

What is Digital Engineering at NASA?



Terry R. Hill
*NASA's OCE Digital Engineering
Program Manager*

Audience: Space Telescope Science Institute
Nov. 18, 2024

*"It is not necessary to change. Survival is not mandatory."
(W. Edwards - Deming Institute, 2019)*



Why Digitally Transform NASA?



**ENDURING
BOLD
MISSION...**

REACH
NEW
HEIGHTS

BENEFIT
ALL
HUMANKIND

REVEAL
THE
UNKNOWN

...NOW IN A CHANGING WORLD

Increasingly bold & complex missions
Increasingly partnered
Increasingly fast
Increasingly affordable
Increasingly transparent
Increasingly inclusive



Chart cleared for public release Jan 9 2024



NASA's DT Strategic Framework



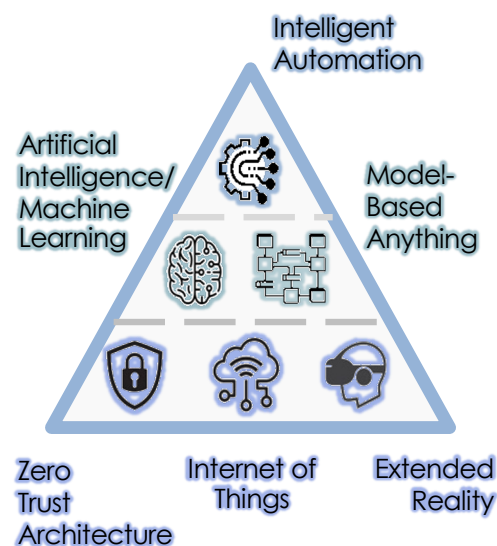
3 FUTURE STATE
GOALS

4 TRANSFORMATION
TARGETS

5 DIGITAL
LEVERS

6 TECHNOLOGY
FOUNDATIONS

7⁺ MISSION
OUTCOMES



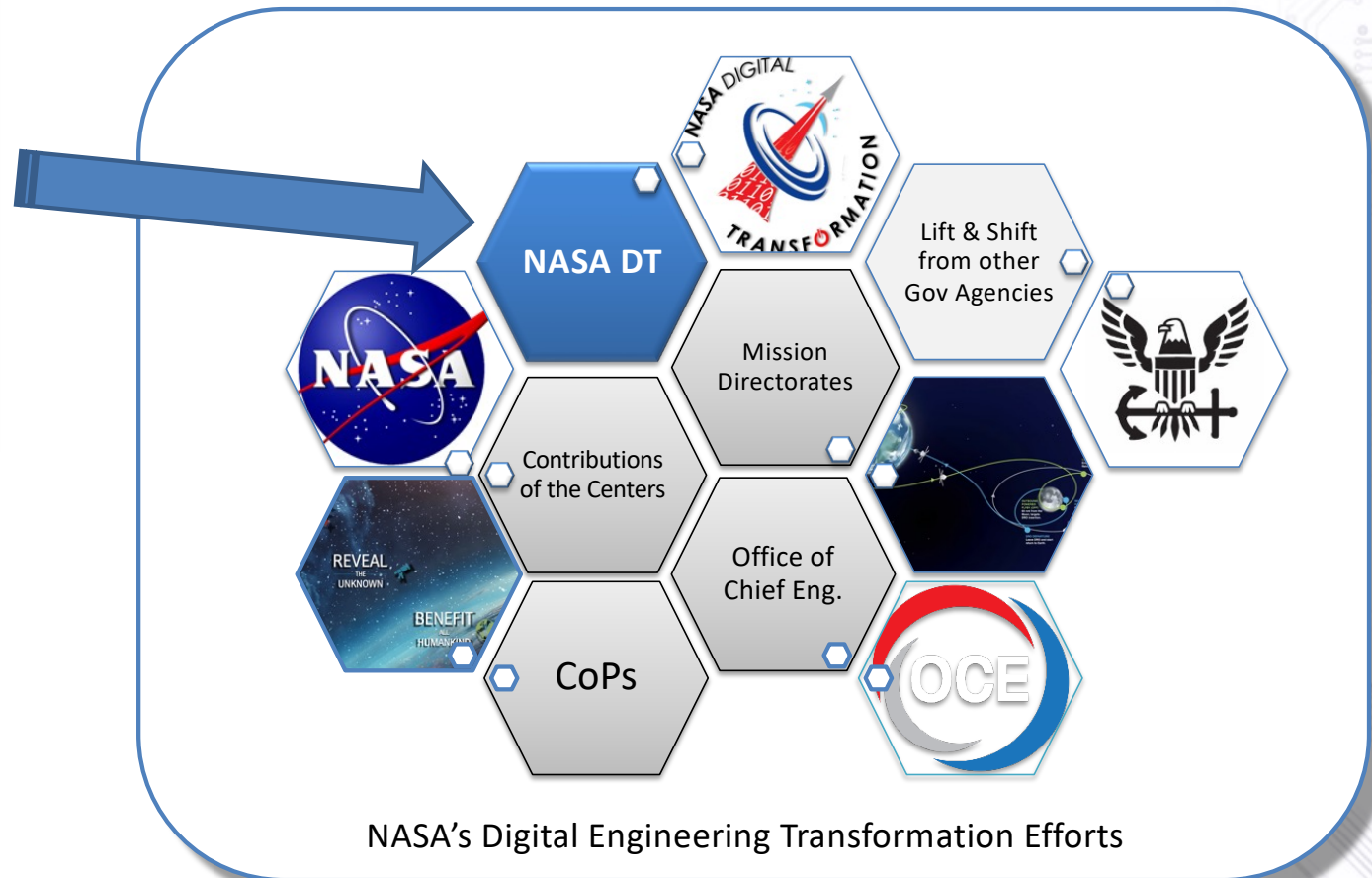
[NASA TM 20220018538](#)

Chart cleared for public release Jan 9 2024



**One
Future NASA**

Transformation of Engineering – It Takes a Village





But Terry ... if we don't do a lot of Engineering but do a lot of software development, why should we care?

Digital Engineering = Data-Centric Engineering

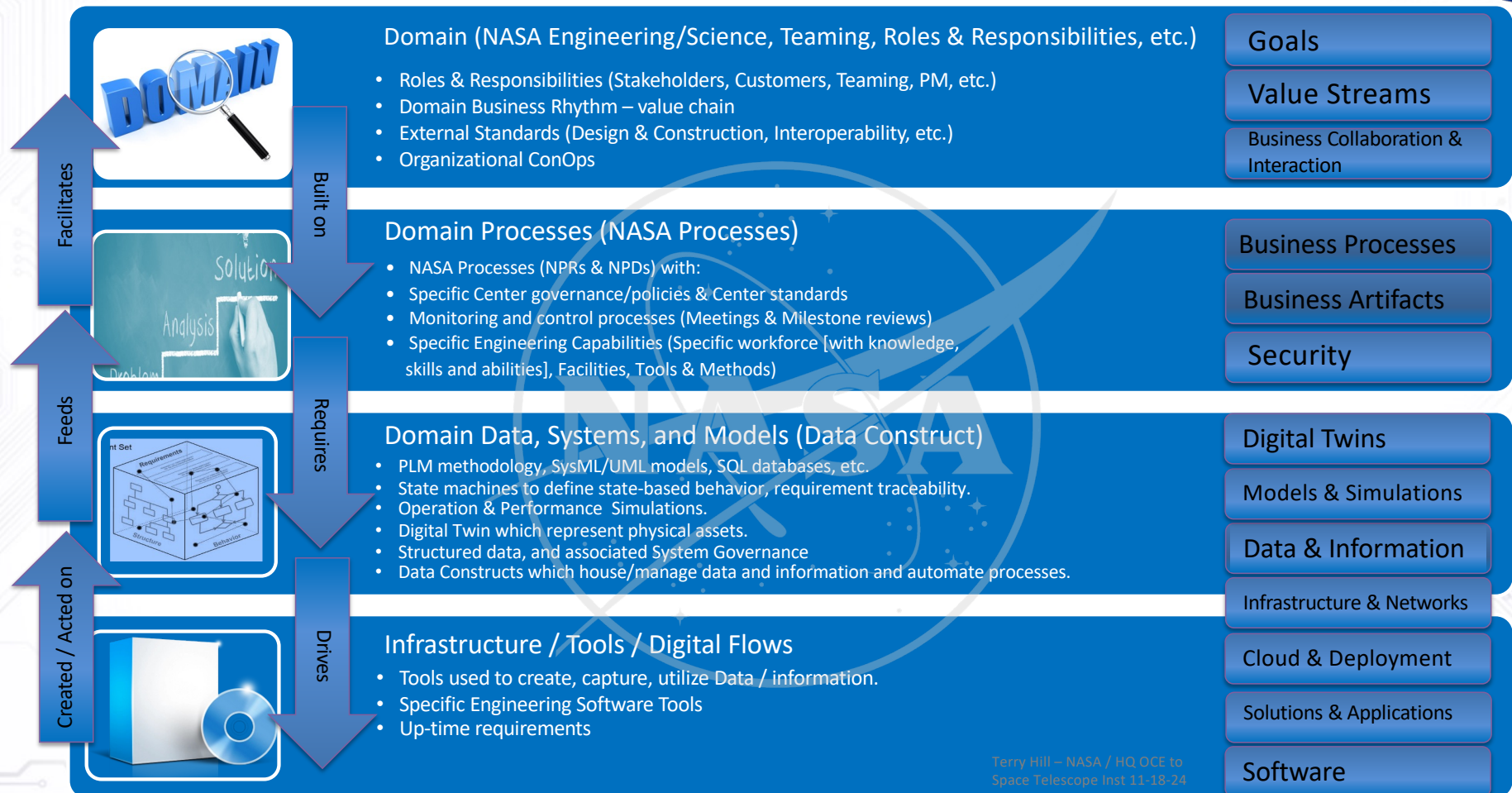
Data-Centric Science

The “4-Layer Cake” Analysis for Identification of Digital Transformation Opportunities



Developed by the Office of Chief Engineer’s Digital Engineering Leadership Team

Architectural Elements



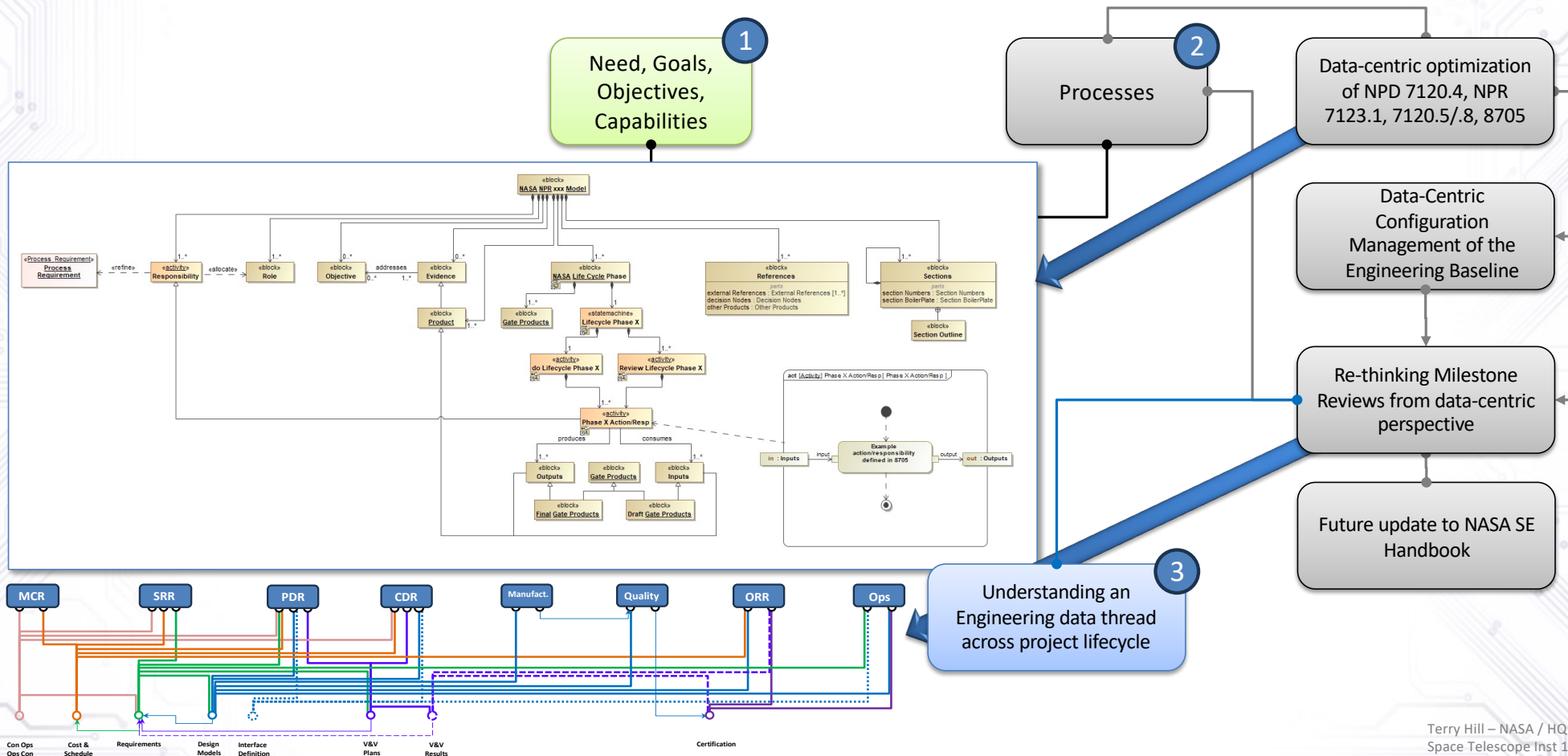
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What is Digital Engineering at NASA

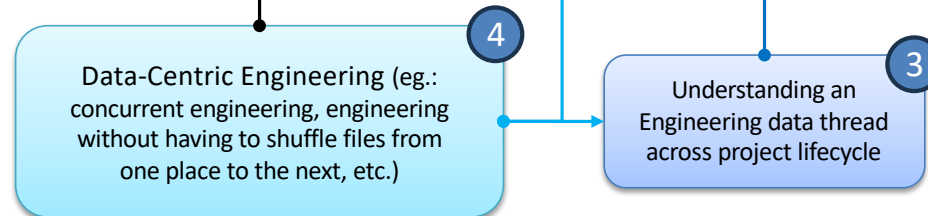
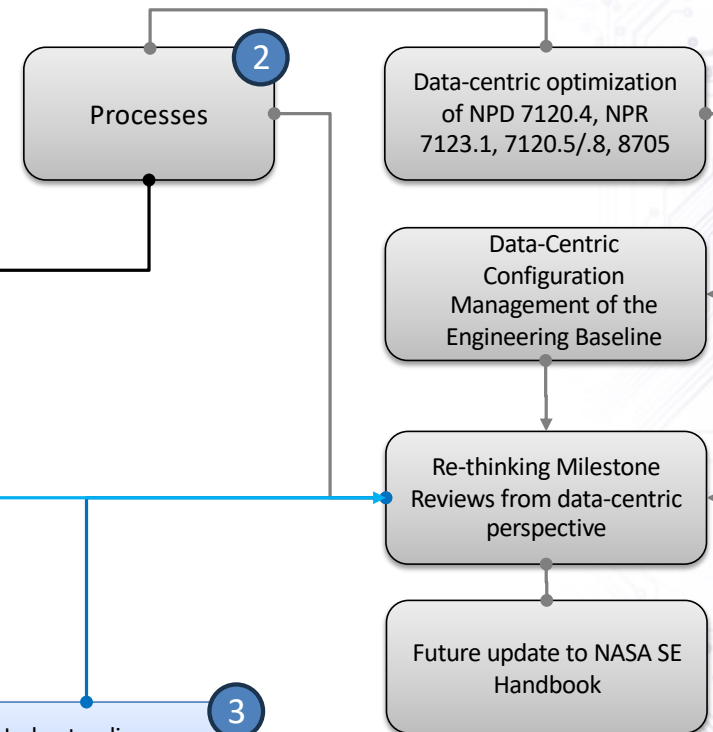


Improve how the Agency Engineering Domain operates over the entire NASA lifecycle by effectively managing complexity, reducing cost and schedule, and improving product integrity via the integration of processes, digital tools, and techniques along with seamless flow of information throughout the engineering system development life-cycle (concept development, design, testing and validation, manufacturing and operations).

What is Digital Engineering at NASA



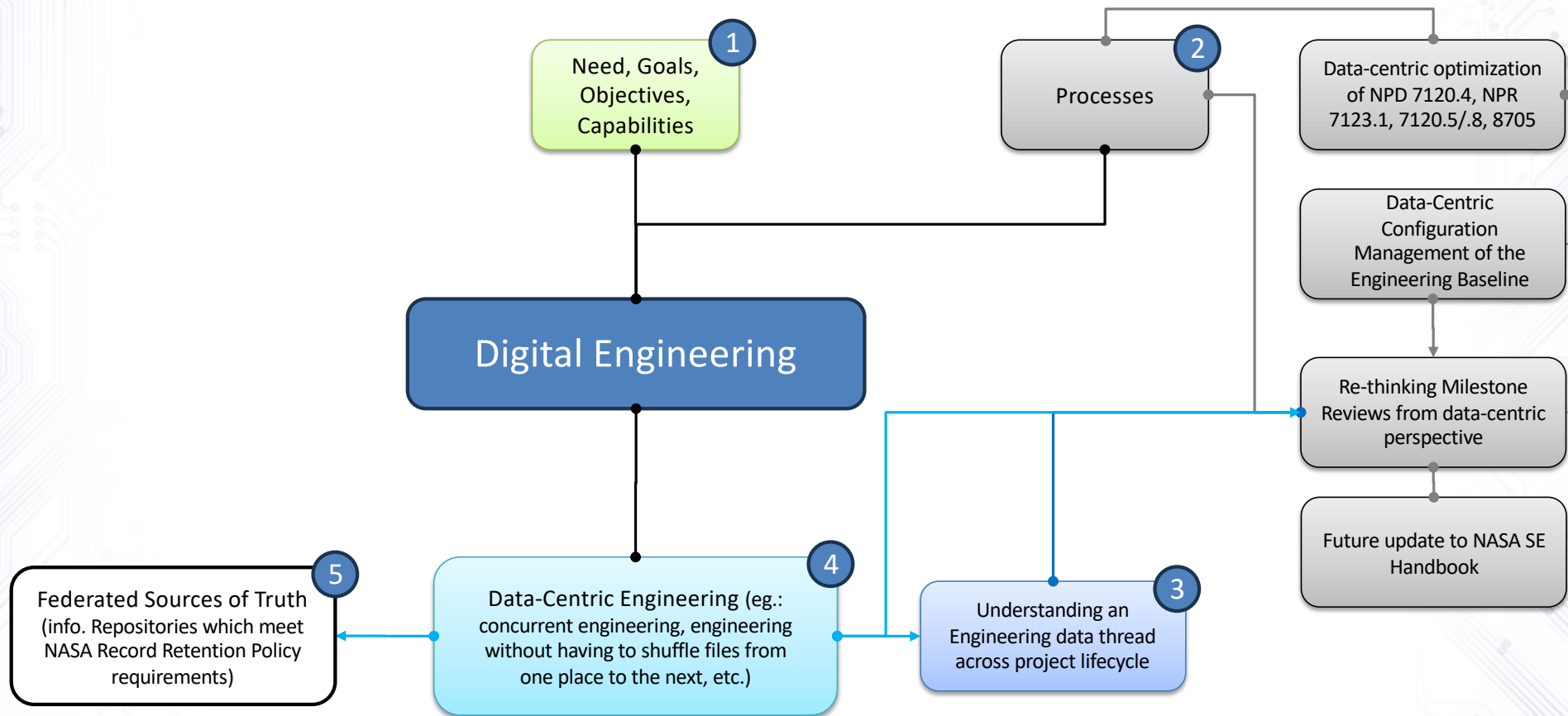
What is Digital Engineering at NASA



Data Thread Layers

Data/model Pedigree	• relation to design/testing CM
Configuration management	• Baseline release • Working version
Information	• Text • Meta data
Parameter	• alpha • numeric

What is Digital Engineering at NASA

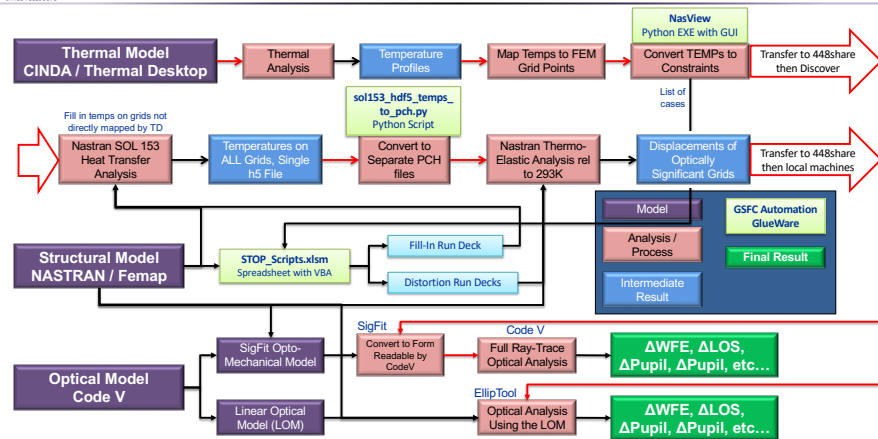


What is Digital Engineering at NASA



GSFC

Roman STOP Production Run Process (M. Akkerman)



Data-centric optimization of NPD 7120.4, NPR 7123.1, 7120.5/.8, 8705

Data-Centric Configuration Management of the Engineering Baseline

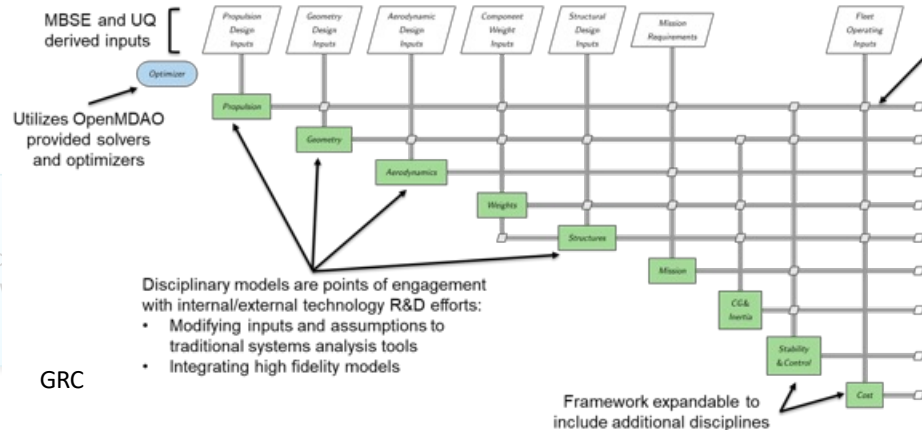
Re-thinking Milestone Review from data-centric perspective

Update to NASA SE handbook

MBSE and UQ connected outputs

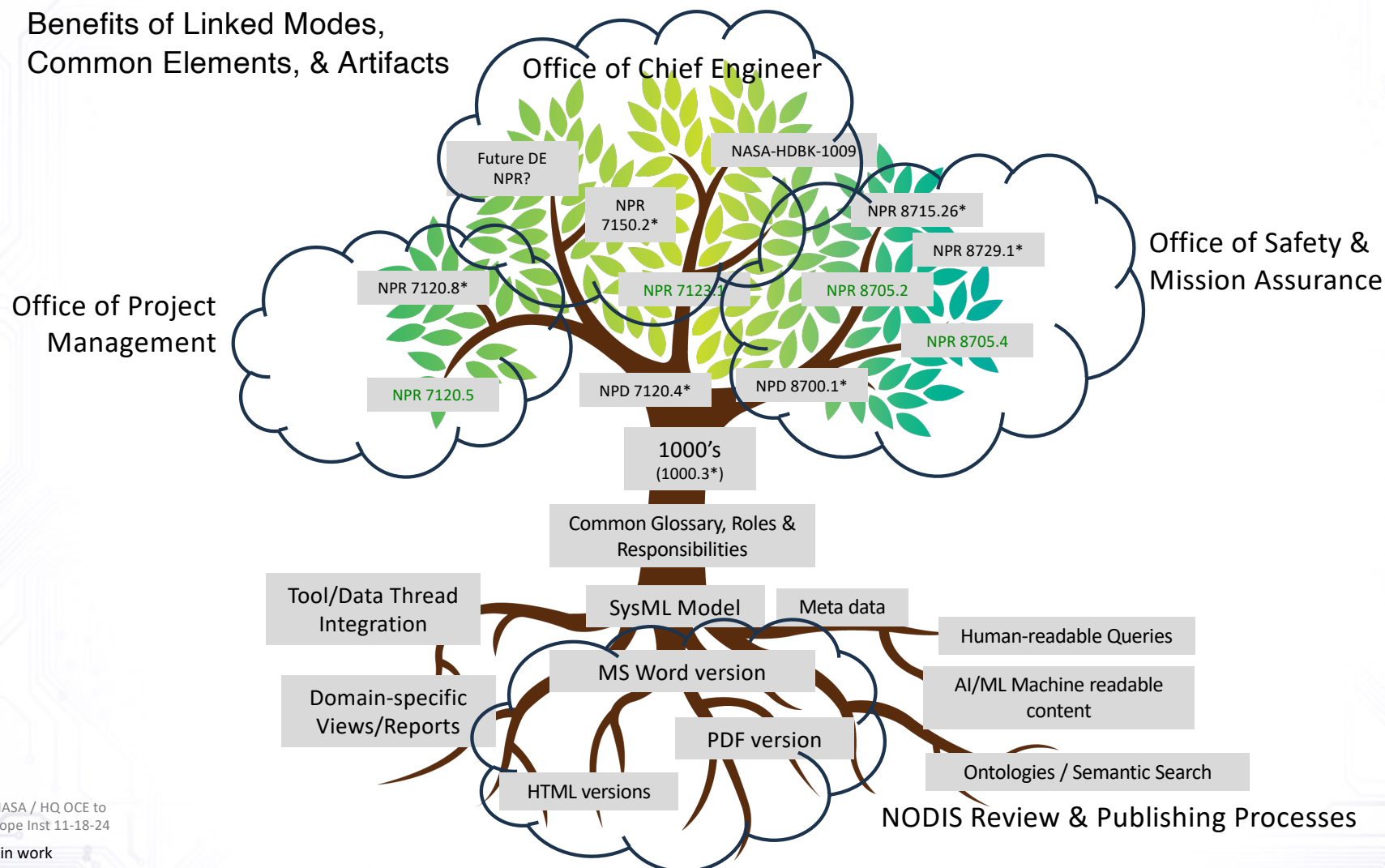
Toolchains (learning how, sharing Lessons Learned)

Federated Sources of Truth (info. Repositories which meet NASA Record Retention Policy requirements)



NPD/NPRs as Models

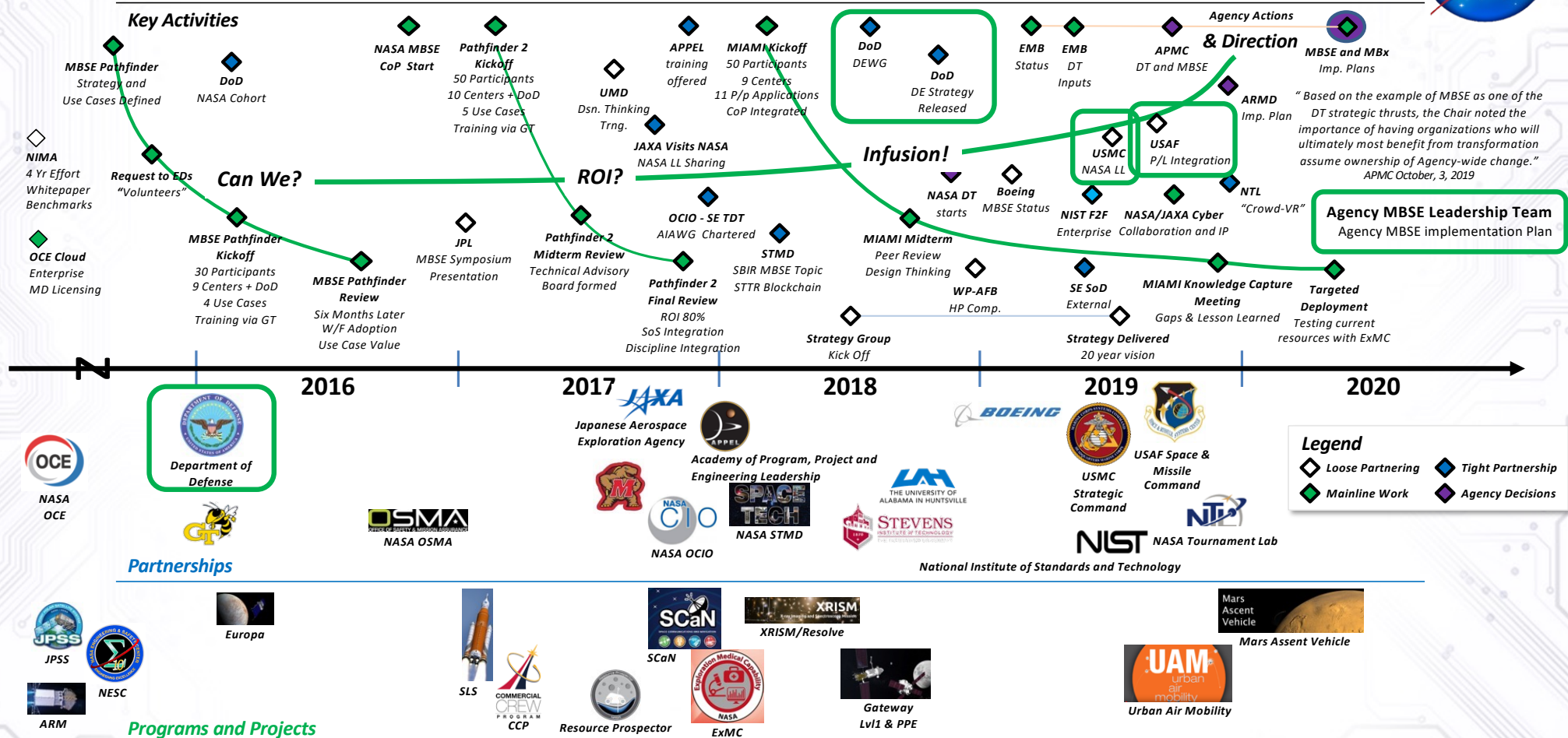
- Benefits of Linked Modes, Common Elements, & Artifacts



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* Modeling in work

MBSE Infusion at NASA



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Systems Engineering/MBSE Accomplishments as part of NASA Digital Engineering Efforts



Utilizing workforce volunteer time

FY20

- Feb. '20 - MBSE Leadership Team (MLT) established by the Engineering Management Board per action from APMC
- NASA released its [NASA-HDBK-1004 NASA Digital Engineering Acquisition Framework Handbook](#) and includes contractual language for statements of work and provided information referencing topics such as Data Requirements Descriptions, model-based data definition, collaboration, architecture, interoperability standards, and general guidance for model-based product/data acquisition requirements.
- CY19 Office of Chief Engineering piloted [MagicDraw \(SysML modeling tool\)](#) with [Teamwork Cloud \(model management\)](#)

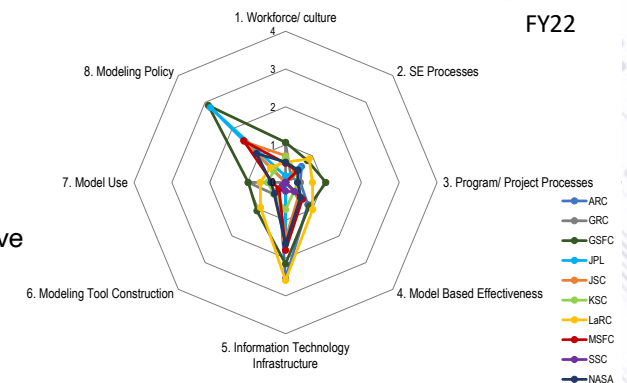
FY21

- Continued to build MLT with reps. from most centers
- Piloted the [INCOSE MBSE Capability assessment](#) to determine usefulness to NASA
- Initiated the MBSE/SysML (Systems Engineering Modeling Language) Orion Digital Twin to address insight concerns by Orion Chief Eng.

Model-Based Capability Categories	Average	ARC	GRC	GSFC	JPL	JSC	KSC	LaRC	MSFC	SSC
1. Workforce/ culture	0.5	0.1	1.0	1.1	0.2	0.7	0.7	0.5	0.5	0.0
2. SE Processes	0.5	0.6	0.2	0.8	0.5	0.4	0.4	0.9	0.4	0.0
3. Program/ Project Processes	0.3	0.4	0.4	1.1	0.0	0.0	0.3	0.7	0.0	0.0
4. Model Based Effectiveness	0.6	0.8	0.5	0.9	0.0	0.5	0.3	1.0	0.6	0.3
5. Information Technology Infrastructure	1.6	2.5	1.6	2.2	1.5	1.5	0.7	2.6	1.8	0.2
6. Modeling Tool Construction	0.4	0.2	0.4	1.1	0.0	0.3	0.4	0.9	0.2	0.1
7. Model Use	0.4	0.0	1.0	1.0	0.0	0.0	0.5	0.7	0.3	0.0
8. Modeling Policy	1.1	0.0	0.0	2.9	2.8	1.5	0.4	0.6	1.6	0.0

FY22

- Incorporated the MLT into the larger NASA Digital Engineering (DE) Agency team.
- Performed initial high-rez MBSE Capability assessment & collected center priorities and vanguard examples.
- [NASA Released NASA-HBK-1009 MBSE Modeling Handbook](#)
- APPEL offered 4 of the 5-tiered MBSE Course from beginner to expert via requirements from MLT
- Completed the MBSE/SysML Orion Digital Twin
- Initiated the [modeling of NPR 7123, 7120.5/8 & 8705 in SysML](#) to assess changes from a data-centric perspective
- Benchmarked 6 large industry partners in how they performed internal MBSE training.
- Began meeting monthly with the NRO MBSE team to share information.
- Using Systems Engineering principals, created the “Four Layered Cake” process to identify opportunities for investment for digital transformation given limited resources.



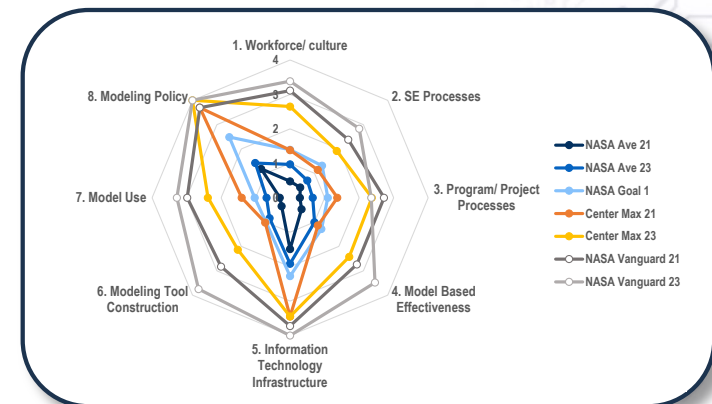
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Systems Engineering Accomplishments as part of NASA Digital Engineering Efforts

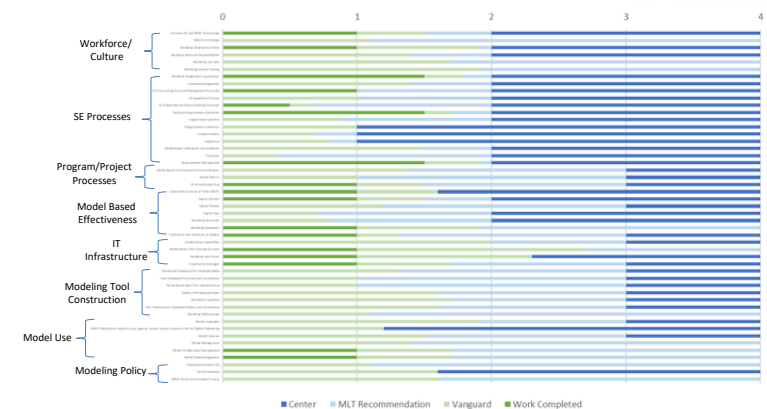
Utilizing workforce volunteer time

FY23

- Used standard SE approach to define what DE means for NASA: NGO's to Capabilities
- Aggressive engagement with DoD, DoE, Intelligence and FAA on DE and SE topics
- Modeling & Data-centric analysis of NPR 7123, 7120.5/8 & 8705
- Agency benchmarking of toolchain capabilities concluded (included SE toolchains)
- [RFI to Industry released](#) which requested input from Industry as to how they want work, collaborated, and exchange info with NASA (Systems Engineering included)
- Added [focus area of Interoperability / data exchange standards](#) for engineering data thread which will create the backbone of digital SE.
- Tier 5 MBSE Training requirements defined and provided to APPEL – see backup chart
- Performed second high-rez MBSE Capability Assessment across the Agency. Used the INCOSE MBSE Assessment tool to create Agency / Center development plan
- MLT's INCOSE International Symposium paper on [Orion MBSE Digital Twin won Best Paper in Model/Simulation category](#)



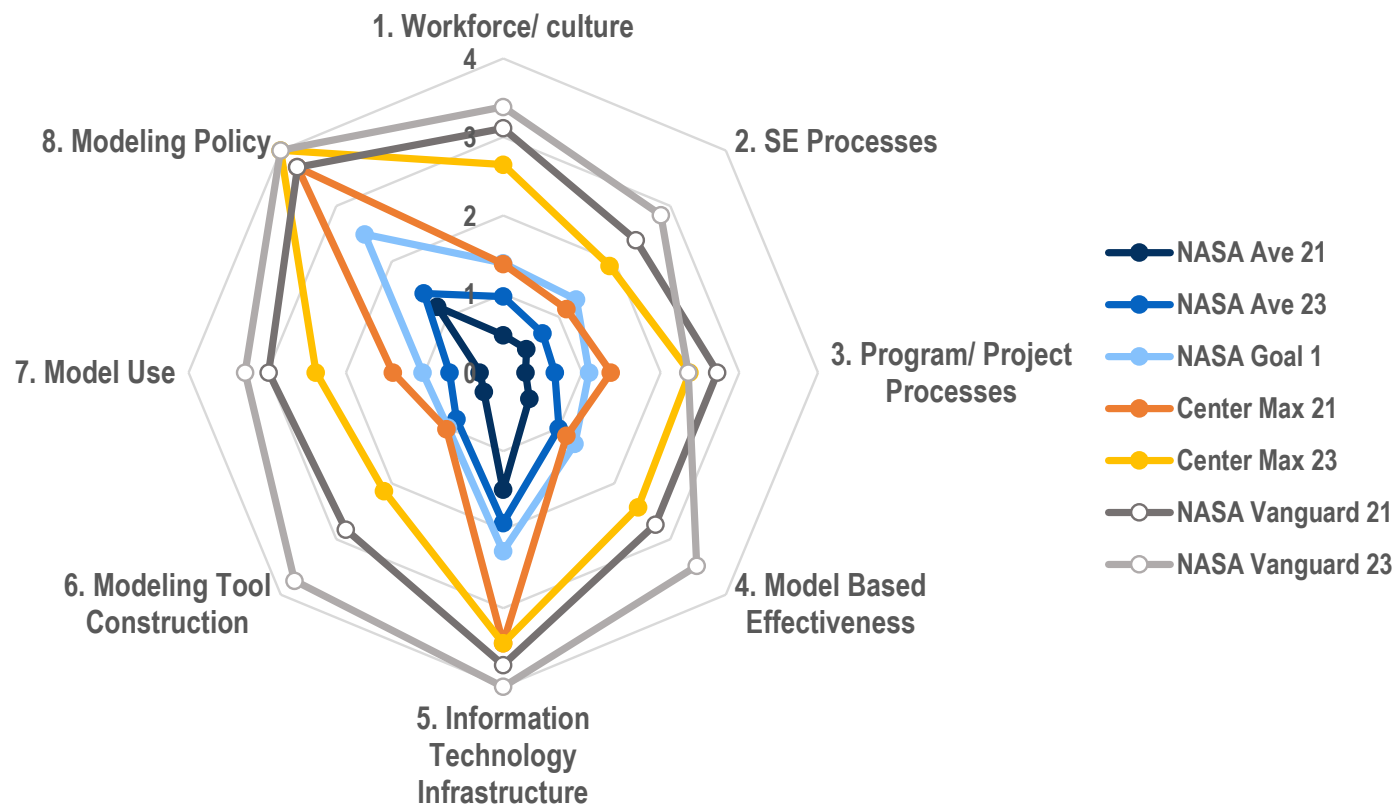
Growth of MBSE Capability seen in FY23 Assessment scoring.



Agency vs Center MBSE Capability Development Plan

FY23

- Used stan
- Aggressiv
- Continue
 - May docu
 - Jun.
- Agency b
- RFI to Inc
collabora
- Added for
thread wh
- Tier 5 ME
- Performe
INCOSE M
- MLT's INC



Project
ses

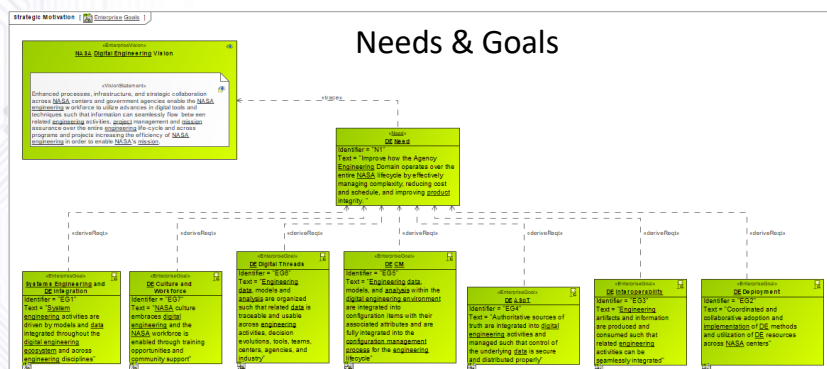
- NASA Ave 21
- NASA Ave 23
- NASA Goal 1
- Center Max 21
- Center Max 23
- NASA Vanguard 21
- NASA Vanguard 23

essment scoring.

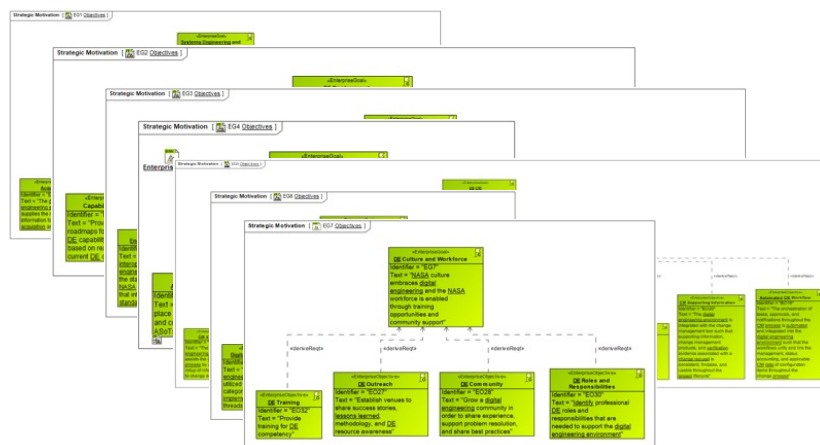
DE Need, Goals, Objectives mapped to Capabilities



- Not Redefining Engineering, Just Identifying Areas to Address to Meet the Intent of DE



- NGOs are baselined
- Mapped Capabilities prioritized and currently under final review
- Operational architectures underway
 - Roles/Responsibilities
 - Activities
 - Use case definition



Objectives

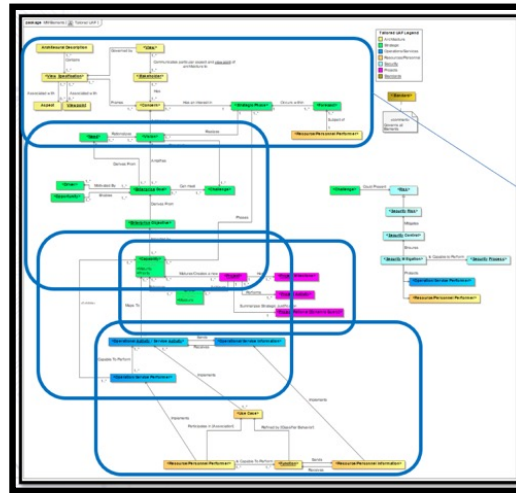


Capabilities

DE Functional Architecture



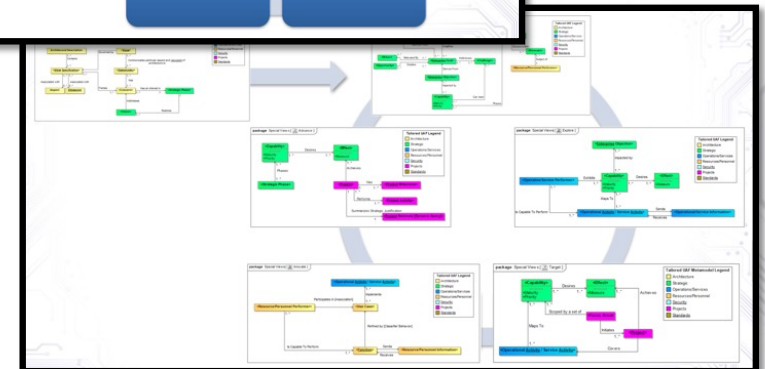
- Modified UAF for NASA use
- Identified architectural elements
- Created cross-cutting views
- Developed workflow
- Aligned views to workflow



DE Meta model

DE Architecture Element Grid
(also maps well to the Four-Layer Cake)

	Structure	Interfaces	Behavior	Guidance	Security
Strategy	Capabilities	Capability Dependencies		Vision Drivers/Opportunities NICs Outcomes Challenges Risks	Security Risk Security Control
Operations/Services	Nasa Org DE Concepts Program/Project Discipline Work Products	Process Dependencies Discipline Interfaces	Lifecycle Process Reviews Design Analysis Cycles Discipline Processes Engineering Activities Decisions	NIRs Handbooks Training Best Practices	Operational Risk Mitigation Service Risk Mitigation Security Procedures
Data	Data in Work Products Data Architectures Data Structures	Data Structure Interfaces		Data Standards Interoperability Standards Schema Standards	Data Risk Mitigation Security Enclaves
Resource/Personnel	Engineers/Teams Tools Toolchains	Engineers/Teams Interfaces Tool Interfaces	Use Cases Functions	Competencies Tool Specific Training Tool Governance API Standards	Resource Risk Mitigation Personnel Risk Mitigation Asset Protection



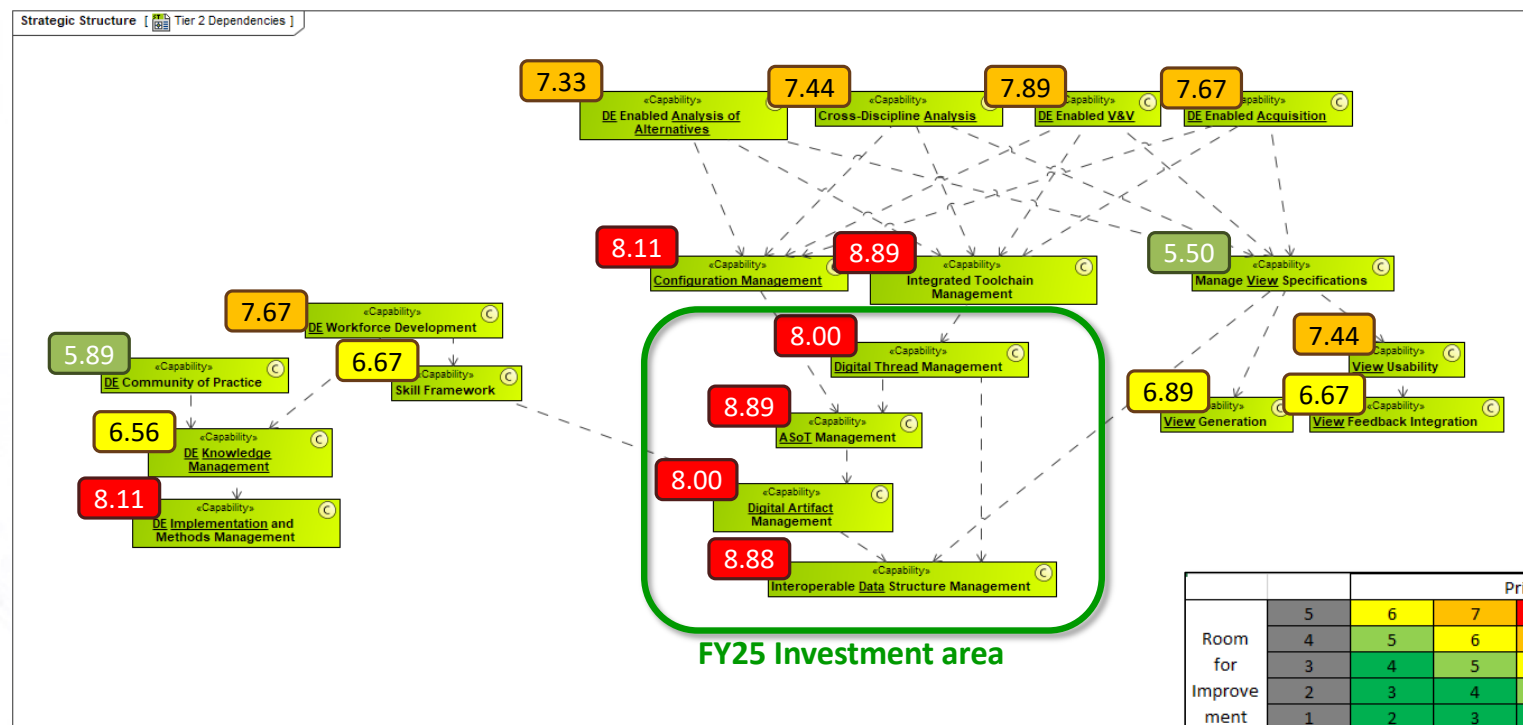
DE Architecture and Views

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DE Capability Ranking

DE Center Reps were asked to rank current opinion on DE Capability importance to use as a measure of effectiveness of the tool, but also to get first prioritization ranking for use in FY25 planning





MBSE Is Now Mainstream in NASA

MBSE / SYSML USAGE WITH ARTEMIS CAMPAIGN

Retooling to Enable Bolder Missions



Overarching Goal of NASA:

- Mitigate the risk and lower expenses of space exploration, science, and discovery to the point where industry is willing and able to profitably take on these on.



What NASA is asked to do in the future will only be harder and more complex



Coupled with flat or decreasing budgets, a driving need to go from concept to operations in less time, at reduced costs, all the while addressing with society's expectations of risk aversion for NASA



New ways of integrating, managing, sharing, and leveraging data and information is needed



NASA is transforming Human Exploration Campaign and Mission planning of the future and the present via:

- Model-Based Systems Engineering (MBSE) methodology and associated models
- To link work groups from Headquarters to Programs to engineering teams at the field Centers
- **To enable mission feasibility, planning, and operations enabling feasible approaches to taking humanity to the Moon and on to Mars**

Retooling to Enable Bolder Missions



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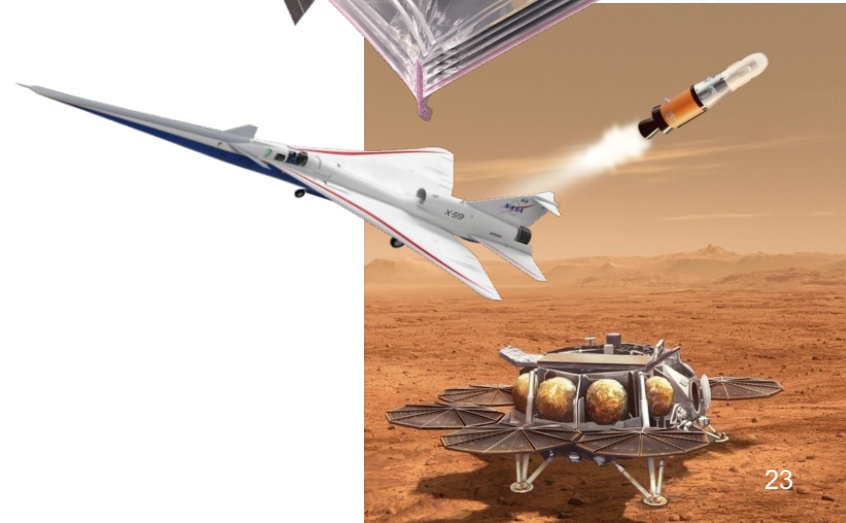
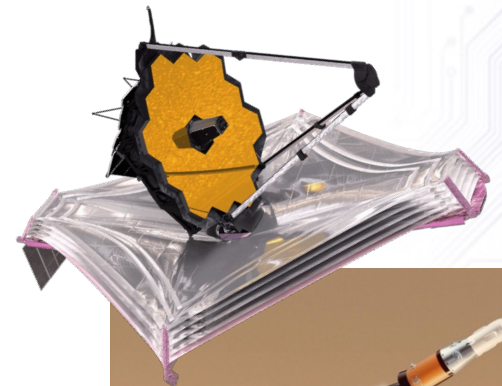
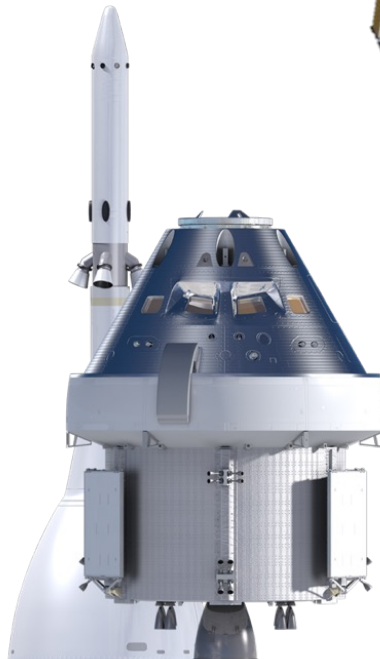
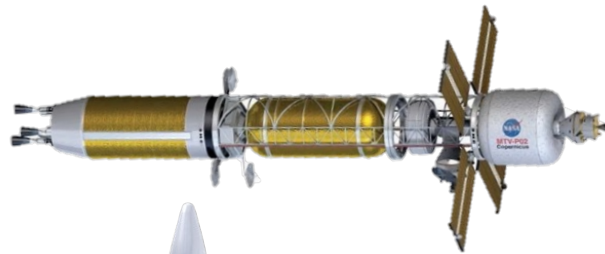
Missions

to Campaigns

to Capabilities



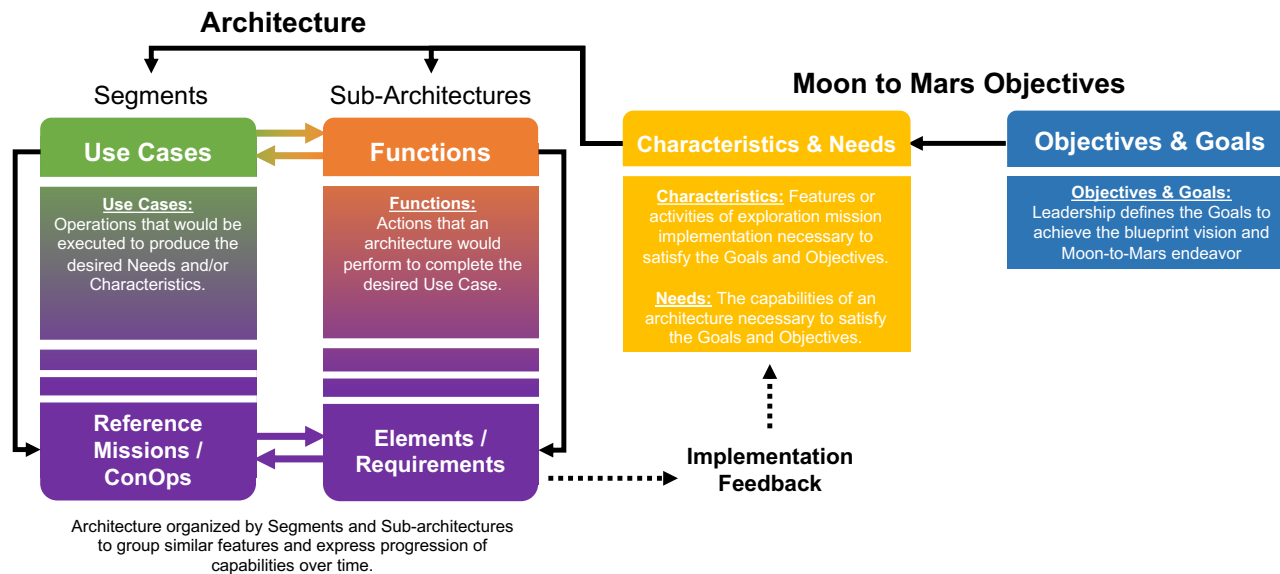
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Architecting from the Right, Engineering from the Left

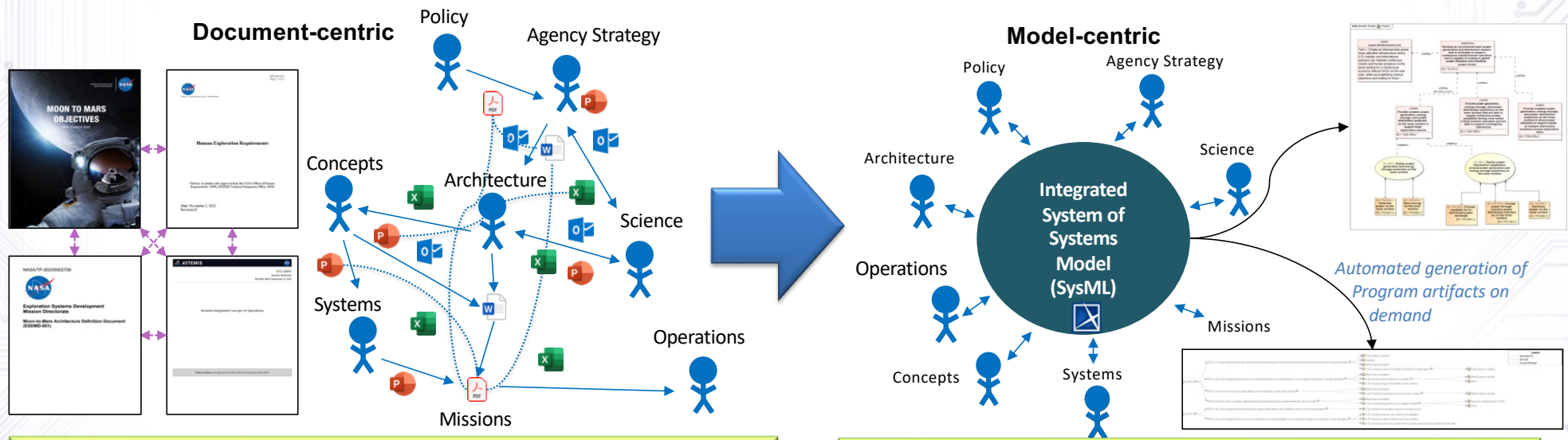


- NASA is leading a global, innovative, and sustainable space exploration initiative with the goal of returning humans to the Moon, achieve long-term surface presence, and continue to Mars
- In 2022 senior leaders, industry, international partners, and academia developed a set of Moon to Mars goals and objectives
- A new process referred to as “architecting from the right, engineering from the left” distills the objectives to architecture components



The decomposition of objectives is just the beginning of a web of data that continues to grow as the architecture evolves and systems are defined

Document-centric to Model-centric Architecture Data Management



- Many documents that describe the M2M architecture and associated data are managed by different teams
- Info in these docs all relate to each other, but aren't directly connected in any way or updated in sync
- Causes discrepancies, redundancies, gaps in info

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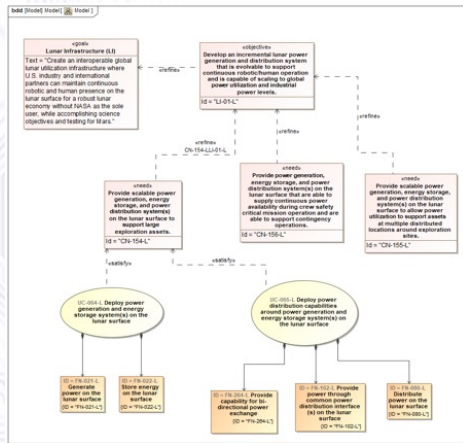
Importing data into a model allows for

- Traceability
- Gap analysis
- Propagated updates of data
- Consistency
- Reduces human error and overall risk
- Allows for easy exportability and shareability

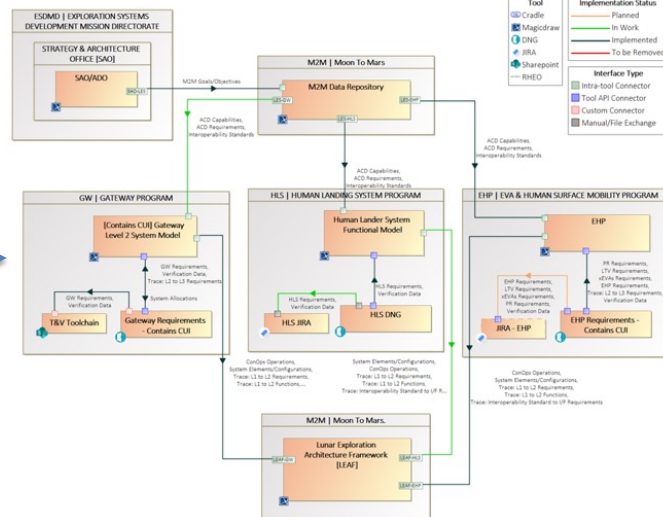
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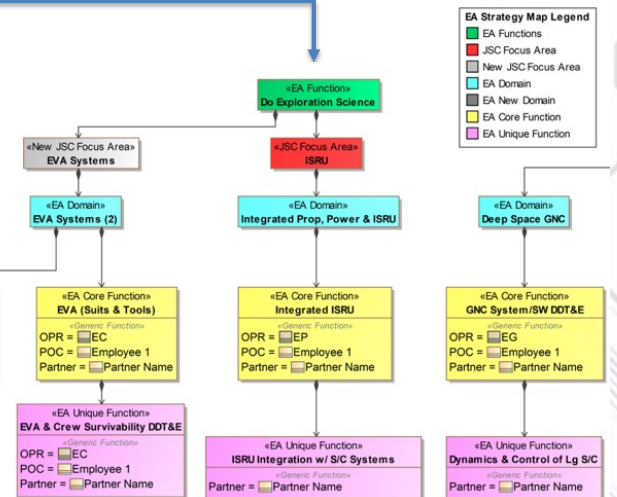
Missions



to Campaigns



to Capabilities



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Integration Across the Artemis Campaign



The Moon to Mars Program Office (M2M PO) was established to support hardware development, mission integration, and risk management for the six Programs to the NASA Artemis campaign: the Space Launch System (SLS) rocket, Orion spacecraft, Exploration Ground Systems (EGS), Human Landing System (HLS), Gateway Space Station, and Extravehicular Activity and Human Surface Mobility.

This set of loosely-coupled Programs form a systems of systems (SoS) which must be integrated together to deliver a tightly-coupled SoS architecture under the Campaign.

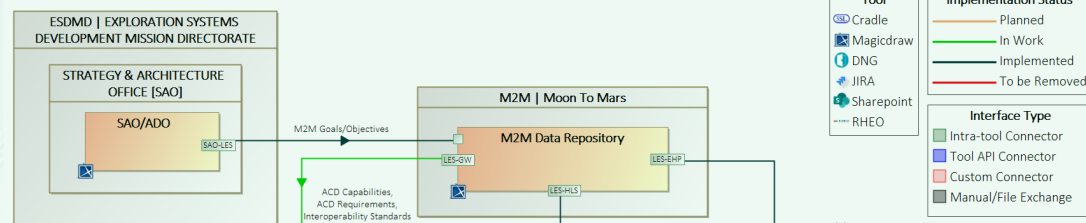
The Integrated Technical Baseline using Model-Based Systems Engineering methodologies enables:

- Simplified Data Sharing/Access across Programmatic boundaries
- Streamlined delivery of Integrated Campaign-level SE&I Products
- A digital thread to understand architecture objectives & impacts from changes/updates
- Isolation of sensitive data across Systems/Program
- Standardization of model customizations, data schemas, modeling processes, etc.

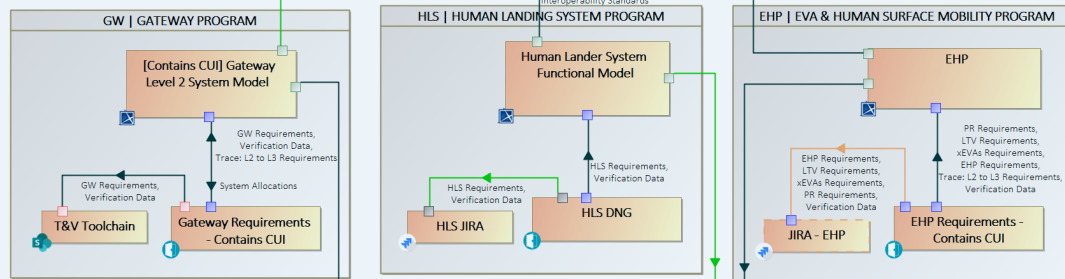
Campaign System of Systems Model Federation



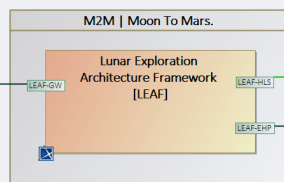
ARCHITECTURE DATA & COMMON DATA LIBRARY



SYSTEM MODELS



INTEGRATED MODEL



The Model Federation Architecture enables integration across the system of systems.

- **Architecture Data & Common Data Library:** Enterprise Data Library including level 1 requirements baseline, design reference mission definition, and capability architecture
- **System Models:** System description model for systems in the architecture. This includes system requirements, functional, and structural architecture
- **Integrated Model:** Artemis campaign model leveraged to support integrated product development. Allows for both isolation & integration of system information

Mission Feasibility and Capability Portfolio Management – The Challenge

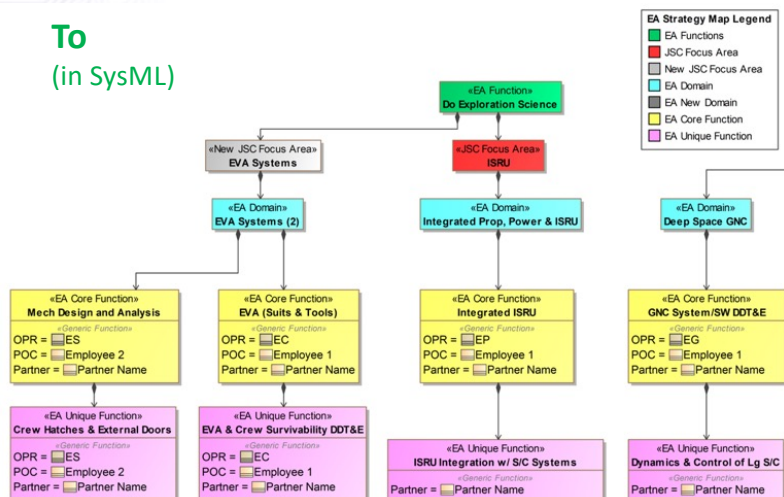


Challenge: Keeping program mission architects synced with Operations, Engineering, and R&D

Challenge: Difficult to devise strategic capability development and plan resources without clear linkage to mission objectives

Solution: Model-centric approach enables parametric linkage updates and shows clear traceability to mission objectives, functions, needs, and technology gaps to help strategically plan and manage engineering portfolio.

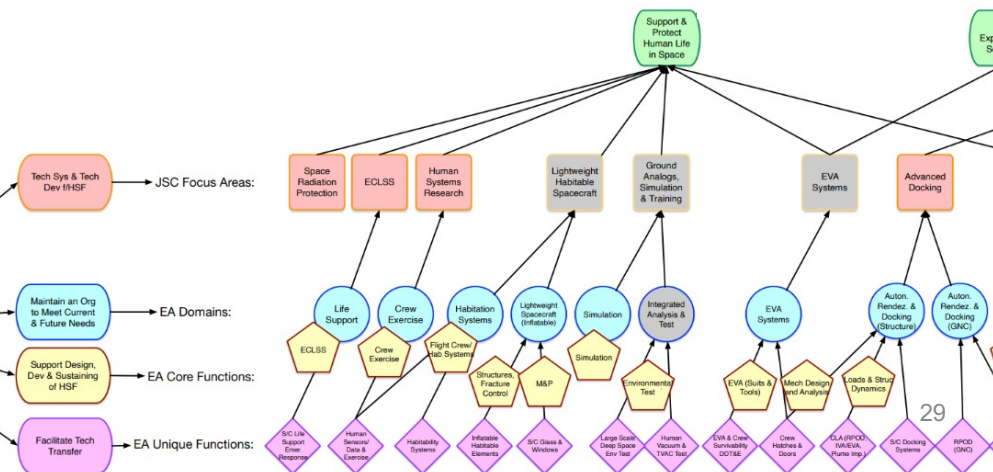
To
(in SysML)



Engineering Roles:

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From
(in Powerpoint & Visio)



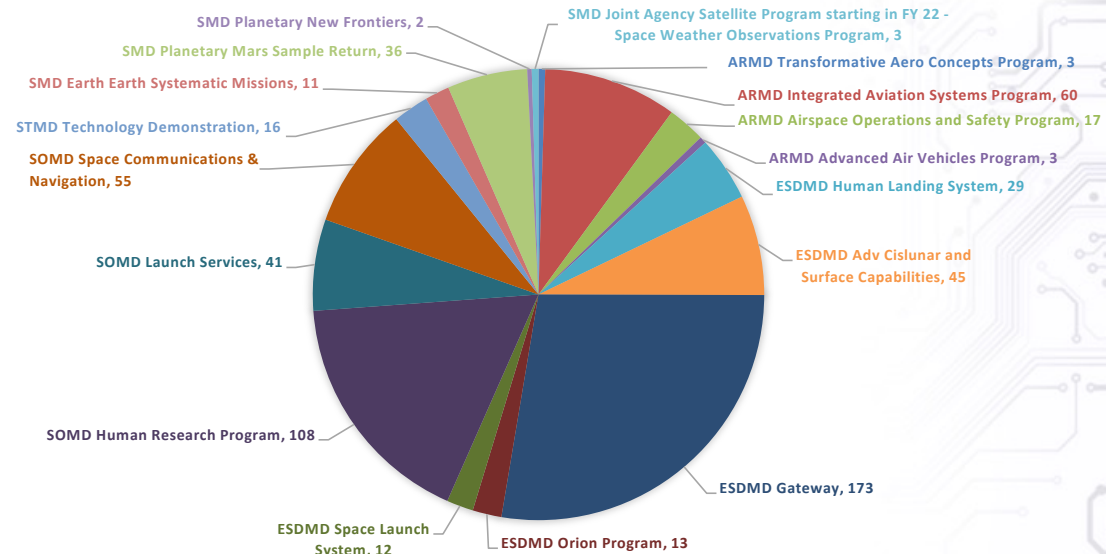
OCE Agency-level MagicDraw license server and Teamwork Cloud (model management)

Number of Models & Users by Mission Directorate and Program (at end of FY23)



- With support from NASA's Office of Chief Engineer since FY15, MBSE methodologies /SysML modeling are used across five mission directorates on most all of the large programs and projects.
- Used by almost 700 unique users from across all Centers in FY23.
- Over 1.4k models created and managed on the OCE Teamwork Cloud

UNIQUE USERS BY PROGRAM

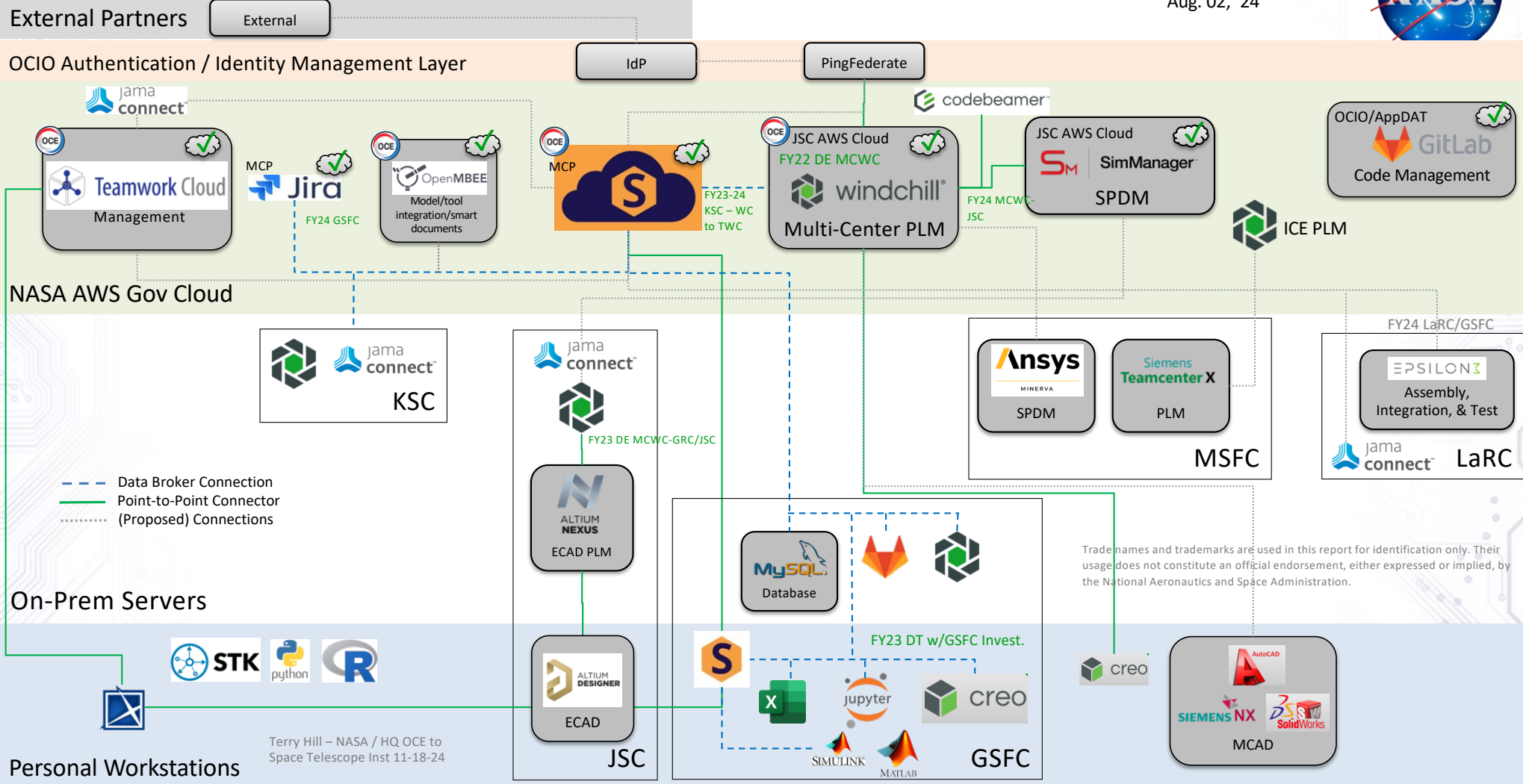


Program	User Count
ARMD Transformative Aero Concepts Program	3
ARMD Integrated Aviation Systems Program	60
ARMD Airspace Operations and Safety Program	17
ARMD Advanced Air Vehicles Program	3
ESDMD Human Landing System	29
ESDMD Adv Cislunar and Surface Capabilities	45
ESDMD Gateway	173
ESDMD Orion Program	13
ESDMD Space Launch System	12
SOMD Human Research Program	108
SOMD Launch Services	41
SOMD Space Communications & Navigation	55
STMD Technology Demonstration	16
SMD Earth Earth Systematic Missions	11
SMD Planetary Mars Sample Return	36
SMD Planetary New Frontiers	2
SMD Joint Agency Satellite Program starting in FY 22 - Space Weather Observations Program	3
Unknown	65
Total	692

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Phased Integration Demonstration of Commonly Used Engineering Tools

Aug. 02, '24



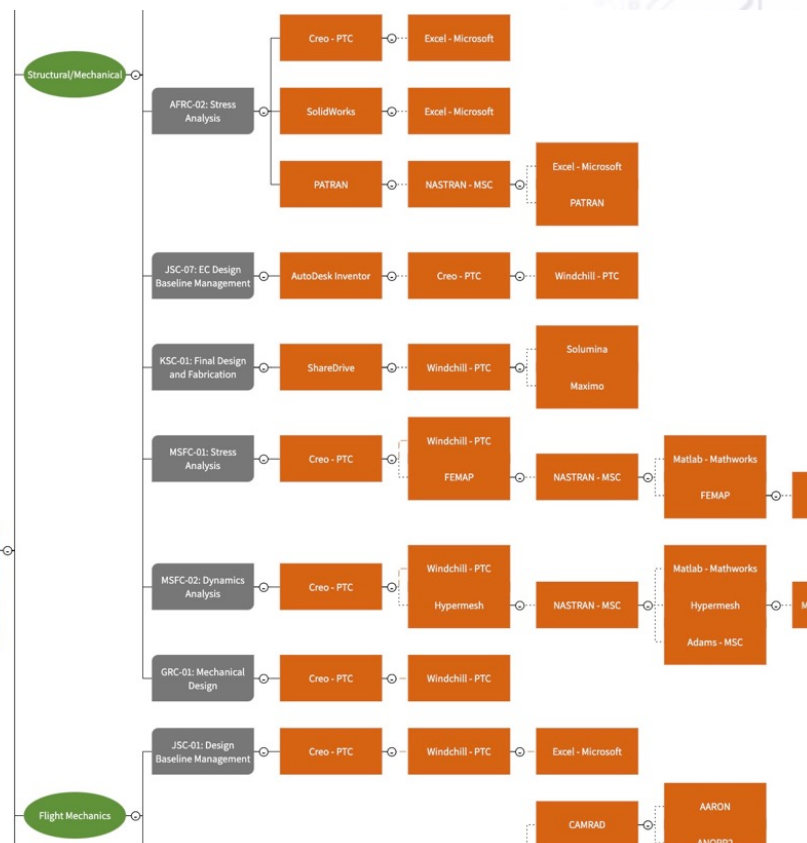
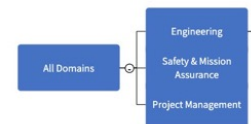


DE Toolchain Dashboard

- Work performed by Stratada Inc.

As part of NASA's Integrated Digital Engineering Transformation initiative, NASA Engineering Directorates needs a comprehensive understanding of all software applications in use for engineering across all of NASA, and the workflows they support.

- A collaborative application enabling stakeholders to input and maintain the tools and tool chain information
- A method to interactively visualize the data to support various needs including:
 - Understanding the current tool usage
 - Prioritizing tools and tool workflows for upgrade
 - Identifying opportunities to eliminate redundant tools
 - Finding ways to make data flows more efficient
 - Supporting future tool selection for new processes



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Built in MS PowerApp (for user input) with an interactive Power BI Dashboard

Data Broker Survey



In Place means the capability is included in the construct.
Limited means that the ecosystem is vendor specific.
Promising means that capability is under development.

Capability/ST D.	Syndeia v3.5 SP2	Open MDAO	Open PDM	SBE Vision	WSTAT	DAKOTA	CATTENS (GSFC)	Violet Labs
OSLC (Partial)								
Connectivity via REST API								
Dynamic Queries								
Security (OAuth 2.0, SAML 2.0, SSO)								
Cloud Services								
Visualizations								
Digital Thread								
SDK Adapter (Python, C#, Java)								

= In Place = Activity = Promising = Limited Capabilities = Without Capability

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Supporting report / white paper will be made available in FY25

Assessment scoring is based upon commercially available offerings and doesn't include capabilities which may have been developed for specific customers

Data Broker Survey



In Place means the capability is included in the construct.
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Engineering Tool Types	Syndeia v3.5	Open MDAO	OpenPDM	SBE Vision	WSTAT	Dakota	CATTENS GSFC	Violet Labs
MBSE (Teamwork Cloud, Rhapsody, etc.)								
Product Life Cycle Mgmt. (PLM)								
Requirements (DOORS, JAMA, etc.)								
Application Life Cycle Mgmt. (ALM)								
Analysis/Simulation								
CAD/DTM								
Test (AI&T)								
Database (AsOT)								

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Connecting Tool ‘How To’ Articles

- Altium (ECAD PLM) to Windchill (Project PLM) Connection

As part of NASA’s digital Engineering tool chain discovery effort, when tools are successfully connected, the DE team is documenting how it is done and will make those instructions available to anyone within NASA.

The first was in connecting the Altium (ECAD) system with the Windchill (Project PLM) system, such that now ECAD, MCAD, and any desired Project artifact can now be associated and baselined in one location for a project.

<https://nasa.sharepoint.com/sites/MBEng/SitePages/Integration-of-Altium-Enterprise-to-Windchill.aspx>

More are on the way ...

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Terry Hill = NASA / HQ OCE to
Space Telescope Inst 11-18-24

The screenshot shows a web page from the NASA Digital Engineering portal. The header includes the NASA logo and navigation links like 'Digital Engineering Home', 'The OCE Cloud', and 'MagicDraw Installation Files'. The article title is 'Integration of Altium Enterprise to Windchill Using OAuth and PingFederate' by Terry Hill (JSC-KF000), AST, Engineering Program Management. It was updated on August 14, 2024, by James Bailey (GRC). The article content describes the process of establishing a connection between Altium Enterprise and Windchill using OAuth and PingFederate, mentioning prerequisites like firewall rules, SLA, and OAuth Delegated Authorization. On the right side of the article, there are two logos: a gold Altium logo and a green Windchill logo.

Digital Engineering
Digital Engineering Home The OCE Cloud MagicDraw Installation Files Office of Chief Engineer OCE Cloud Internal ... Edit Not following

+ New Promote Page details Analytics Published 9/9/2024 Share

NASA HQ OCE DIGITAL ENGINEERING

Integration of Altium Enterprise to Windchill Using OAuth and PingFederate

Hill, Terry (JSC-KF000)
AST, ENGINEERING PROGRAM MANAGEMENT

Updated: Aug. 14, 2024 – James Bailey (GRC)

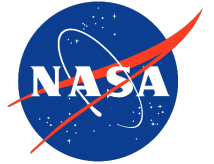
These instructions describe how to establish a connection from Altium Enterprise to Windchill using OAuth and PingFederate. Be sure to work with IT Security to configure any changes to security settings around the validity of SAML and OAuth tokens to meet your organizational needs

Prerequisites:

- Firewall rules are open for communication between sites where Altium Enterprise server and Windchill server are installed (If applicable)
- Service Level Agreement (SLA), Interconnection Security Agreement (ISA), Memorandum of Understanding or Agreement (MOU/A) for instances that exist on separate security plans as applicable.
- OAuth Delegated Authorization
 - Identity Provider (IdP) that provides OAuth w/ Delegated Authorization
 - If IdP is different from IdP for Windchill Authentication (Or isn't configured to accept the Altium Enterprise Kerberos session), a secondary authentication will be required as for OAuth to work, it needs a valid authentication session.
 - JWT Tokens were used in this example. Altium Enterprise doesn't seem to support Opaque tokens
 - If JWT's are used, token must include iat and nbf attributes so Windchill can perform introspection to validate the token.
- Windchill, Altium Enterprise and IdP must be configured for TLS.

Expand sections below for detailed instructions.

- ▼ **OAuth Delegated Authorization**
- ▼ **IdP Configuration, Configuration for OAuth, & Data Store Connections**



DE Training



DE Training

- **APPEL – OCE Funded**

FY23 MBSE Training:

- 3 Courses Offered (each a 4-day course)
- 48 Attendees

- L4** • Real World Application of Model-Based Systems Engineering
- L3** • Model Based Systems Engineering Design & Analysis
- L4** • Managing Models and Modelers

Skill Level Training

- L1** Level 1 **L2** Level 2 **L3** Level 3 **L4** Level 4 **L5** Level 4

FY24 MBSE Training:

- 6 Courses Offered
- 82 Attendees (projected)

- L4** • Ensuring MBSE Model Consistency (4-day course)
- L4** • Managing Models and Modelers (4-day course)
- L4** • Ensuring MBSE Model Consistency - By Design (4-day course)
- L1** • MBSE For NASA Managers - Pilot #1 - Aug 28 '24 (1-day course)
- L1** • MBSE For NASA Managers - Pilot #2 - Sep 23 '24 (1-day course)
- L2** • MBSE for Technical Leaders and Subsystem Engineers - Pilot #1 – Sep 17-18 '24 (2-day course)

Developed initial foundational MBSE courses (Levels 1-3) in February 2018.

Reviewed and updated MBSE Skills Matrix in Fall 2022.

In 2021 with input from the MBSE Leadership Team, introduced the MBSE Lead Series – consisting of 4 advanced MBSE courses – designed to support the skills of our lead modelers.



DE Training

- OCE Created

NASA's Introduction to Digital Engineering



What is Digital Engineering?

Digital Engineering (DE) is the embracing of new technology and tools that better connect systems and data over the entire lifecycle of a program or project, revolutionizing the way NASA engineers do their jobs.

It 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

It completely digitizes and transforms the engineering lifecycle, leveraging data, models, and simulations to design, engineer, build, operate and maintain complex missions and projects.

Traditionally, NASA's engineering processes were inherently serial and produced siloed data, and often not meeting the requirements of an authoritative source of truth. Disparate data leads to inefficiencies, inconsistencies, and challenges in maintaining information throughout a project.

Traditional engineering process

NASA's Digital Engineering Program Overview



NASA's Digital Engineering Program Overview

[START COURSE](#)

NASA's Digital Engineering program is improving how the Agency Engineering Domain operates over the entire NASA lifecycle through the coordinated efforts of six data-centric focus areas.

This course was developed for all NASA Civil Servants and was created by the Digital Academy, a catalyst project within the agency's Digital Transformation initiative.

Click on the first lesson below—or the "Start Course" button above—when you're ready to begin.

- [Introduction](#)
- [Model-Based Systems Engineering](#)
- [Interdisciplinary Digital Engineering](#)
- [Design to Manufacturing & Inspection](#)
- [Product Lifecycle Management \(PLM\) Systems](#)
- [Integrated Testbeds: Data Threads](#)
- [Check Your Understanding](#)
- [Course Summary](#)



DE Training

- **Procured Self-Directed (Percipio)**

- In FY24 the NASA DE Leadership Team made available almost **1000 online learning items (digital engineering training modules and digital books)**
 - Aligned with the NASA definition of digital engineering mapping of desired skill capabilities
 - Via COTS training platform
- Content area Managers identify and curate digital engineering resources from Agency training courses, other government learning providers, and private sector off-the-shelf courses and training videos
- Collecting these resources in one location provides a helpful entry point for personnel learning basic skills as well as those with more DE experience who need support to understand a particular tool or practice.
- In FY24 (10/1/23 - 8/8/24) **1,378 NASA learners** have accessed **581 unique learning items** of the 1000 aligned with the NASA definition of digital engineering mapping of desired skill capabilities **2,870 times**.

NASA ENGINEERING LEARNING TRENDS

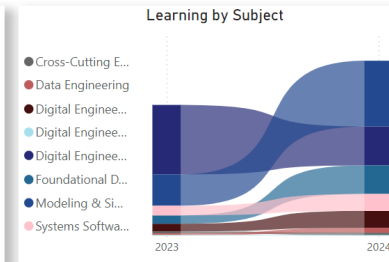
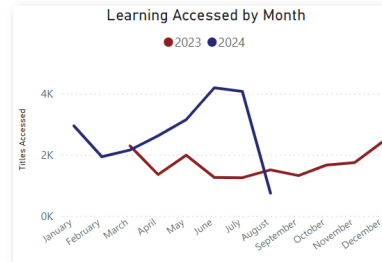
2,765
Unique Learners

38,797
Titles Accessed

EMPLOYEE TYPE
☐ Civil Service Emplo...
☐ Contractor

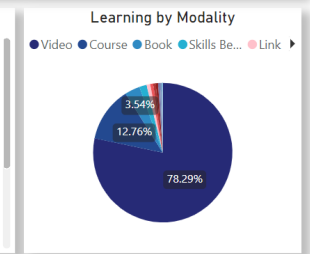
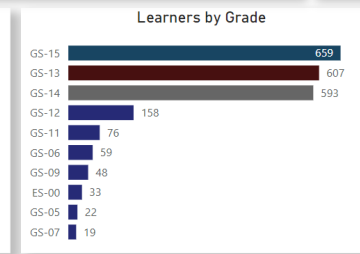
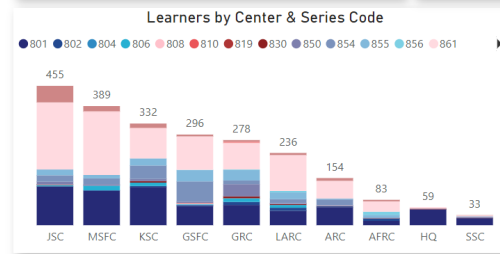
SUBJECT
All

STATUS
All



Top Content by Learners

Content Title	Learners
Neurodiversity in the Workplace	110
Leading an AI Transformation	101
Fundamentals of AI & ML: Introduction to Artificial Intelligence	93
AI/ML for Non-tech Learners	88
Leading in the Age of Generative AI	84
AI/ML at NASA	64
Data Literacy (Beginner Level)	64
Story Telling with Data	55



* Only reflects people with engineering series code

Over 1000 on-line DE Training modules, ebooks, videos, etc.: [NASA Digital Engineering](#)

Artificial Intelligence and Digital Twins

Suggestions of where to start:

Use it for activities which eat up a lot of human labor time with minimal value?



Renamed as Augmented Intelligence?



Use it to help keep track and status of our processes and systems, functionality, and health?



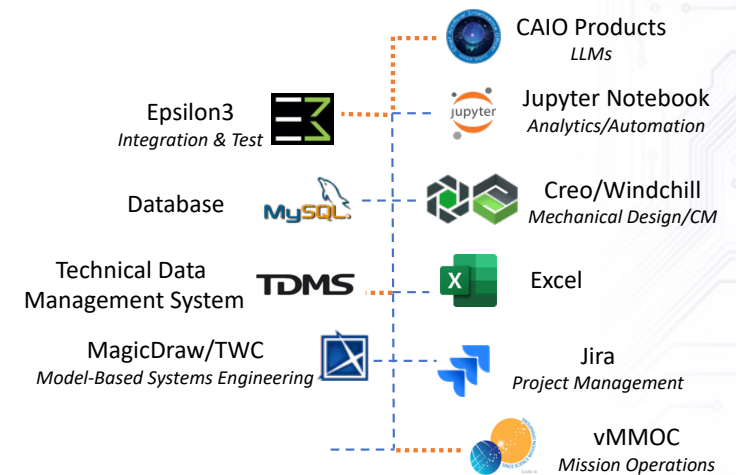
Use it to analyze data / information which is ill suited for humans in a timely manner?



What about Habitable Worlds Observatory?



- Goddard Digital Engineering (GDE) partnered with HWO (PE & PMO) in FY24 to pilot a collaboration solution for HWO
- What scenarios should be considered?
 - Simplify search across multiple sources
 - Find and summarize connected information
 - Papers, meeting transcripts, presentations, etc.
 - Enable 1000+ individuals to coordinate on an evolving concept vision
 - Generate draft documents using connected information
 - Scientific analysis, data processing, and simulation
 - Knowledge capture with decision context



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FY25 NASA Integrated Digital Engineering Transformation Team

Nov. 2024



Champions:

Charles Cockrell (LaRC) – DE Champion
Tony Sanders (GSFC) – DE Dep. Champion
Jonathan Ransom (LaRC) – Inter-Disciplinary Digital Engineering Co-lead & Champion

NASA Org Reps:

Tony Diventi (HQ) – OS&MA Rep
Christina Haymes (DT Architecture) – DT Rep.
Beth Sheridan (JSC) – NASA CM/DM CoP Lead
Trevor Grondin (LaRC) – NASA MBSE CoP Lead
Edward Mclarney (LaRC) – AI/ML Lead/Rep to DE
Phil Augustine (JSC) – Human Health & Performance

EMB IT WG

Pat McDuffy (MSFC) – Lead
• John Baca (AFRC)
• Parash Bhavsar (ARC)
• **Bob Zalewski** (GRC)
• Michelle Longo (GSFC)
• Cindi Kingery (JPL)
• Jamie Payne (OCIO SLAM)
• Greg Stiggins (JSC)
• Tommy Mack (KSC)
• Chris Thames (LaRC)
• Dawn Davis (SSC)

OCE Cloud Team

George Plattsmier (MSFC) – Lead
Murali Raju (MSFC)
Lee Martin (MSFC)

Center Reps:

(Center Actions & Reporting)
- **AFRC**
ARC: **Scott Miller** – Rep
GRC: Derrick Cheston – Rep
GSFC: **Aaron Comis** – Rep
JSC: **Greg Pierce** – Rep
JPL: Chris Delp – Rep
KSC: **Dan Sparling** – Rep
LaRC:
• Amanda Cutright (LaRC) – Rep
• Anna-Maria McGowan (LaRC)
MSFC: Justin Pociask – Rep
SSC: **Zachary Lewton** – Rep

Terry Hill – OCE/HQ DE Program Manager
Trish Nicoli (KSC) – Deputy Manager
Tom Engler (KSC) – Associate Manager

Systems Engineering & Integration

Trish Nicoli (KSC) – DE SE&I Lead / MLT Lead

- Karma Snyder (SSC) – DE Integration Lead
- **Josh Heeren** (JSC) – DE SE / Modeling Lead
- **?? – DE Smart Review Lead**
- NPR Modeling –
 - **Rob Morgenstern** (GSFC)
 - **Edie Parrott** (GRC)
 - David Chiras (KSC)

MBSE Leadership Team - **Trish Nicoli** (KSC) – Lead

Trevor Grondin (LaRC) – MBSE CoP Lead
Beth Sheridan (JSC) – NASA CM/DM CoP Lead
Josh Heeren (JSC) – Modeling Lead
Processes Group

- **Edie Parrott** (GRC)
- **Rob Morgenstern** (GSFC)
- Steve Cornford (OSMA)

Tools Group

- Samantha Infeld (LaRC) – Lead
- **Alberto Blanco** (LaRC)
- Brian Ferguson (LaRC)
- Paul Gill (MSFC)

Center Reps

- Christopher Acuff – AFRC
- **Greg Pierce** – (JSC)
- **Dan Sparling** – KSC
- **George Plattsmier** – MSFC
- Scott Miller – ARC

Workforce Group

- Tim Schuler (GRC) – Lead
- Frank Gati (GRC)
- **Zachary Lewton** (SSC)

Rep.
Christina Haymes – DT Int. Lead
Tony Diventi – OSMA Rep
Jon Holladay – OCE SE TDL

DE Training

??
Jess Deibert – Communication / Education / Training

Terry Hill – NASA / HQ OCE to Space Telescope Inst 11-18-24

Integrated Toolchain / Data Thread

DE Toolchain Lead – **Albert Blanco** (LaRC)

- **PLM Lead - Tim Stiglets** (SSC)
Active Members:
 - GRC – **Jim Bailey**, **Bob Zalewski**
 - JSC – Jeff Reilly, Chris Hare
 - KSC – **Stephen DeBlois**, **Trish Nicoli**
 - LaRC – Nick Vitullo, Shawn Taylor, Jan Puchalski
 - SSC – Thang LeCenter POCs:
 - AFRC – **Joseph Gonzalez**
 - GSRC – **Al Goncer**, **Laura Ingram**
 - MSFC – Steve King (ICE), **David Whitten**
 - HQ Logistics – Vince Cappello
- **MBSE Tools Lead - ??**
- **Design to Manufacturing Lead - David Whitten** (MSFC)
 - AFRC – **Joseph Gonzales**
 - ARC – **TBD**
 - GRC – Jack Dalzell, **James Bailey**
 - GSFC – **Al Goncer**, **Ryan McClelland**
 - Supporting: **Aaron Comis**, **Oneal Cunanan**, **Laura Ingram**, **Brian Simpson**
 - JPL – Eduardo Dorantes
 - JSC – Sean Miller, Robert Blaine
 - Supporting: Kelly Bryant
 - KSC – Adam Dokos, **John Ingalls**
 - Supporting: **Curtis Dugger**, **Brian Kryszczynski**, **Stephen DeBlois**
 - LaRC – Jared Fell, Nick Kemp
 - Supporting: Scott Hill, Greg Phillips
 - MSFC – Jim Meehan
 - Supporting: Robby Bilbrey, Zach Taylor
 - SSC – Jonathan Dickey
 - Supporting: **Tim Stiglets**
- **Greg Pierce** (JSC) – SysML Digital Twin Lead
- **Steven Arnold** (GRC) – Advanced Materials Devel. w/AI
- **Inter-Disciplinary Digital Engineering Lead – Aaron Comis** (GSFC)
 - Co-leads: **Jonathan B. Ransom** (LaRC), Michael M. Madden (LaRC), Thomas Chen (JSC)
 - AFRC – Wesley Li
 - ARC – Nathan Benz
 - GRC – **Steven Arnold**, Karl Vaden, Robert Falck, Shira Nadile
 - GSFC – David J. Benson
 - JPL – Gregory Davis
 - KSC – **Curtis Dugger**, Hannah Jarrett, **Brian R. Kryszczynski**, **John Ingalls**, Doug Willard, Craig Fortier, **Stephen DeBlois**, **Patricia Nicoli**
 - JSC – James Smith, Lui Wang, Jeffrey Michel, Benjamin Quasius
 - LaRC – Bil Kleb, David H. Covington
 - MSFC – Christopher J. Spencer, Jaganathan Ranganathan
 - SSC – Paula L. Hensarling
 - HQ-OCE – Robert Moreland
 - Generative Design CoP – **Ryan S. McClelland** (GSFC)
 - Uncertainty Quantification CoP –
 - Giuseppe Cataldo (GSFC)
 - James E. Warner (LaRC)
 - **?? – Generative Topological Optimization Lead**
 - Tanya Andrews (MSFC) – AR/VR Lead

Yellow text indicated open position. Green text indicates multiple duties.

REACH
NEW
HEIGHTS



REVEAL
THE
UNKNOWN



Questions?

BENEFIT
ALL
HUMANKIND

