33rd Annual INCOSE international symposium

hybrid event

Honolulu HI USA

Panel: Utilizing Model and Data Governance to Enhance Digital Engineering Execution

33rd Annual INCOSE international symposium

hybrid event

Honolulu HI USA

Dr. Heidi Davidz, ManTech International

Utilizing Model and Data Governance to Enhance Digital Engineering Execution

What is Model Governance?

Documented decisions, rights, and accountabilities

for model related processes,

executed according to an agreed upon set of rules

which describe:

- who can take
- what actions with
- what models,
- when, under
- what circumstances, using
- what methods.

Transparent

Collaborative

Measurable

Adapted from Pak 2021

Why Governance?

"Digital Engineering (DE) is an integrated digital approach that uses authoritative sources of system data and models as a continuum across disciplines to support lifecycle activities from concept through disposal"

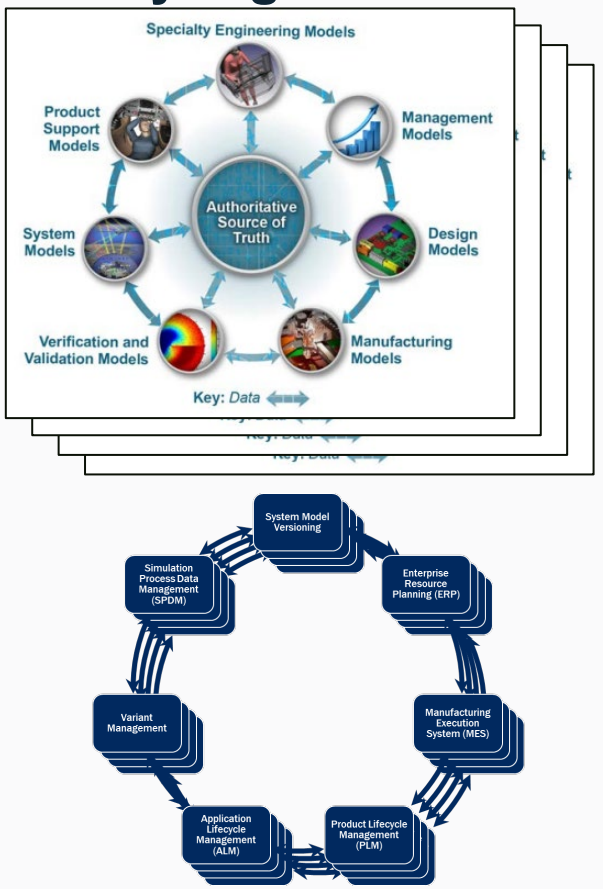
Adapted from DoD 2018

Use models

Different domains

Distributed data management

Many organizations



Reality

Governance across a digital thread must address a set of data management tools to ensure quality for decision making

Why Governance?

Organize the Digital Engineering ecosystem to execute efficiently and reduce the cost of confusion, churn, rework

- **Scope** – WHAT models/data are in the program DE ecosystem?
- **Roles** – WHO needs to interact with those models/data?
- **Purpose** - WHY are models/data needed for the mission?
- **Process** – HOW do WHAT actions happen WHEN?
- **Location** - WHERE do models/data reside in the infrastructure?

Governance vs. Management

Model Governance

Govern – Define and oversee the right things

Model Management

Manage – Do the right things

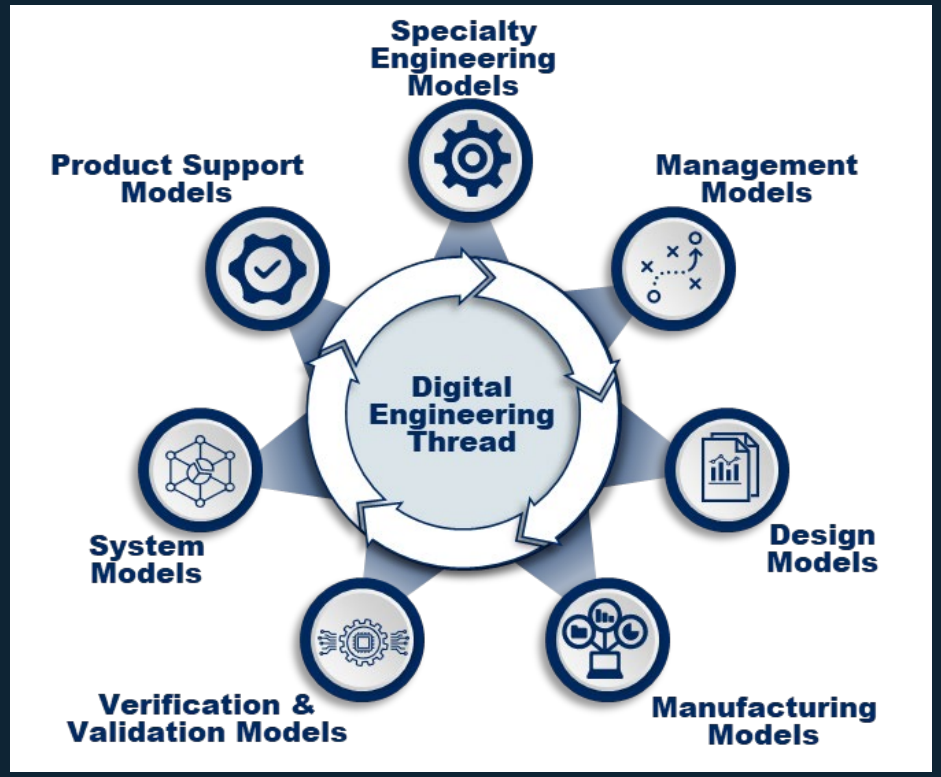
Model Governance ensures Model Management is happening

Adapted from Ladley 2020

Two Sides of the Same Coin

Digital Engineering and Solution Debt

- Technical debt is the implied cost of additional rework caused by choosing a limited solution now
- Solution debt attempts a more comprehensive view across discipline and lifecycle, including data debt
- Evaluating solution debt includes: (1) impact, (2) fix cost, (3) contagion



From Redman 2017, Grandperrin 2022, Taylor et al 2022

DE Connects Data in Useful Ways, but Can "Super Spread" Debt Impact

One Solution

Design, deploy, sustain an effective data and model governance program

ManTech Model Governance Guide

As Digital Engineering (DE) employs a digital thread with a broad range of interconnected models, it can be difficult to govern linked models across disciplines and contractual boundaries. This approach includes:

GUIDANCE – Model-based guidance with in-model work instructions,

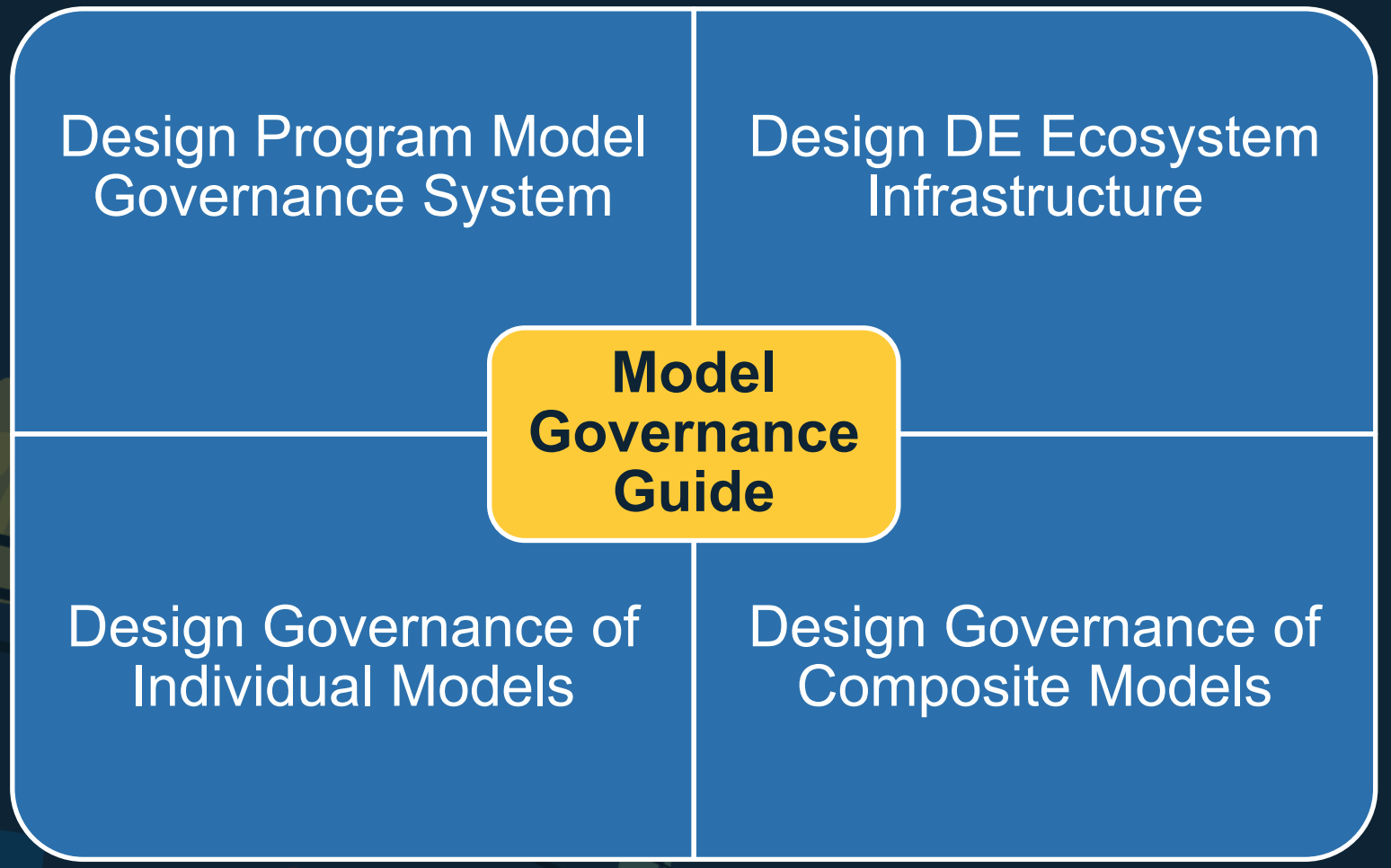
INTEGRATION – Integration of the overall model governance system, DE Ecosystem (DEE) infrastructure, individual models, and composite models,

PURPOSE – Traceability of model purpose and resolution of technical debt,

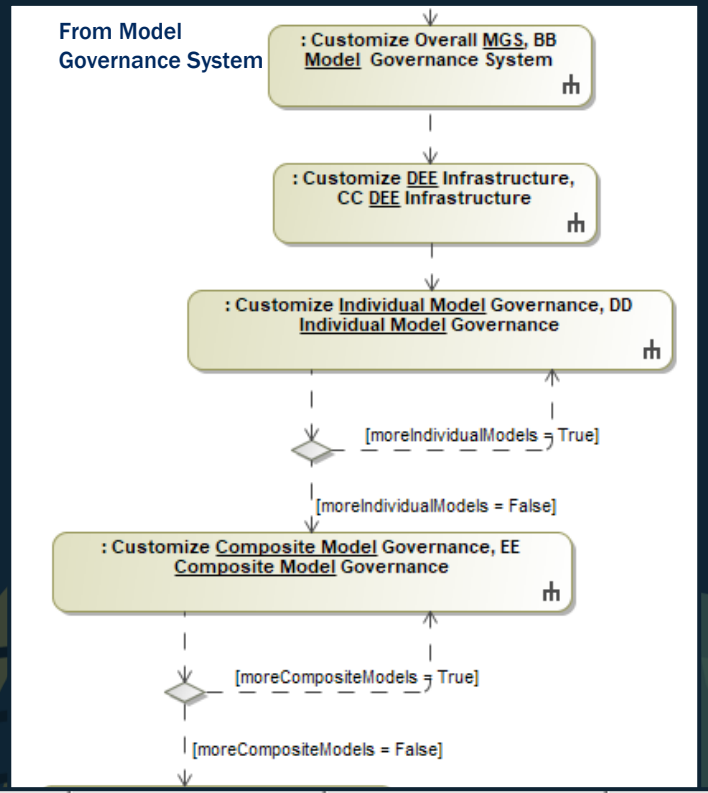
VALIDATION – Automated validation for insight on compliance,

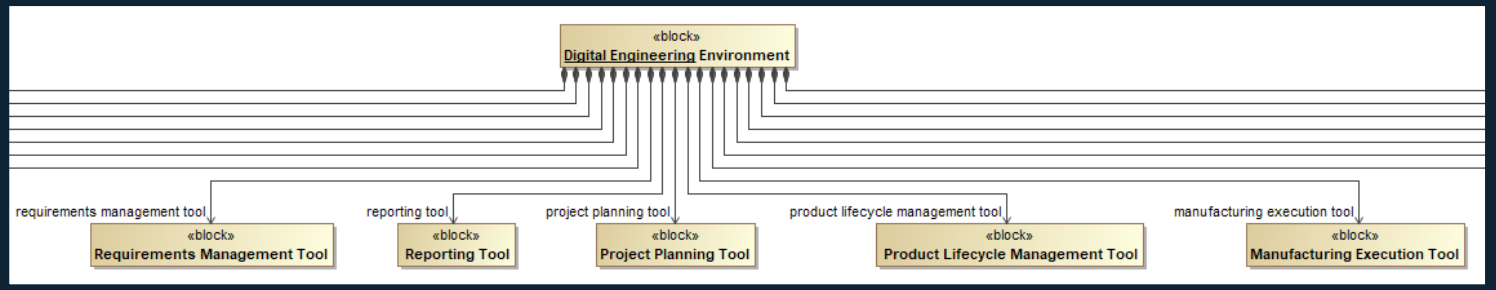
FLEXIBILITY – Customization for flexibility and tailoring (flex-engineering®).

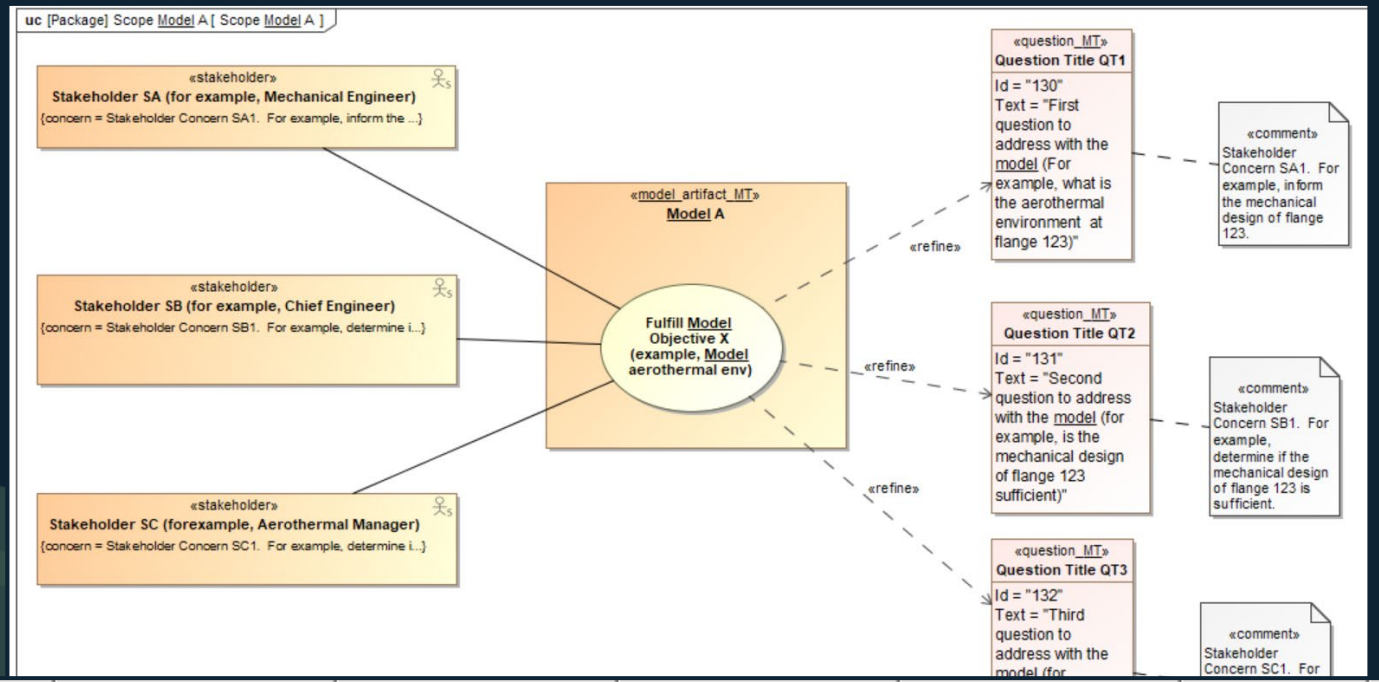
Design the Program DE Governance



Model Snapshots







#	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

Ensure Models and Infrastructure Address Program Needs

References

- Clark, Bill, “A Taxonomy of Tech Debt,” available at, https://technology.riotgames.com/news/taxonomy-tech-debt, April 2018, accessed February 2023.
- Davidz, Heidi, Douglas Orellana, Tammy Bogart, Wayne Thomasson, “Utilizing Automation and Ontologies to Design, Deploy, and Sustain an Effective Model Governance Program,” NDIA SME 2022, November 2022.
- Davidz, Heidi, Doug Orellana, “Employing Elastic Model Governance to Streamline Ground Vehicle Development,” 14th Annual Ground Vehicle Systems Engineering and Technology Symposium and Advanced Planning Briefing for Industry, August 2022.
- Davidz, Heidi, Doug Orellana, “Controlling the Digital Engineering Ecosystem: An Elastic Model Governance Guide for the Digital Thread,” 32nd Annual INCOSE International Symposium, Detroit, MI, June 2022.
- Davidz, Heidi, Doug Orellana, “Governing the Digital Ecosystem: ManTech’s Elastic Model Governance Guide and Validation Tool,” Dassault Systemes 2022 MBSE Cyber Experience Symposium, Allen, TX, March 2022.
- Davidz, Heidi, Doug Orellana, Rebecca Pak, “Taking Authority Over Your Modeling Enterprise: ManTech’s Elastic Model Governance Approach,” National Defense Industrial Association (NDIA) 2021 Virtual Systems and Mission Engineering Conference, December 2021.
- Duarte, Tiago, “Technical Debt and Unplanned Work on Software Development,” September 2020, available at, https://www.coletiv.com/blog/technical-debt-and-unplanned-work-on-software-development, accessed February 2023.
- Grandperrin, Jonathan, “Bad Data: A $3T-per-year Problem with a Solution”, April 2022, available at https://venturebeat.com/datadecisionmakers/bad-data-a-3t-per-year-problem-with-a-solution/, accessed February 2023.
- Ladley, John, “Data Governance: How to Design, Deploy, and Sustain an Effective Data Governance Program, 2nd Edition, Academic Press, 2020.
- Pak, Rebekah, “A3 Data Governance: Data Governance Introduction and General Process,” May 2021.
- Redman, Thomas C., “Seizing Opportunity in Data Quality”, MIT Sloan Management Review, November 2017,available at, https://sloanreview.mit.edu/article/seizing-opportunity-in-data-quality/, accessed February 2023.
- SAIC, “Digital Engineering Validation Tool,” available at, https://www.saic.com/digital-engineering-validation-tool , accessed February 2023.
- Taylor, Matthew, Heidi Davidz, Douglas Orellana, “Solution Debt in the Age of Digital Engineering,” NDIA SME 2022, November 2022.
- Taylor, Matthew, “An Elastic Approach to Digital Engineering,” NDIA Systems and Mission Engineering Conference, December 2021.
- US Department of Defense, “Digital Engineering Strategy,” 2018, viewed 20 November 2021, available at, https://ac.cto.mil/wp-content/uploads/2019/06/2018-Digital-Engineering-Strategy_Approved_PrintVersion.pdf, accessed February 2023.

33rd Annual INCOSE international symposium

hybrid event

Honolulu HI USA

www.incose.org/symp2023

#INCOSEIS

33rd Annual INCOSE international symposium
hybrid event
Honolulu HI USA

Jordan Howie, The Aerospace Corporation

Model Portfolio Management

Model Portfolio Management

What is it, and why do we need it?

- Acquirers are getting a large variance of responses by asking for “Model Management” work
- “Model Management” scored low by organizations – INCOSE Model-Based Capabilities Matrix
- “Model Management” as a significant area of improvement – SERC SE Survey
- No prior guide or standard that addresses managing a collection of models

INCOSE is adopting Aerospace’s Model Portfolio Management (MPM) Guide to assist organizations with managing their collections of models. The guide will serve as a solicitation reference document.

Portfolio

*A collection of **projects** grouped together to facilitate effective management of work to meet strategic business objectives. (Mathur, 2006)*

Model Portfolio

A collection of models where the evaluation of that collection has been identified as being significant to mission accomplishment/enterprise management.

Model Portfolio Management

The administration or control of a collection of models, the purpose of which, is to achieve strategic objectives with particular attention to utilizing organizational resources in an efficient manner.

Model Portfolio Management Use Cases

How to use the MPM Guide

Users

- Manage a portfolio of models
- Meet business needs
- Characterize models
- Access control to models and model elements
- Establish common standards
- Reference document for contracts
- Define terms and principles
- Establish model portfolio governance
- Maintain repository cofiguration
- Enhance integration and assurance
- Evolve IT infrastructure

The MPM Guide can be used in several different ways to promote model governance and management

MPM Life Cycle

Model Portfolio Manager (MPM)

Performs

Coordinates with

Model Management

- Model Acquisition
- Model Integration
- Configuration Management of Portfolio
- Model Management Access
- Modeling Quality
- Model Products

Model Portfolio Governance

- Business Strategy
- Operational Strategy
- Roadmap
- Scope Management
- Process Optimization
- Performance Metrics
- Sponsorship

MPM requires roles and responsibilities to be established to facilitate the portfolio through its life cycle

33rd Annual INCOSE international symposium

hybrid event

Honolulu HI USA

www.incose.org/symp2023

#INCOSEIS

33rd Annual INCOSE international symposium
hybrid event
Honolulu HI USA

Ryan Noguchi, The Aerospace Corporation

Governance for MBSE

MBSE Model Lifecycle Processes

Key Questions to be Answered

Architecting Models	• How do we architect the model for maximize chances for success? How do we define the model content needed to answer stakeholders' questions?
Planning Models	• How do we plan and manage the modeling effort? How do we adapt our plans to address evolving knowledge and emerging needs?
Building Models	• How do we build models to achieve greater consistency, quality, and interoperability? Which modeling constructs should we use (or not) and how should we use them?
Using Models	• How do we use reusable query and reporting templates, model extraction and transformation methods, and collaborative tools to best extract value from models?
Verifying Models	• How do we verify that models are satisfying users' needs? How do we verify that we're getting good value from our modeling efforts?
Governing Models	• How do we govern the models to ensure they can be trusted to serve as ASOTs? How do we ensure models evolve in a controlled manner that doesn't break users?
Federating Models	• How do federate models to achieve outcomes larger than the sum of their parts? How do we govern these model federations to avoid chaos?
Sustaining Models	• How do we sustain and curate these models over time? How do we track the evolving maturity of models over time?

Modeling shouldn't just be about building models—How many of these other questions are you addressing in your modeling efforts?

MBSE Model Lifecycle Model

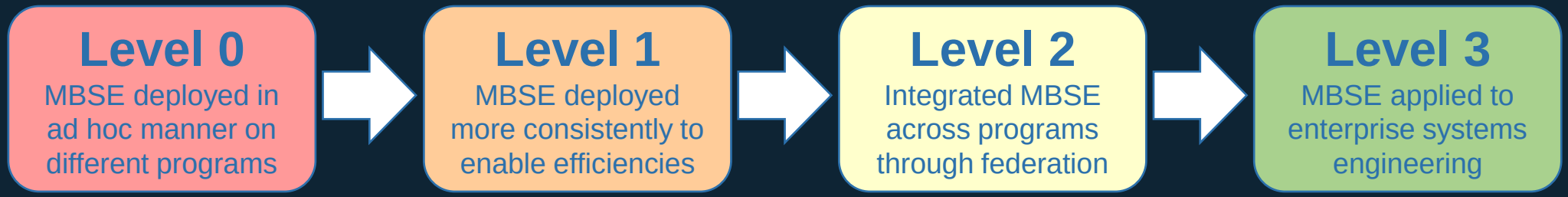
Key Questions to be Answered

Architecting Models	• How do we **architect** the model for maximize chances for success? How do we define the **model content** needed to answer stakeholders' questions?
Planning Models	• How do we **plan** and **manage** the modeling effort? How do we **adapt** our plans to address evolving knowledge and emerging needs?
Building Models	• How do we build models to achieve greater **consistency, quality, and interoperability**? Which modeling constructs should we use (or not) and how should we use them?
Using Models	• How do we use reusable query and reporting templates, model extraction and transformation methods, and collaborative tools to best **extract value** from models?
Verifying Models	• How do we verify that models are **satisfying users' needs**? How do we verify that we're getting good **value** from our modeling efforts?
Governing Models	• How do we govern the models to ensure they can be **trusted** to serve as ASOTs? How do we ensure models evolve in a **controlled manner** that doesn't break users?
Federating Models	• How do federate models to achieve outcomes larger than the sum of their parts? How do we govern these model federations to **avoid chaos**?
Sustaining Models	• How do we **sustain** and **curate** these models over time? How do we track the **evolving maturity** of models over time?

MBSE governance is largely focused on addressing these sorts of questions

Enterprise MBSE Maturity Scales

- MBSE maturity can be measured by its level of implementation in the Enterprise
- Most organizations still in Level 0 and 1



(From *Think Globally, Act Locally: Adapting MBSE to the Enterprise Context – 2022 INCOSE International Symposium*)

- To progress to Level 1, need:
  - *Common modeling methodologies*
  - *Common modeling processes*
  - *Common modeling toolsets and repositories*
  - *Standardized modeling templates*
  - *Standardized modeling profiles—often SysML*
  - *Decent reuse of models between programs*

- To progress to Level 2, need:
  - *Minimize divergence in MBSE implementation*
  - *Adopt key Enterprise-Ready modeling practices*
    - Clear Partitioning of ASOT
    - Modeling for Federation
    - Modeling for Reuse
    - Exploiting Abstraction Layers

Progressing forward in MBSE maturity as an enterprise requires some convergence of MBSE implementations

MBSE Methodology Governance

- Establish governance board of experienced MBSE practitioners
- Execute a collaborative governance process
  - Identify issues facing modelers or model users
  - Identify concerns to be addressed
  - Identify questions to be answered
  - Identify alternatives to be assessed
  - Identify tradeoffs to be explored
  - Identify preliminary guidance
  - Perform consensus review
  - Document consensus guidance
  - Establish reassessment criteria
- Goal is to provide defensible guidance to model architects, builders, and users
  - Acknowledging various perspectives and needs
  - Achieving appropriate balance between competing factors
  - Promoting convergence to best practices

Convergence of MBSE methodology is needed to achieve greater consistency, quality, and interoperability of models

33rd Annual INCOSE international symposium

hybrid event

Honolulu HI USA

www.incose.org/symp2023

#INCOSEIS

33rd Annual INCOSE international symposium

hybrid event

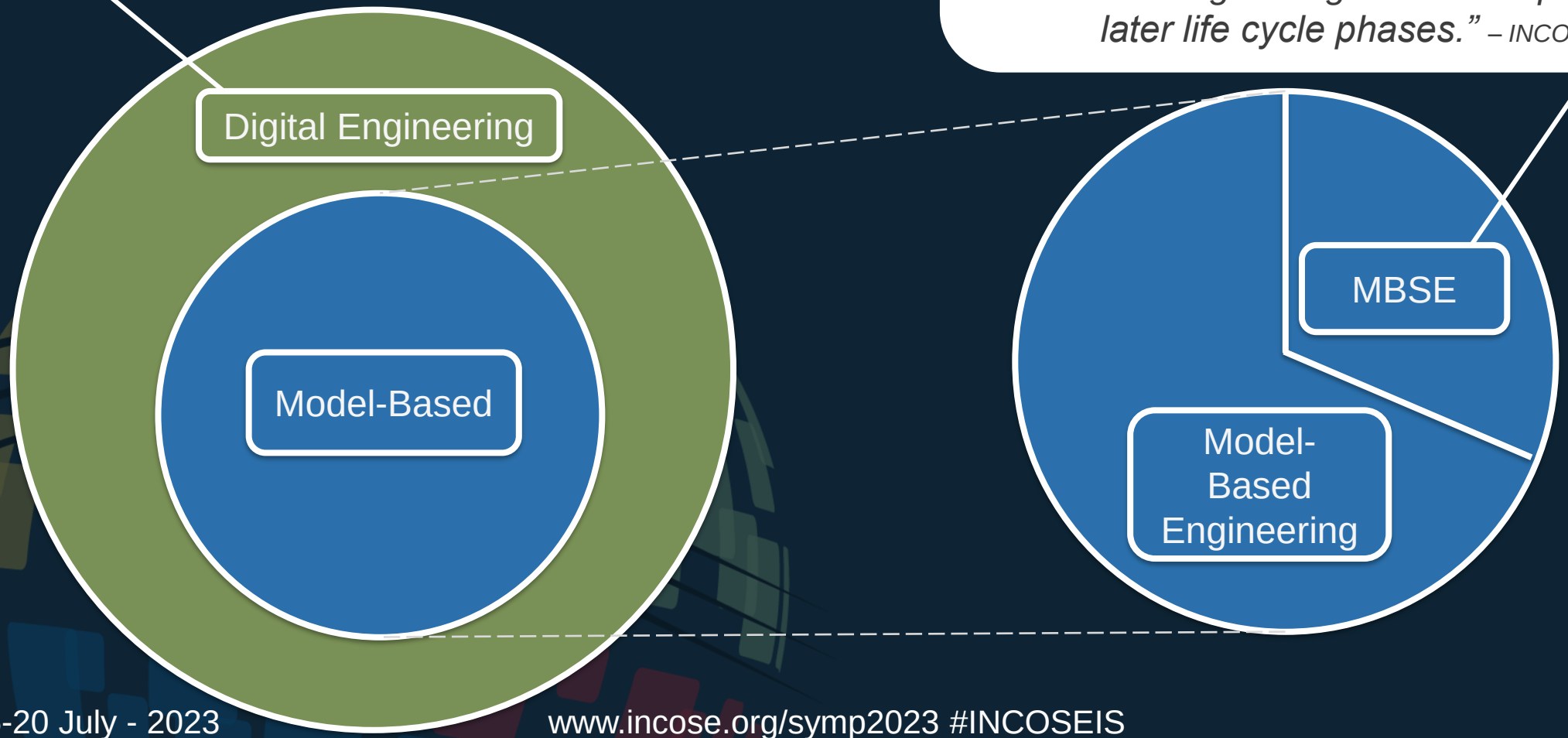
Honolulu HI USA

Sarah Scheithauer, Georgia Tech Research Institute (GTRI)

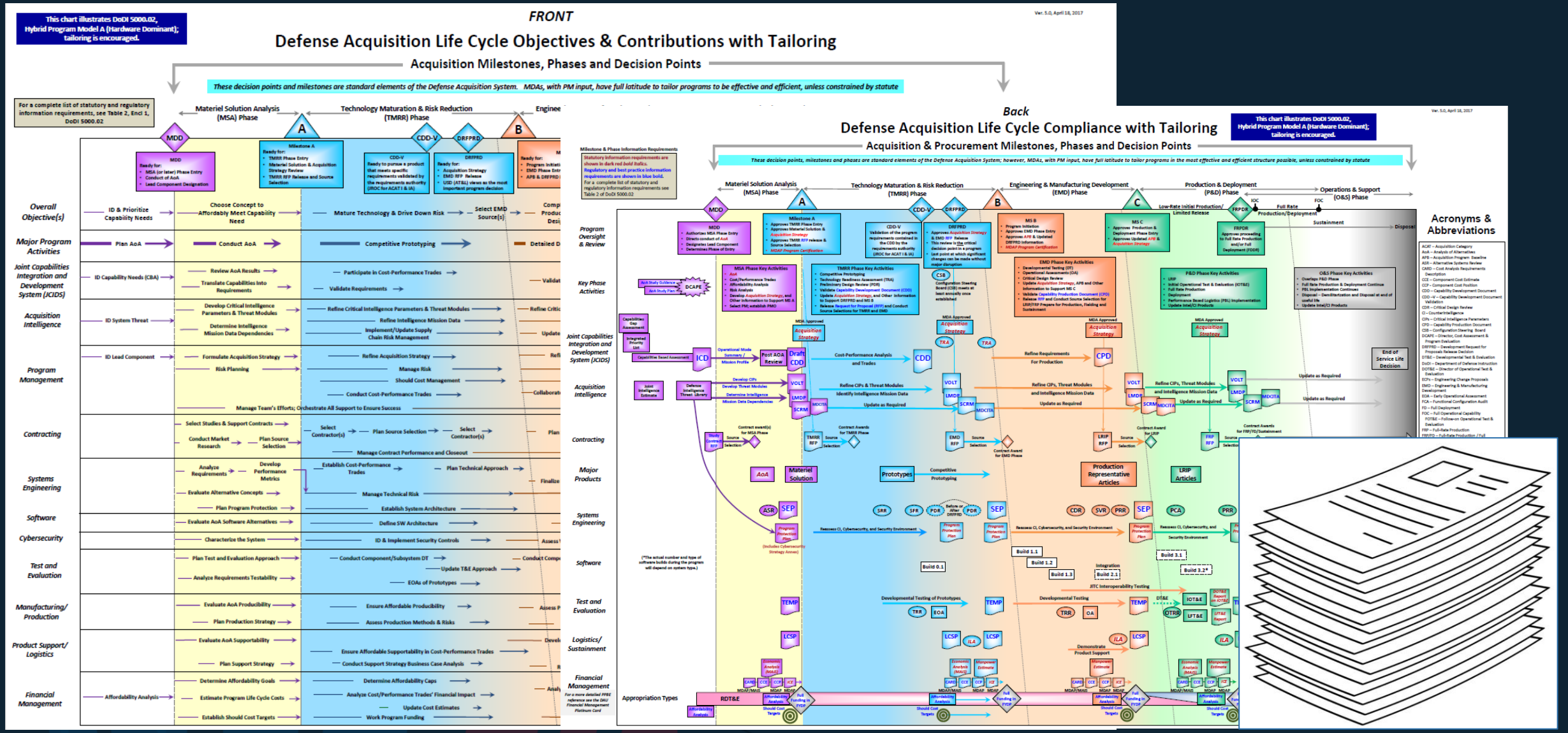
Model Governance: An Acquisitions Perspective

"Digital Engineering is an integrated digital approach that uses authoritative sources of system data and models as a continuum across disciples to support lifecycle activities from concept through disposal" - USD(R&E)

"Model-Based Systems Engineering is the formalized application of modeling to support system requirements, design, analysis, verification, and validation activities beginning in the conceptual design phase and continuing throughout development and later life cycle phases." – INCOSE

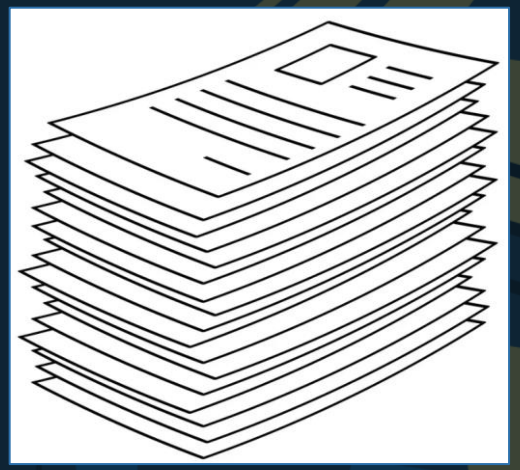


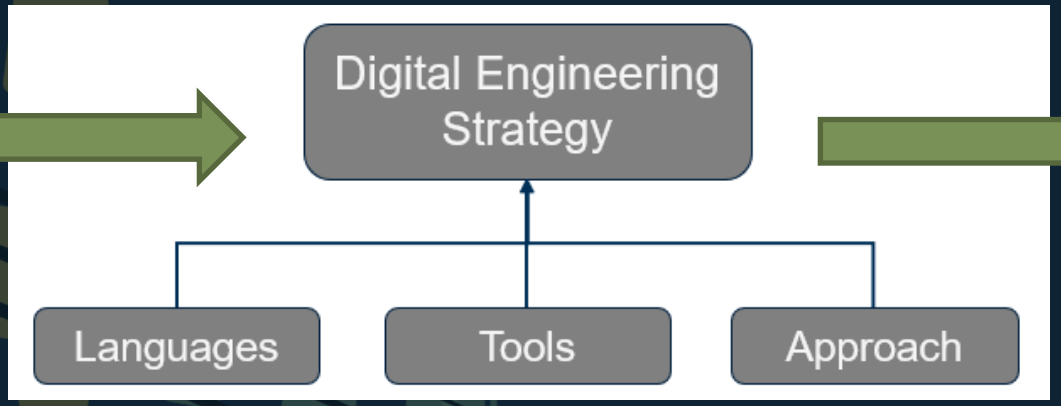
Traditional DoD Acquisition Process

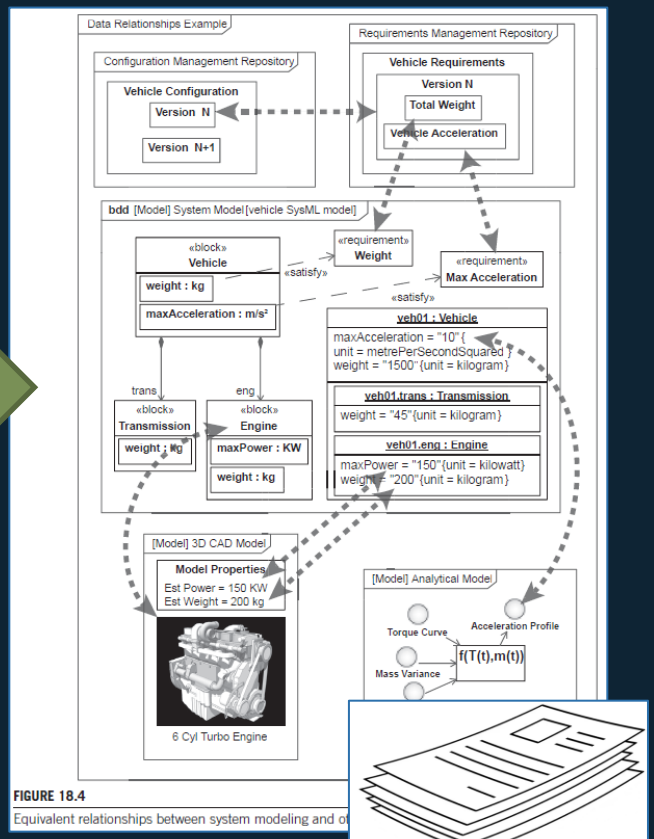


Model-Based Acquisition in Context of MBSE and DE

"Model-based acquisition is the technical approach to acquisition that uses models and other digital artifacts as the primary means of information exchange, rather than document-based information exchange." – *OMG MBAcq User Group*

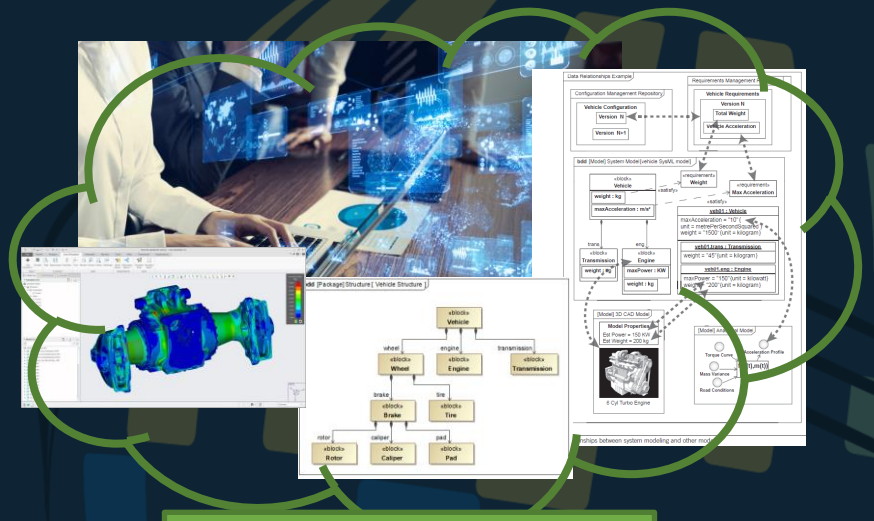






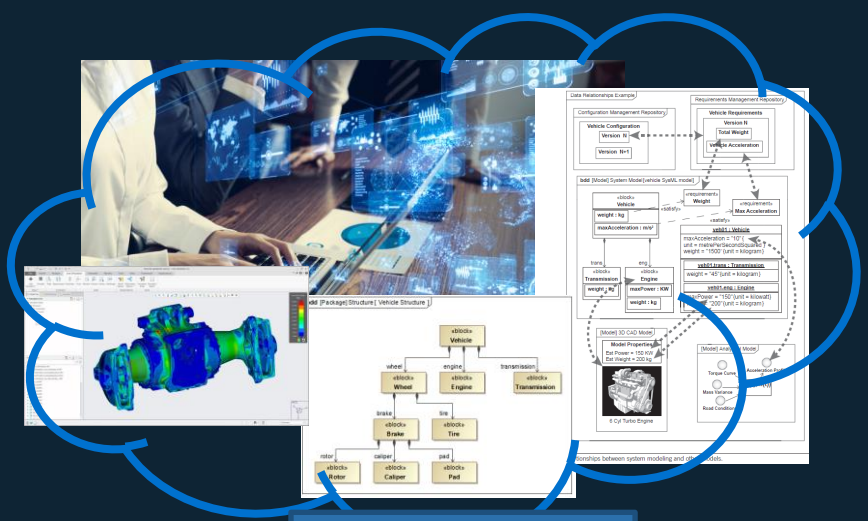
Importance of Governance in Hybrid Digital Engineering Environments (DEE)

- Hardware, network, and security constraints often prevent the Government from operating in the same DEE as the Contractor(s) throughout the acquisition process.
- Many DoD acquisition programs currently adopt a "hybrid" DEE approach, which introduces additional complexities in terms of bi-directional digital data exchange and the maintenance of a consistent digital thread throughout the data lifecycle.



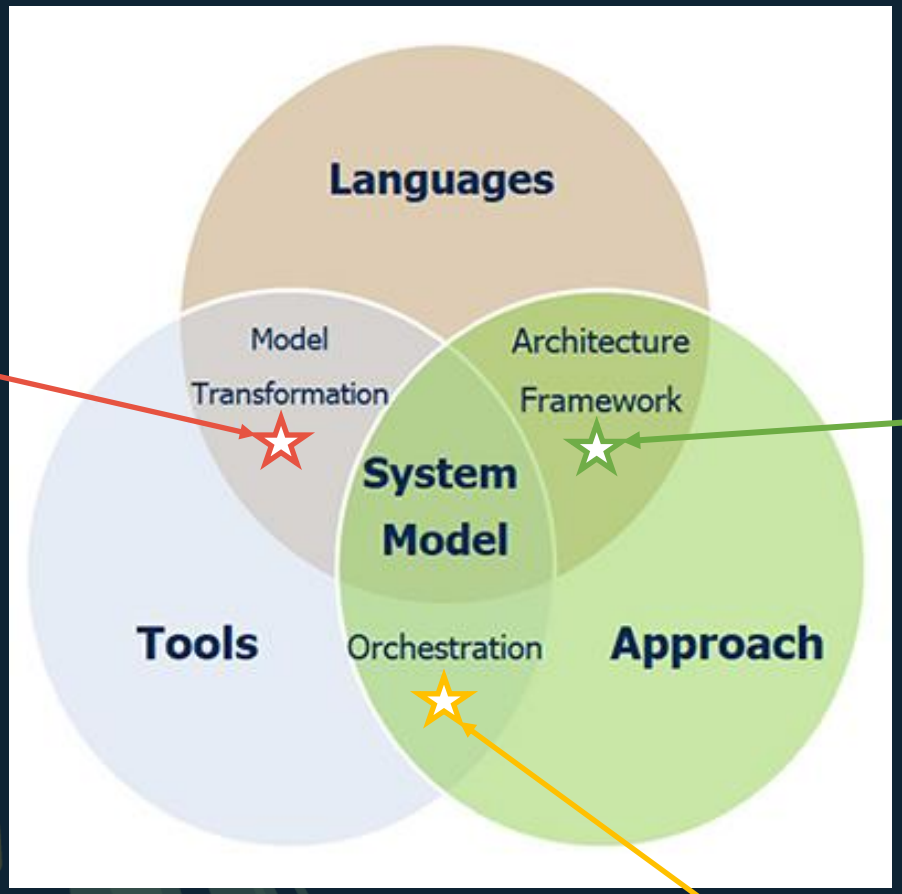
Contractor DEE

Shared DEE Interface



Gov't DEE

- What data are being exchanged, and between whom?
- Are data exchanged in both directions?
- What is the volume of data?
- How often is the data exchanged and over what duration?
- Do the sending and receiving tools use the same modeling languages and formats, or is translation required?
- How is the data going to be stored, managed, and maintained?



- What is the common practice for creating, interpreting, analyzing, and using data within a particular domain?
- Who are the stakeholders associated with the information, and what are their needs and concerns?
- What data needs to be delivered to satisfy stakeholder needs?
- What are the data interfaces and dependencies?
- What are the min viable requirements and constraints that might impact the DE approach?

Friedenthal, Moore, A., & Steiner, R. (2008). *A practical guide to SysML the Systems Modeling Language / Sanford Friedenthal, Alan Moore, Rick Steiner.* (1st edition). Elsevier/Morgan Kaufmann.

A model governance plan plays a vital role in program planning as it can be developed iteratively throughout the acquisition process. It serves to inform decisions, document the rationale behind the digital engineering approach, and capture the decisions made regarding digital engineering environments.

- What resources (people, hardware, software, network) are needed to execute the DE strategy?
- Which standards/processes must be followed?
- Do new standards/processes need to be put into place?

Summary

- Model governance encompasses more than just models; it extends to all digital data across the acquisition lifecycle, from the RFP to the contractor deliverables.
- In the acquisition process, multiple digital engineering environments are typically involved, and careful consideration must be given to the data exchange between these environments.
- Having a robust model governance plan is essential for the following reasons:
  - It helps define the scope of the digital engineering strategy and provides an understanding of the digital data required to execute the strategy effectively.
  - It enables tracking of program decisions and the underlying rationale concerning digital engineering.
  - It facilitates documentation of the evolving configuration of the digital engineering environments (DEEs) as they mature.
  - It aids in comprehending the necessary processes for utilizing and managing data effectively.
  - It serves as a comprehensive reference for the workforce, outlining all data requirements such as sources, locations, fidelity, access, training, and more.

References and Contact Info

- https://www.dau.edu/tools/t/Department-of-Defense-Acquisition-Life-Cycle-Chart
- https://ac.cto.mil/de-ms-glossary/
- https://www.incose.org/about-systems-engineering/system-and-se-definition/se-glossary
- Friedenthal, S., Moore, A., & Steiner, R. (2015). A practical guide to sysml : the systems modeling language (Third, Ser. The mk/omg press). Elsevier/Morgan Kaufmann. Retrieved March 16, 2023
- Delligatti, L. (2014). *Sysml distilled : a brief guide to the systems modeling language*. Addison-Wesley. Retrieved March 16, 2023
- https://ac.cto.mil/digital_engineering/

Sarah Scheithauer

Sarah.Scheithauer@gtri.gatech.edu

33rd Annual INCOSE international symposium

hybrid event

Honolulu HI USA

www.incose.org/symp2023

#INCOSEIS