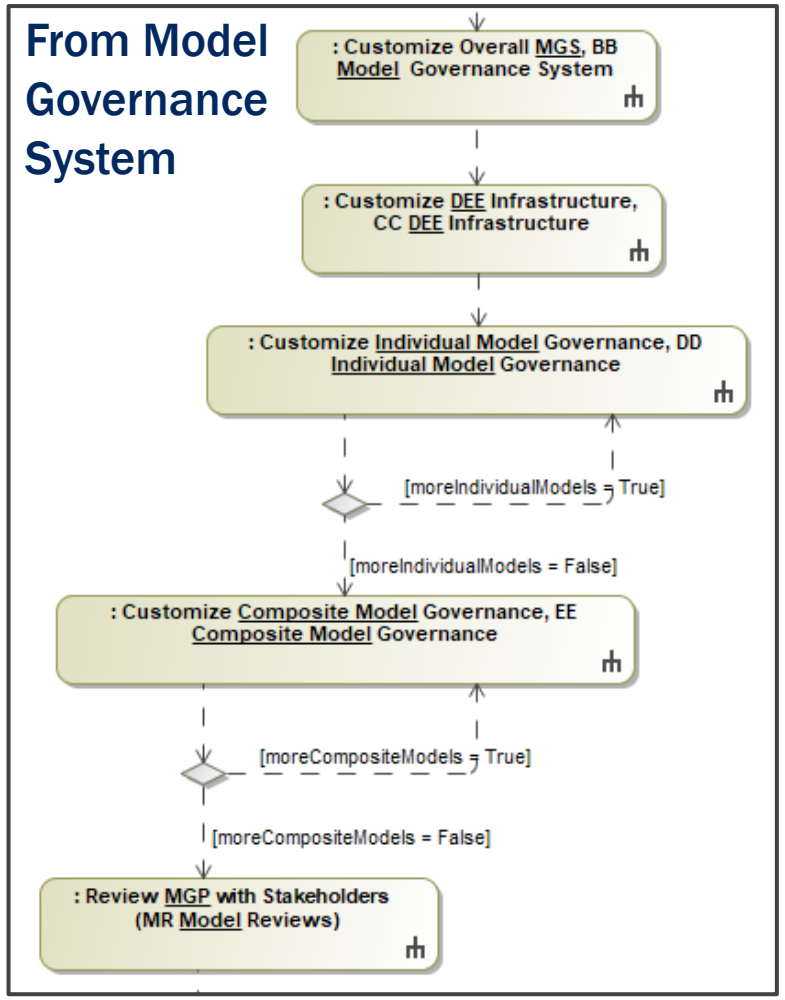
Structure

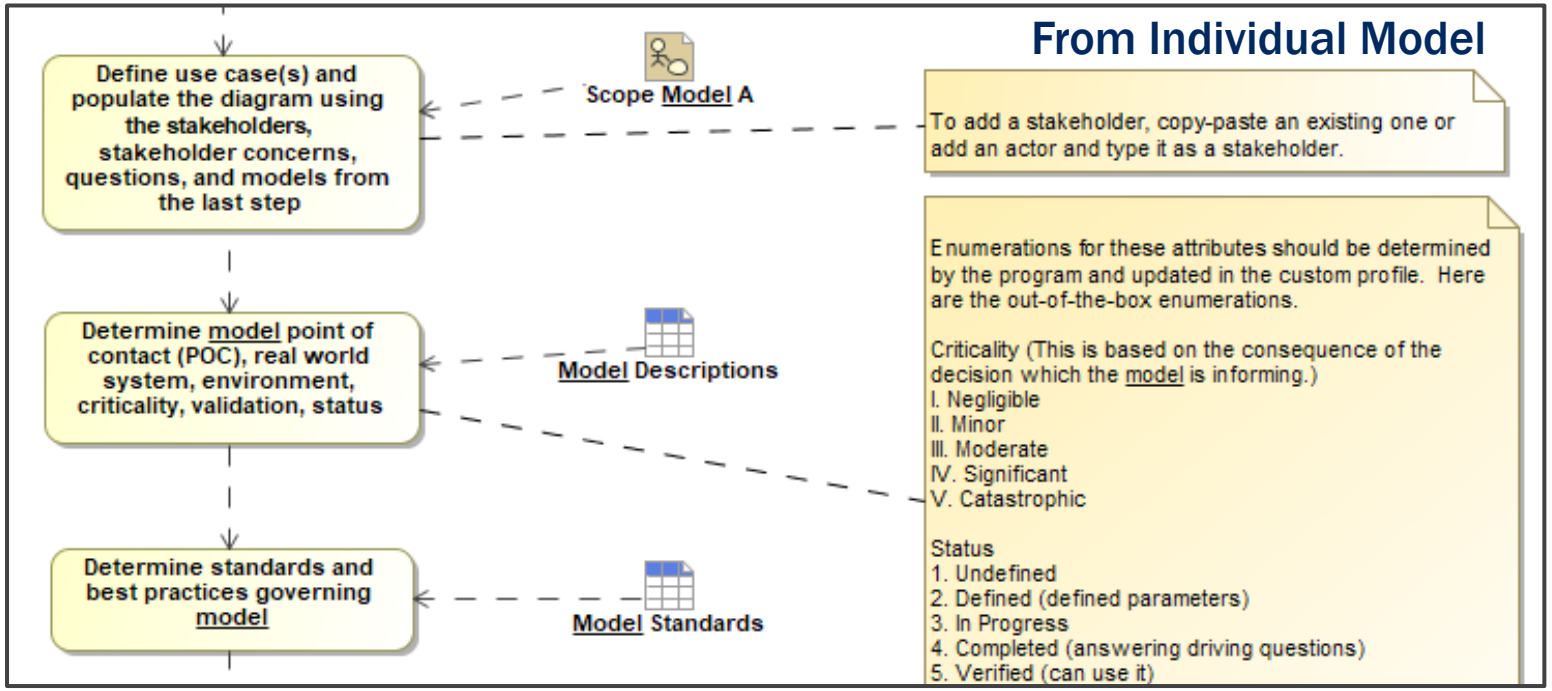




Repeatable Structure to Easily Find Information

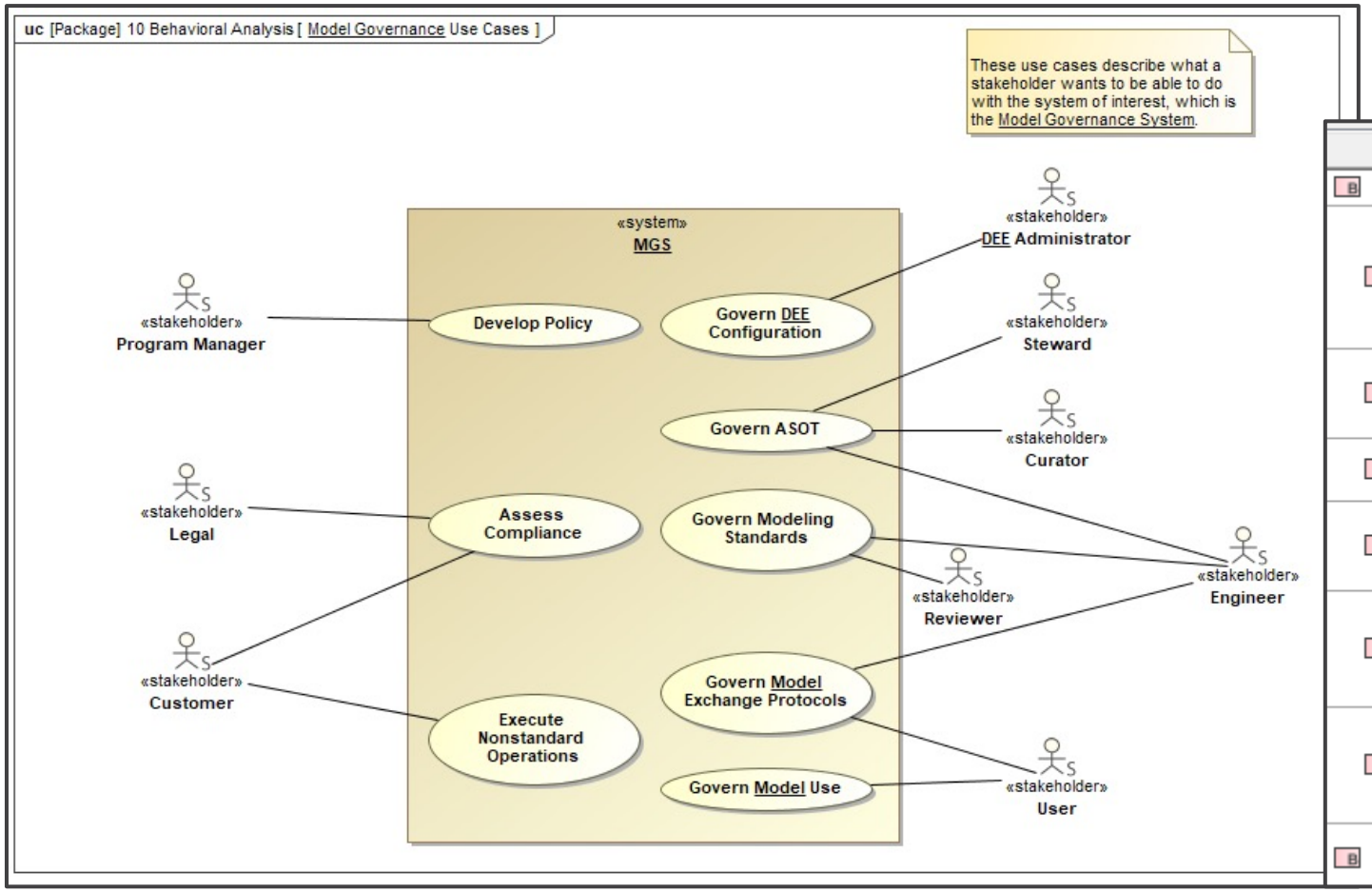
Work Instructions





Instructions Provided at Point of Need

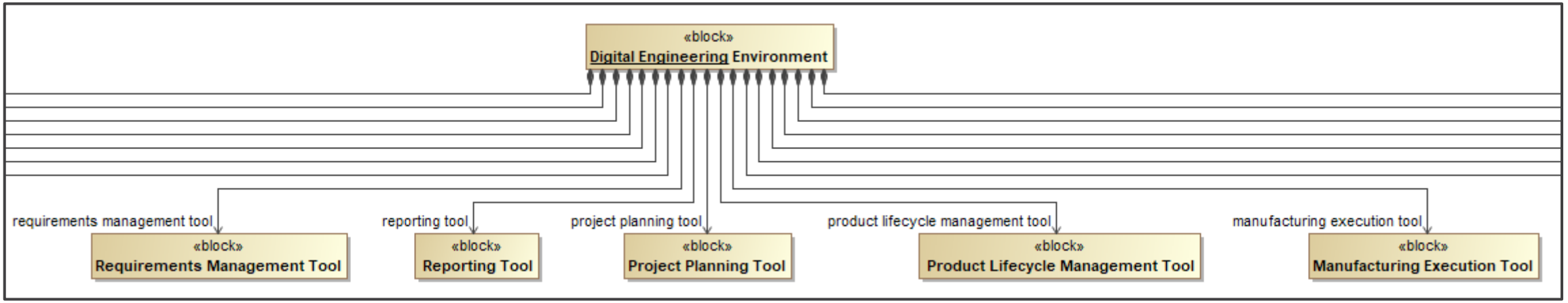
Model Governance System

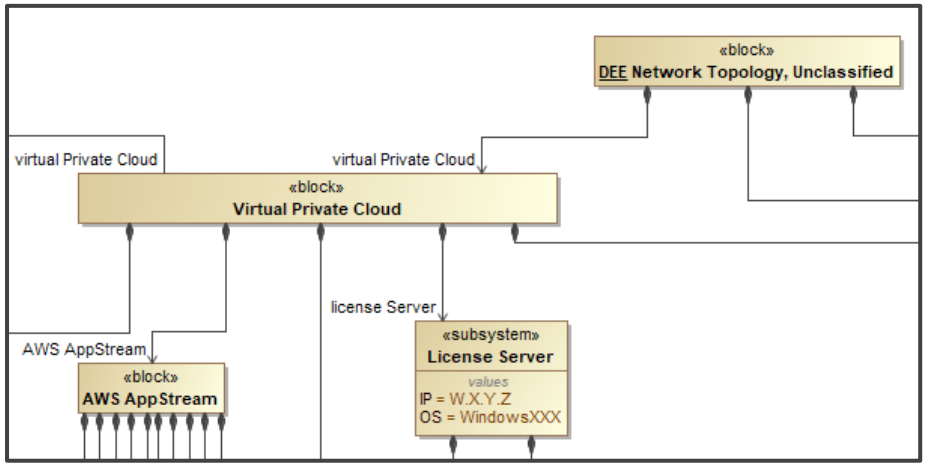


Name	Text	Traced To
26 MGS Services		
26.1 Different Kinds	The MGS services shall include models of different kinds including geometric, analysis, and logical models (refer to model taxonomy in SEBoK Part 2 'Representing Systems with Models').	Fisher, Amit, M. Nol
26.2 Results	The MGS services shall include artifacts that result from the execution of models such as simulation and analysis results.	Fisher, Amit, M. Nol
26.3 Inputs	The MGS services shall include needed inputs to stimulate the models.	Fisher, Amit, M. Nol
26.4 Views	The MGS services shall include artifacts that are generated as views of the models including documents and reports.	Fisher, Amit, M. Nol
26.5 Environments	The MGS services shall include the tools and environments used to create, review, update and delete the models and related artifacts.	Fisher, Amit, M. Nol
26.6 Metadata	The MGS services shall include metadata about the models, the related artifacts, the tools and environments, and the users of the models and related artifacts.	Fisher, Amit, M. Nol
27 Model Content Modification	The MGS shall not modify the model content (excluding its metadata).	Fisher, Amit, M. Nol

Design the Governance System Itself

DEE Infrastructure

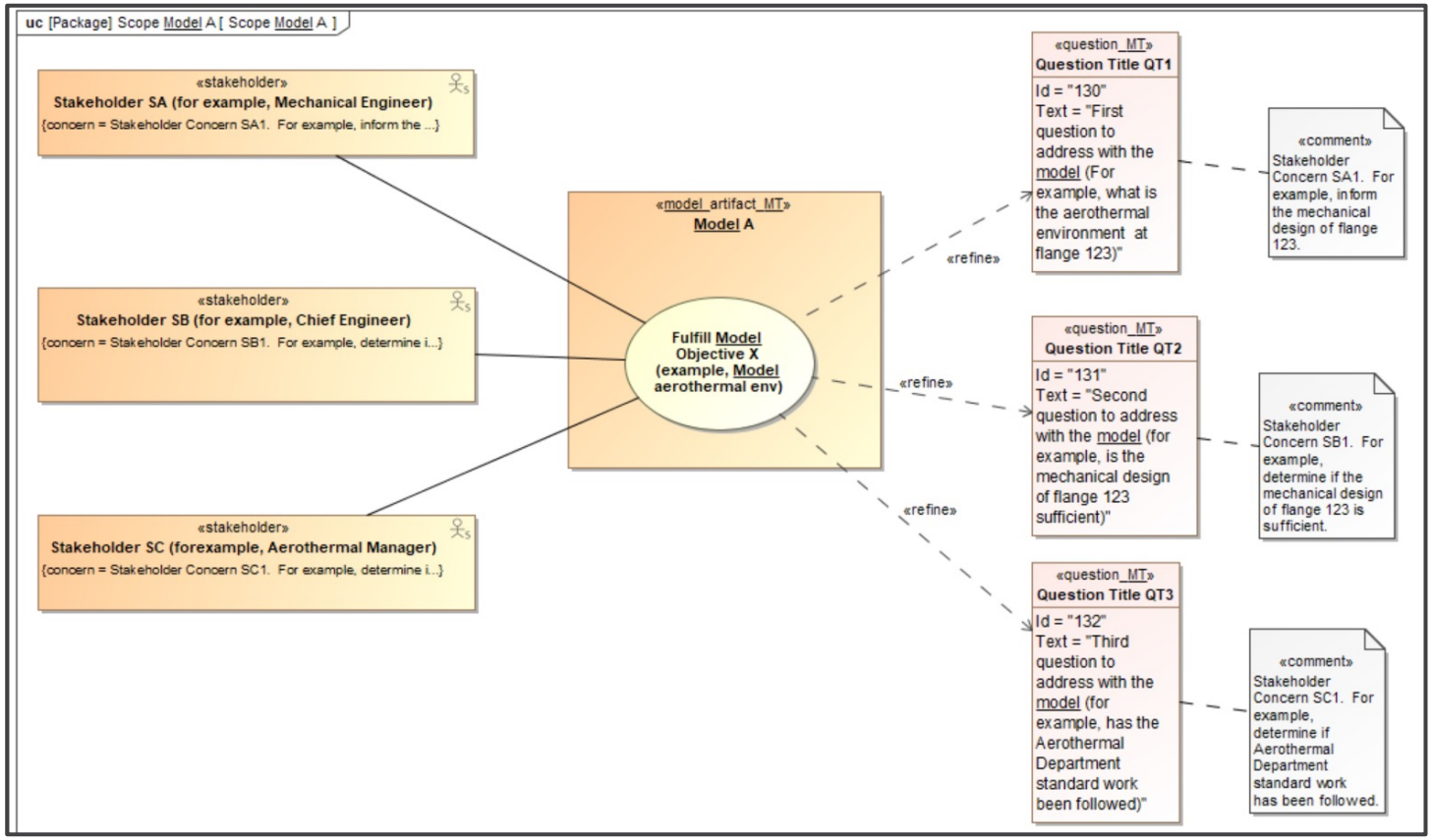




Name	Documentation	Realizes	Associations
Cameo Enterprise Architecture	Dassault Cameo is a model-based systems engineering tool.	Architecture Tool Verification Management T	Teamwork Cloud FlexNet Publisher Cameo Collaborator AWS AppStream
Matlab	Matlab is an analytical tool.	Analytical Tool	Computer A AWS AppStream
ModelCenter	ModelCenter is a tool which enables trades and multi-disciplinary optimization.	Analytical Tool Trades and Optimization T	FlexNet Embedded AWS AppStream

Include DEE Infrastructure Details and Relationship to Models

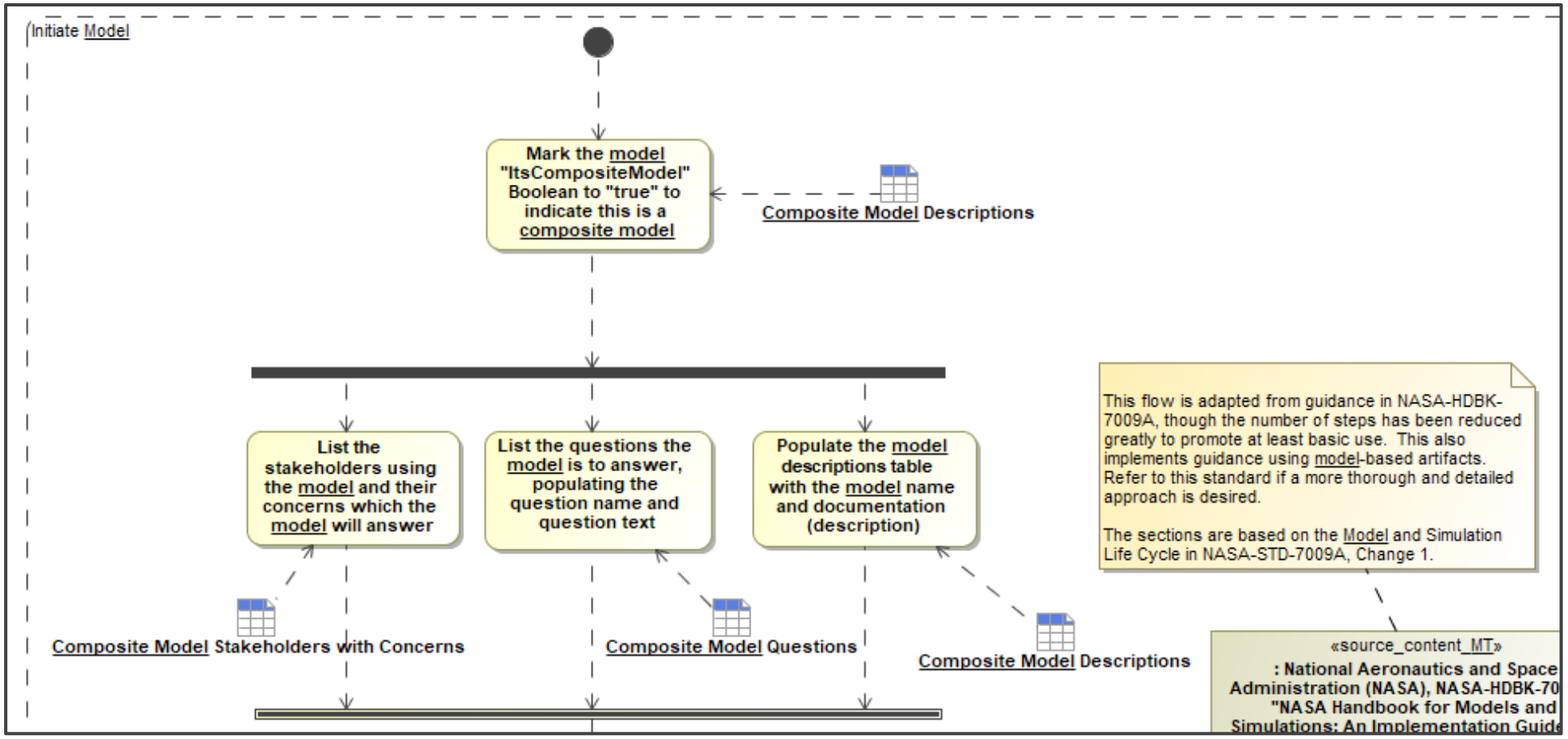
Individual Models



#	Name	Documentation	Associated Assumptions	Associated Risks	Traced to Standards	Use Cases	Questions2	Satisfies	Allocated To	Location
1	Model A	This is the description of Model A...	Assumption B Assumption A	Risk R1	Standard 1 (for example, I Best Practice 3 (for examp Standard 2 (for example, (	Fulfill Model Objective X (e	Question Title QT1 Question Title QT2 Question Title QT3	23 Modeling Questions MGSG-116 Risk MGSG-2 Model Name	ansys : ANSYS	AWS AppStream

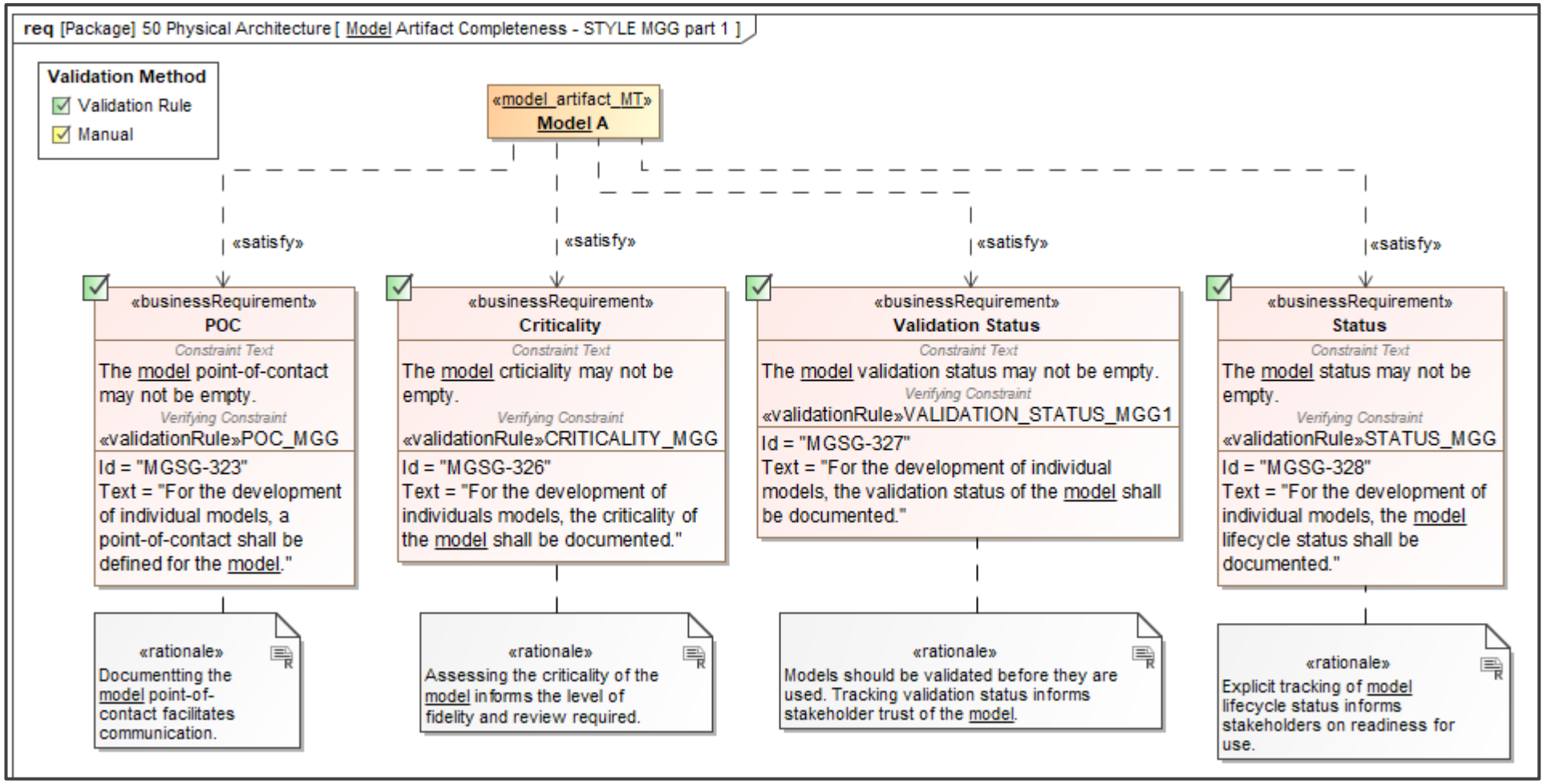
Scoping and Traceability for Models to Address Stakeholder Needs

Composite Models



Define Composite Model Characteristics to Track Linked Model Needs

Automated Validation



Automated Validation Highlights Compliance

User Statement

"The Model Governance Guide provided our team with a framework for developing data governance rules and techniques to execute a rigorous enterprise modeling program. Establishing a set of model controls is no different and just as important as establishing Security Controls in the Cybersecurity discipline. With this effort, our customer will improve their business process management, degree of data integrity, and communication and transparency among Stakeholders. Without Model Governance the desired degree of model and data integrity cannot be achieved."

Mark Stimeling and Rebecca Quintero
ManTech Marine Systems Engineering Directorate

Model Governance Guide Changes in Work

- Further utilize data governance literature to design robust implementation programs
- Update package structure for security viewpoint with attack vectors, security enclaves, threats, controls
- Incorporate learning from program use
- Add validation rule testing diagrams
- Address evolving standards
- Enhance governance automation

Transparent

Collaborative

Measurable

Summary

Summary

As Digital Engineering (DE) ecosystems proliferate, there is a need to robustly manage heterogeneous linked models and data across disciplines, cultures, and contractual boundaries. The Elastic Model Governance Guide includes:

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Adaptation from graphic[1]

Model governance enhances value delivered to customers

Thank you!

- For more information, contact
  - Dr. Heidi Davidz, Heidi.Davidz@ManTech.com
  - Dr. Douglas Orellana, Douglas.Orellana@ManTech.com

References

1. US Department of Defense 2018, 'Digital Engineering Strategy', viewed 20 November 2021, https://ac.cto.mil/wp-content/uploads/2019/06/2018-Digital-Engineering-Strategy_Approved_PrintVersion.pdf.
2. INCOSE, Systems Engineering Vision 2035, available at, https://www.incose.org/about-systems-engineering/se-vision-2035, accessed February 2022.
3. Schadt, EE, MD Linderman, J Sorenson, L Lee, and GP Nolan 2010, 'Computational Solutions to Large-Scale Data Management and Analysis', Nature Reviews Genetics, 11(9), pp.647-657.
4. Hoheb, Al, M. Zetilyan, A. Chang, J. Howie, "Model Portfolio Management (MPM) Guide: A Guide to Defining the Scope, Purpose, Tasks and Products of Model Portfolio Management," The Aerospace Corporation Systems Engineering Forum, May 11, 2021, available at, https://custom.cvent.com/CDB22CFE0C9E4A08A08CC433A7A4E713/files/db524a94cefc48909a659d4304496cb7.pdf, accessed November 2021.
5. Pathrose, Shijin, "Why Organizations Need to Leverage Data Governance on Dark Data," SG Analytics, published in Data Aggregation & Management, blog archives, October 2019, available at, https://us.sganalytics.com/blog/why-leverage-data-governance-on-dark-data/#:~:text=The%20dark%20data%20is%20a%20huge%20chunk%20of,cost-effective%20than%20managing%20its%20storage%20without%20a%20cause, accessed November 2021.
6. National Aeronautics and Space Administration (NASA), NASA-STD-7009A w/Change 1, "Standard for Models and Simulations," Approved 2016-12-07, available at, https://standards.nasa.gov/standard/nasa/nasa-std-7009, accessed November 2021.
7. NASA, NASA-HDBK-7009A, "NASA Handbook for Models and Simulations: An Implementation Guide for NASA-STD-7009A," approved 2019-05-08, available at, https://standards.nasa.gov/standard/nasa/nasa-hdbk-7009, accessed November 2021.
8. Fisher, Amit, M. Nolan, S. Friedenthal, M. Loeffler, M. Sampson, M. Bajaj, L. VanZandt, K. Hovery, J. Palmer, L. Hart, "Model Lifecycle Management for MBSE," International Council on Systems Engineering (INCOSE) International Symposium, July 2014.
9. Open Model Based Engineering Environment (OpenMBEE), available at, https://www.openmbee.org/, accessed November 2021.
10. Karban, Robert, C. Delp, YouTube video, "OpenMBEE Intro @MODELS'20," January 2021, available at, https://www.youtube.com/watch?v=ofKgcDrBFZQ, accessed November 2021.
11. Hoheb, A., A. Chang, M. Zetilyan, J. Howie, "Model Portfolio Management Guide," Aerospace Corporation Technical Operating Report TOR-2020-01577, September 2020.
12. Hale, Joe, A. Hoheb, "INCOSE Model-Based Capabilities Matrix and User's Guide," Version 1.0, January 2020.
13. INCOSE Configuration Management Working Group, "Configuration Management in the Context of a Model-Based Enterprise," white paper revision B, accessed November 2021.
14. Pak, Rebekah, "A^3 Data Governance: Data Governance Introduction and General Process," May 2021.
15. Digital Curation Centre, DCC Publications, available at, https://www.dcc.ac.uk/publications/research-publications, accessed November 2021.
16. Rhodes, Donna, "Investigating Model Credibility within a Model Curation Context," Conference on Systems Engineering Research (CSER) 2020.
17. Rhodes, Donna, "Model Curation: Requisite Leadership and Practice in Digital Engineering Enterprises," CSER 2019.
18. United States Department of Defense, "DoD Instruction 5000.02, Operation of the Adaptive Acquisition Framework,'" https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/500002p.pdf?ver=2020-01-23-144114-093.
19. Taylor, Matt, "An Elastic Approach to Digital Engineering," NDIA Systems and Mission Engineering Conference, December 2021.
20. SAIC, "Digital Engineering Validation Tool," available at, https://www.saic.com/digital-engineering-validation-tool, accessed November 2021.

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