

ModelBased Mission Assurance (MBMA) in the Context of NASA's Digital Transformation (DT) Program

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Purpose and Agenda

Purpose:

- Overview of ModelBased Mission Assurance (MBMA) in the context of NASA's Digital Transformation (DT) Program
- Address Working Group Questions
- Seek benchmarking/leveraging opportunities

Agenda:

- 1. NASA DT Program Overview
- 2. NASA Data Foundation F.A.I.R./F.A.I.R.U.S.T
- 3. What is MBx and MBMA
- 4. Why MBMA
- 5. Summary did we address the Work Group questions \odot

NASA's Digital Transformation Overview



The What?





DIGITIZED





DT is employing digital technologies (e.g., AI, mobile, cloud, data) to **change a process, product, or capability so dramatically** (e.g., real-time, intelligent, personalized, anywhere, anytime) that it's **unrecognizable compared to its traditional form.**

The Why?



Rearchitect our WORK Deliver increasingly complex missions leveraging increasingly complicated partnerships, on shorter timelines to achieve bolder outcomes that inspire the world



Elevate our WORKFORCE Experience

Create a seamless, integrated, and inclusive **employee experience** that **energizes** our people by feeling **connected** to the NASA enterprise, continuously **grow**, and take **pride** in rapidly delivering **high-value work**



Create Adaptive WORKPLACES

Optimize a sustainable 21st Century **cyber-physical work environment** that powers **flexible**, **adaptable**, **efficient**, **and effective** employee and partner **teaming**.



Built on NASA's Strategic Thrust Focus Areas:

• Data

10x or more

improvement

- Culture & Workforce (C&W)
- Process Transformation
- Collaboration
- Artificial Intelligence/Machine Learning (AL/ML)
- Model-Based Anything (MBx)

Digital technologies can radically accelerate NASA's transformation goals.

Emerging NASA Data Enterprise built upon <u>FAIR</u> (<u>F</u>indable, <u>A</u>ccessible, <u>I</u>nteroperable, <u>R</u>eusable)



(Findable, Accessible, Interoperable, Reusable, Understandable, Secure, and Trustworthy)

Agency & SMA Data Governance:

Intersection between DT Data and Modeling activities

FOCUS: Data & Data-Process mapping inventory around MBMA, MBx, FAIR, and "FAIRUST"



Evolving MBx Domain Structure (Notional Baseline – June 2020)



MBMA (June 2021) – SMA's complement to MBE, MB Institutional Management, and MB Mission Management emerging as its own Sub-Domain under MBx. Being broken out as a complementary Sub-Domain.



Commonality between MBSE, MBMA and MBx

<u>Notes</u>:

- (1) There is a lot of commonality between the domains with many of the concepts and much of the nomenclature being the same.
- (2) The SysML modeling language enables extensions and some are required to supported additional SE domain activities.
- (3) & (4) Much of the domains
 (e.g., SMA, SE, Discipline
 Engineering, Program
 Management, Acquisition),
 however, are beyond the depth
 of SysML alone and will require
 interfaces or interface tools to
 exchange products or data.



MBx provides the overarching integrated (or interoperable) modeling environment that encompasses the interfaces, interface tools, and corresponding exchange of cross-domain products, data, and knowledge.

Evolving MBx Domain Structure - MBMA



A way to self-organíze MB communítíes ξ our work

Model-Based Mission Assurance (MBMA); SMA's complement to Model Based Systems Engineering, Model-Based Mission Management (MBMM), and Model-Based Institutional Management; is focused on digitally transforming delivery of fundamental SMA functions, such as

- Assuring Safety and Mission Success through oversite and insight in the acquisition, development and operation of NASA missions
- Providing for delivery of technical products and processes to qualitatively and quantitatively characterize risks for NASA missions covering the safety, reliability and quality of hardware, software, and human systems integration over the life cycle
- Supporting decision making in the acceptance of risks on NASA missions; though development and adoption of advanced mission assurance capabilities that continually enable more efficient, effective, and agile safety and mission assurance of NASA's mission as part of an integrated, model-based, enterprise environment.

Elements of this digitally transformed environment will include:

Use of Objective Driven Requirements and accepted Standards tied to Risk Classification, Risk acceptance thresholds, mission unique characteristics, and knowledge gained from prior mission to enable adaptable and innovative SMA planning and execution:

- Model-Based SMA Plan Development
- Model-Based Assurance Case (measure execution progress, including leading gap/issue/risk indicators to provide earlier and continuous insight, oversight, and support of programmatic decision making and review activities)



SMA Transformed State

More

- 1. Digitally Transformed Launch Services, Developer/Govt data (e.g. NCRs/PFRs, QA IRs)
- 2. MB/AI/ML Life Cycle Insight/Oversight SMA/SMS knowledge available continuously
- 3. MB/AI/ML Cross-Cutting Agency Risk Management Systems
- 4. Spacecraft and Aircraft Design Single Source of Truth Design for Minimum risks, combining SMA factors (e.g., reliability, hazards), redundancy, with traditional factors
- 5. Aircraft and S/C Ops trends/precursors/health and prognostics status both ground and flight (Prevent issues before they occur)
- 6. Building Blocks, Data Process connectivity Design out/Prevent Issues from ever occurring

SMA/SMS Transitional State

Digitally Transforming Life Cycle Insight/Oversight

SMA/MBMA Pilot Activities



NASA

How would you define Mission Assurance and Flight Worthiness? Assuring Safety and Mission Success through oversite and insight in the acquisition, development and operation of NASA missions

What does it mean to be "model based"? Formalizing connectivity and integration of knowledge and processes to enable more timely, more robust, and more effective delivery of analysis and products.

What would be the benefits of MA/FW being model based vs. document based? Earlier Insights, Robust Information Contextualization, Increased velocity and higher fidelity decision Making

How would you incorporate model-based practices in MA/FW? What are the barriers? Separate Management Chains, Different Drivers. Any opportunities? Alignment around common end-item Goals (i.e., Mission Success, Safe execution)

Do you have any ideas for collaboration/pathfinder activities to demonstrate MBMA/FW?

Formulation – Machine Assisted Planning; Workflows - Machine Assisted Life Cycle Reviews; Risk Management Systems; Common MetaData STDs



Any Questions or Feedback?

Thanks, Tony and Steve



BACK-UP

Office of Safety and Mission Assurance Priority Areas

Leverage & Integrate

- Evolve policy, standards, and training to make SMA practices more objectives-driven and risk-informed
- Further adapt oversight to recent contract models; enhance independent assessment of program oversight
- Invest in evidence-based assessment of programs and supply chain based on recent lessons learned
- Respond to SPDs and Presidential Memorandums

Evolve policy and oversight to increasingly agile and commercial acquisition practices

- Advise Agency on systemic and significant risks to Safety and Mission Success
- Strengthen identification, management, and communication of concerns related to institutional safety, mission assurance, and safety culture
- Establish delegated discipline leads/experts at centers
- Coordinate with MSD on the resolution of institutional safety concerns (hazards, continuity of SMA functions) in the MAPped NASA Enterprise

- Conduct audits, investigations, assessments, and reviews
- Partner and invest to advance assurance capabilities addressing changes in spacecraft design and operations and environmental/external threats
- Fund activities as budget allows; coordinate with MDs regarding noncompliances and cross-cutting risks
- Maintain expertise with national significance

Integrate SMS across the Enterprise via tools, training, and oversight

Leverage NASA's Digital Transformation

- Support Agency-level Digital Transformation efforts
- Partner and invest to establish assurance capabilities
- Pursue novel assurance strategies based on greater access to data
- Strengthen SMA operations and collaboration

Policy Evolution and Earlier Risk Identification

Objectives Driven Requirements (GSN), Machine-Assisted Planning, Machine-Assisted Assurance Case, and Machine-Assisted Reviews



Assurance Implementation Matrix (AIM)