

Ground System Architectures Workshop ***Driving Innovation for Enterprise Integration***

February 23–March 3, 2022 | Virtual Event

Digital Standards Working Group ***Working Group D Outbrief***

Dean Bucher

Principal Director, Digital Engineering Integration

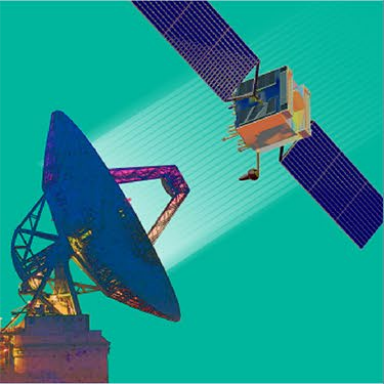
Barbara Braun

Principal Director, Enterprise Systems Engineering Office

28 February 2019

© 2022 The Aerospace Corporation

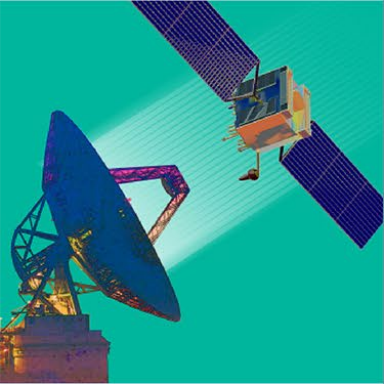
Approved for public release. OTR 2022-00616.



Digital Standards Working Group

Introduction

- Problem Statement
 - *Tomorrow's space and ground architectures must be flexible, scalable, and interoperable*
 - *In an increasingly interconnected world, **standardization is critical for mission success, but all standardization requires compromise***
 - *What makes a good digital (data and models) standard, and where can standardization offer us the most return on investment?*
- This working group will discuss the role of standards in digital transformation from two perspectives:
 - *Utilization of digital engineering approaches and methodologies to define and manage design and interface standards across a complex space enterprise*
 - *Definition of digital standards to enable DE to be applied consistently across the enterprise (particularly between government and industry) and to enable interoperability between data, models, and tools*



Digital Standards Working Group

Agenda

- **Digital Engineering Overview**
- **Part 1:** Utilization of digital engineering approaches and methodologies to define and manage design and interface standards across a complex space enterprise
- **Break (5 min)**
- **Part 2:** Definition of digital standards to enable DE to be applied consistently across the enterprise (particularly between government and industry) and to enable interoperability between data, models, and tools
- **Summary**



High Level Guide to Digital Engineering

Digital Engineering 101

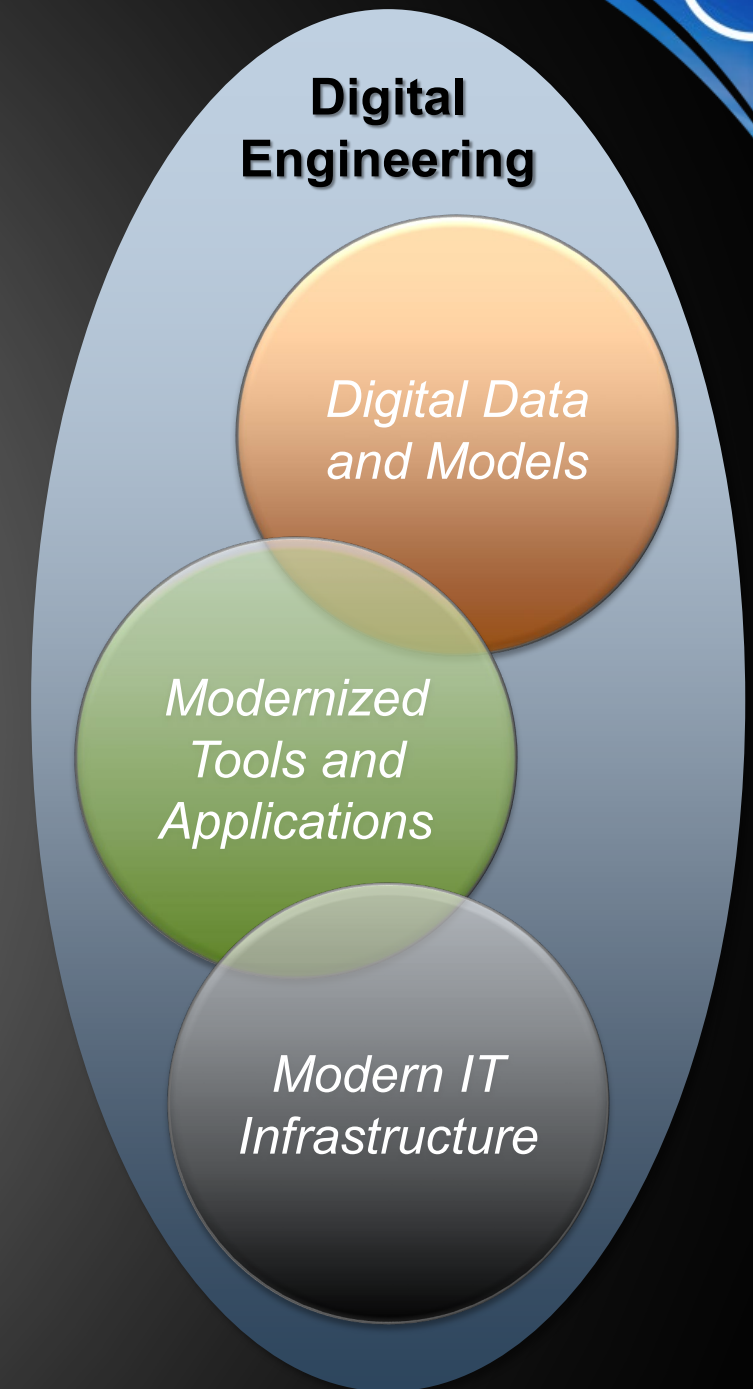
Dean A. Bucher
Principal Director
Digital Engineering Integration

Approved for public release. Subset of OTR2021-00974.

Digital Engineering “in a Nutshell”

Digital Engineering 101

- At the highest level, DE is the next generation of modeling, simulation, and analysis tools, data, and supporting IT infrastructure
 - **Revolutionary** (vs. evolutionary) **transformation** in “doing business”
 - *Affects every aspect of the full system lifecycle, from cradle to grave*
- Primary features that differentiate DE from prior generations:
 - *Modeling, simulation, and analysis expected to be persistent and continuous*
 - *Models and data expected to be continually evolving, authoritative, and pervasive*
 - Rather than developed in stovepipes for single-purpose analyses/decisions
 - *Data, models, and analytical tools connected via fully digital interfaces*
 - Enables automation and the application of AI/ML technologies
 - Minimizes the need for human processing and translation to transfer data and analysis results across platforms
 - *Data, models, and tools consolidated into common enterprise-wide ecosystems*
 - Enables broader access and usage
 - Provides substantial increases in computing power and analysis efficiency

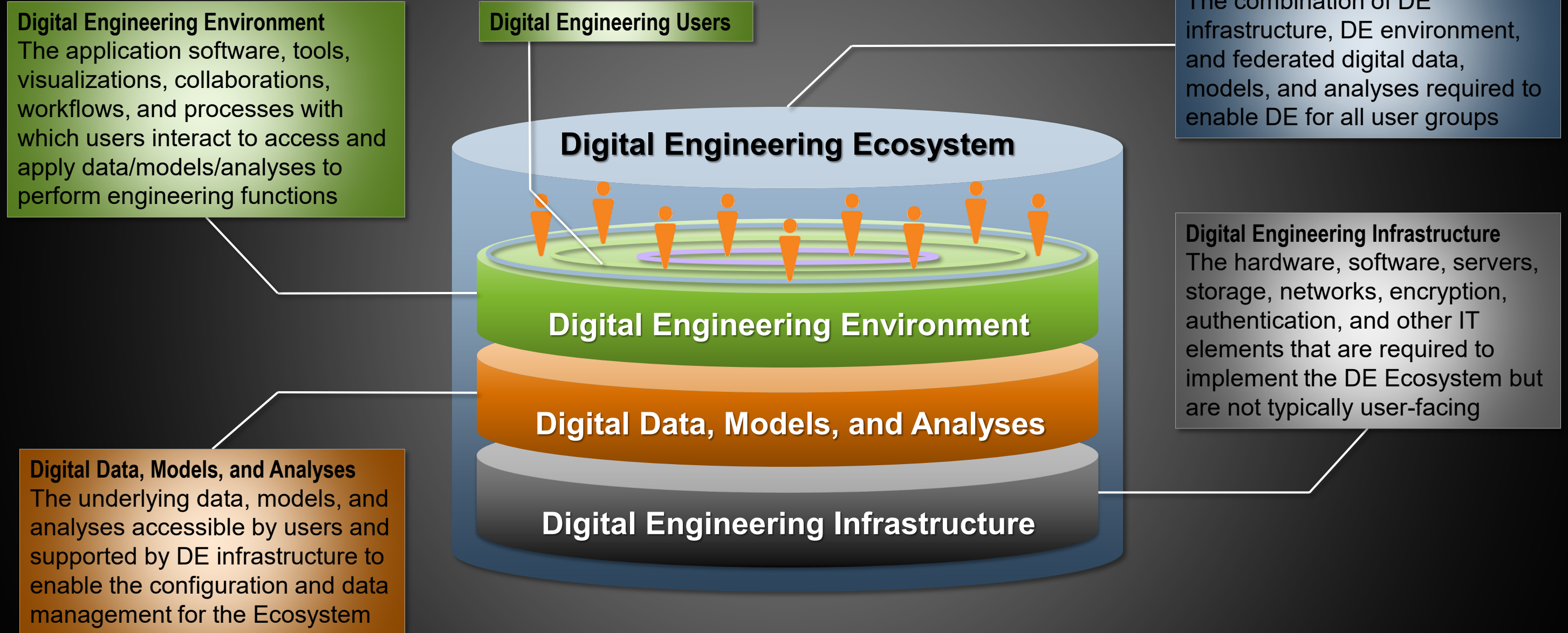


Digital Engineering leverages modern technologies and processes at an enterprise scale to perform traditional engineering functions in new ways in order to improve efficiency and enhance capabilities delivered



What is a Digital Engineering Ecosystem?

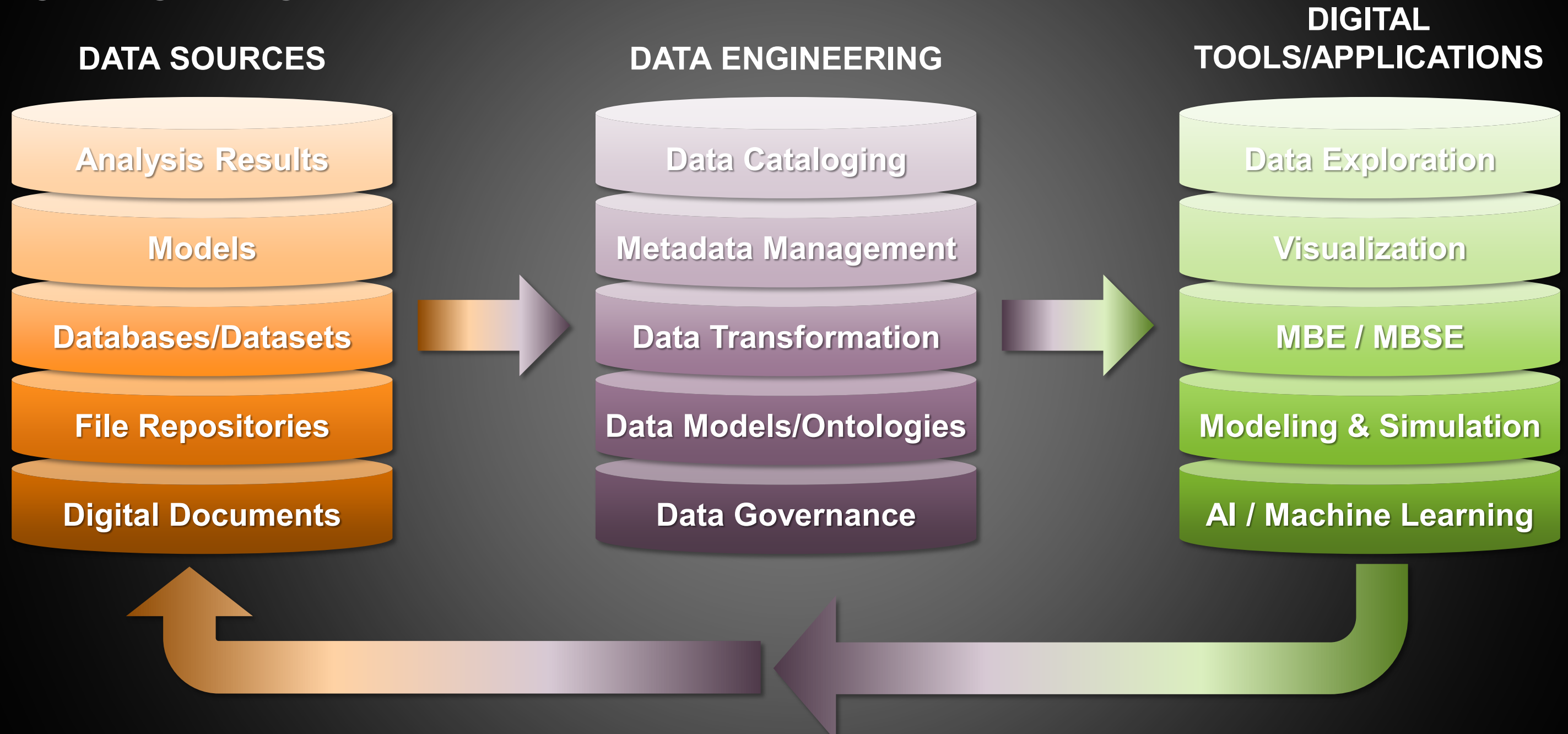
Digital Engineering 101



Digital Engineering Ecosystem serves as a common interface for all user groups (e.g. engineers, analysts, program managers, decision makers) to support and execute all engineering and business functions

Data Engineering: Critical Enabler for Connecting Data to Applications

Digital Engineering 101

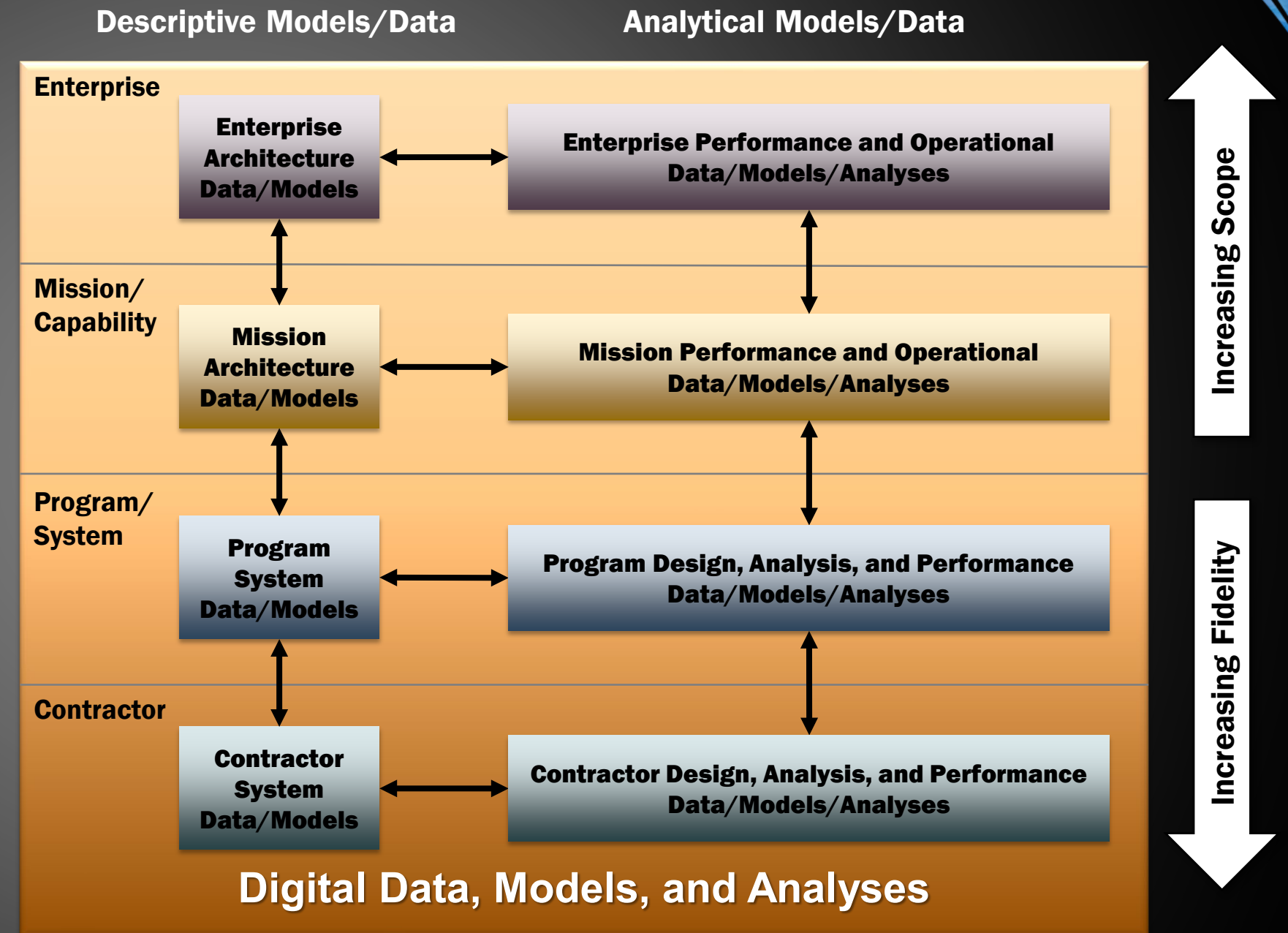


Data Engineering focuses directly on the transportation, transformation, and storage of data for numerous digital applications including Digital Engineering

Digital Data, Models, and Analyses at All Levels of the Enterprise

Digital Engineering 101

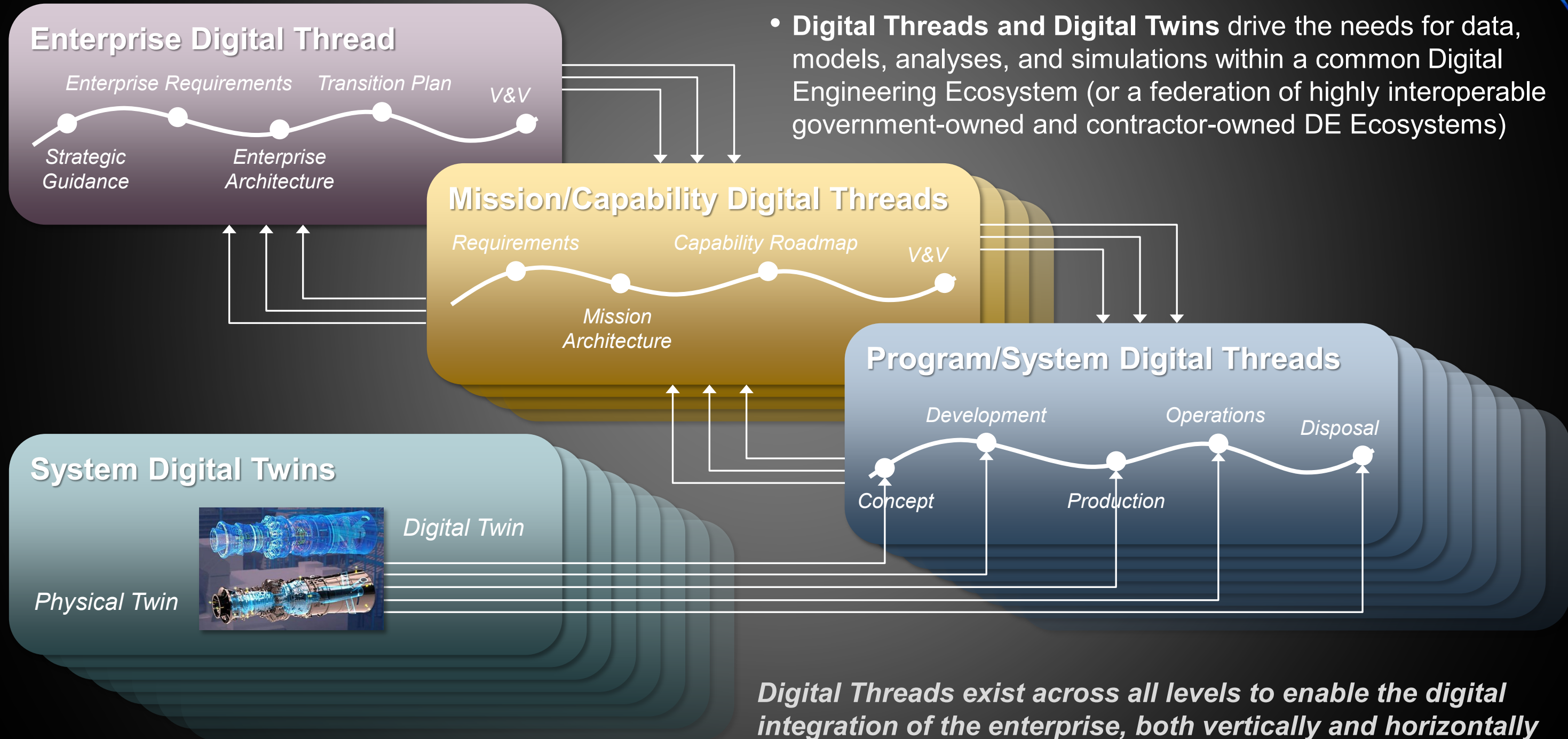
- Data/Models at each layer of the enterprise are loosely coupled with data/models in adjacent layers
 - Information flows down to inform acquisition activities
 - Information flows up to inform decisions at higher echelons of the organization
- Synchronization of data/models enforces the single authoritative source of truth
 - Sharing of models between layers prevents duplication of work

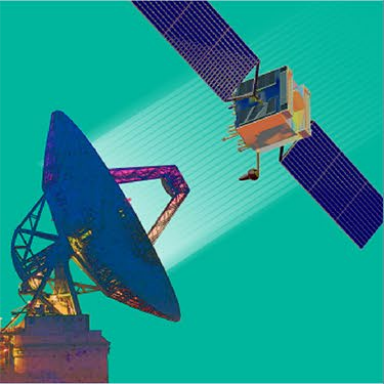


Decisions at all levels of the enterprise require comprehensive knowledge of impacts and dependencies supported by authoritative data, models, and analyses managed at all levels in a common DE Ecosystem

Digital Threads and Digital Twins: Drivers for Data, Models, and Analyses

Digital Engineering 101

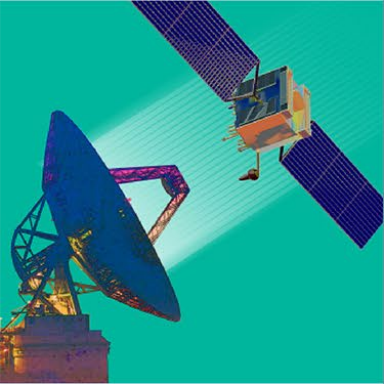




Digital Standards Working Group

Part 1: Utilization of digital engineering approaches and methodologies to define and manage design and interface standards across a complex space enterprise

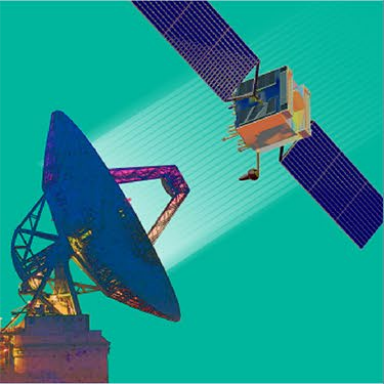
- Government Reference Architectures (GRAs)
 - *Needed to define key interfaces (e.g. payloads to bus) as a potential enabler to MOSA*
 - *Interoperability between the GRA and contractor models is important (e.g. style guides)*
 - Initially focused on MBSE-based GRA, but eventually extending to the broader aspects of DE
 - *GRAs need to be built in a pre-planned, purposeful way*
 - Models/digital products are different on the government and industry sides of the interface
 - *Interface specs between government and industry needs to be fleshed out further (i.e. MSIW)*
 - Recommended as a future topic for industry days
 - ***Open question:*** *How do we enable federation of multiple GRAs, both across a portfolio of programs and across multiple agencies/organizations?*
 - CONOPS for combining models, data, and analytics



Digital Standards Working Group

Part 1: Utilization of digital engineering approaches and methodologies to define and manage design and interface standards across a complex space enterprise

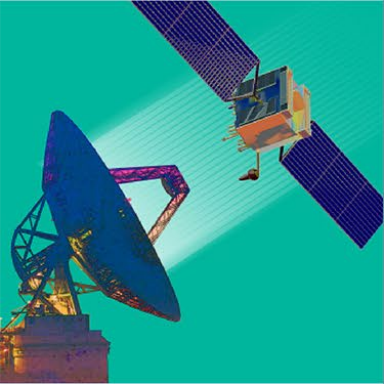
- Current Specs and Standards
 - *Need to move away from the paper-based specs and standards documents*
 - *Focus on the “what” rather than the “how”*
 - *Digitization of existing spec and standards may be an opportunity to pursue*
 - *Stitching together what we already have from the bottoms up*
 - *Standard nomenclature and profiles are critical enablers to the integration/federation of models*
 - *Highly customized SysML, XMI means that it’s hard to exchange models*
 - *Important to interface across different vendor tools*
- Standards Development
 - *Government can no longer “own” standards*
 - *Need to standardize the exchange of information between programs*
 - *Leverage lessons learned from industry needs to feed into the definition of standards*
 - *“Digital ICD” may be a way to define model interface standards*



Digital Standards Working Group

Part 1: Utilization of digital engineering approaches and methodologies to define and manage design and interface standards across a complex space enterprise

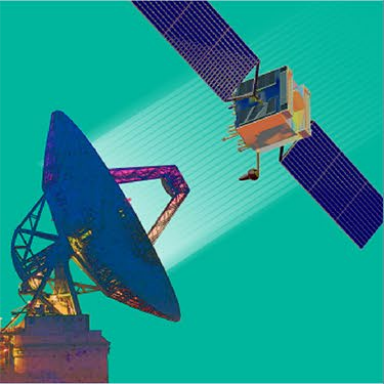
- Opportunities to Utilize DE
 - *Functional Models as Specs*
 - Need to move away from functional spec documents
 - **Open question:** Can this be applied to software only or both software and hardware?
 - *Recognize that agile approaches aren't easily applied to hardware (yet)*
 - *Digital Design CDRLs*
 - CDRL for an MBSE Development Plan
 - *Aerospace currently working on guidance documents*
 - Need improved methods for how to facilitate the review of models that are delivered as digital CDRLs (e.g. defined workflows)
 - *Ensuring the feedback loop from reviews and config control are appropriately managed*
 - **Open question:** What paper CDRLs could be implemented in the models (e.g. SE-based products)?



Digital Standards Working Group

Part 2: Definition of digital standards to enable DE to be applied consistently across the enterprise (particularly between government and industry) and to enable interoperability between data, models, and tools

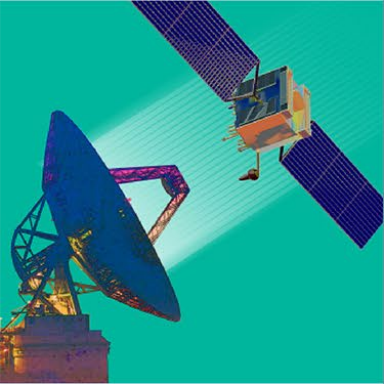
- Industry Day on Digital Standards
 - *GRA standards, nomenclature, interfaces (i.e. “Digital ICD”)*
 - Need the “Digital ICD” before a GRA is released
 - *Address the roles of a government reference model vs. government reference architecture*
 - *Contractor bidders library based on the model*
 - Need modeling standard/guidance for defining level of detail needed to interface with GRA
 - *Reference: **James Martin’s presentation at NDIA***
 - *Style guides: SSC/ZA and SWAC guides released*
 - Need to include model development plan in the DID
 - *“**Guidance for an MBSE Development Plan**” (DID/CDRL/V&V guidance)*
 - *Setting methods for how to apply digital engineering in a repeatable way*



Digital Standards Working Group

Part 2: Definition of digital standards to enable DE to be applied consistently across the enterprise (particularly between government and industry) and to enable interoperability between data, models, and tools

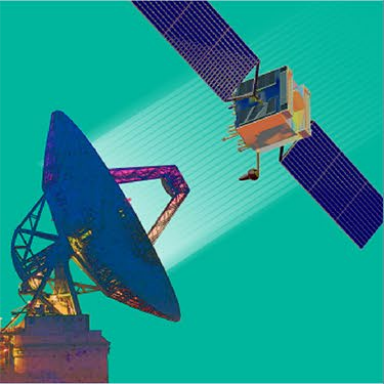
- Digital Twins (DTs)
 - *Drive modeling to another level of complexity than the system/architecture level models*
 - *Need to be scoped for the specific use cases that they are intended to support (e.g. wargaming, training, etc.)*
 - **Open question:** How do we validate/trust/certify that the DTs represent reality?
 - *Cost/ROI has to be factored when determining the application of DTs*
 - *Need a taxonomy of model fidelity*
 - Needs to be based on the purpose of and use cases for the DTs
 - *Need to account what environment will host the DT and how it is contracted*
 - May need to define a “DT ICD” based on the purpose of how the DTs will be utilized by the government
 - **Open question:** How do we handle the “delivery” of DTs to the government? How will the DTs be maintained?



Digital Standards Working Group

Part 2: Definition of digital standards to enable DE to be applied consistently across the enterprise (particularly between government and industry) and to enable interoperability between data, models, and tools

- Interoperability of Tools
 - *Adoption of profiles and modeling standards that provide the “rules of engagement/development” for modeling approaches*
 - *Current pain points: importing/exporting data between tools (third party tools exist that can translate, but not perfect), multiple profiles/frameworks to choose from (DoDAF, UPDM, UAF)*
 - Needs to be worked in a coordinated and consolidated way with the vendor community
- Motivating the Transition to DE
 - *Establish the value proposition*
 - *Expand the SME perspective to better understand the bigger picture*
 - *Quantifying the benefits to the decision makers and the SMEs*



Digital Standards Working Group

Mission Success Improvement Workshop

- **To continue the conversation.....**



Formerly the Mission Assurance Improvement Workshop

Topic: Digital Engineering Standards

- *Industry / Aerospace / Government Workshop*
- *Kickoff workshop mid- to late March 2022*
- *Weekly “tiger team” meetings*
- *Outbrief after 3-4 months*

Contact Barbara Braun (barbara.m.braun@aero.org) if interested in participating