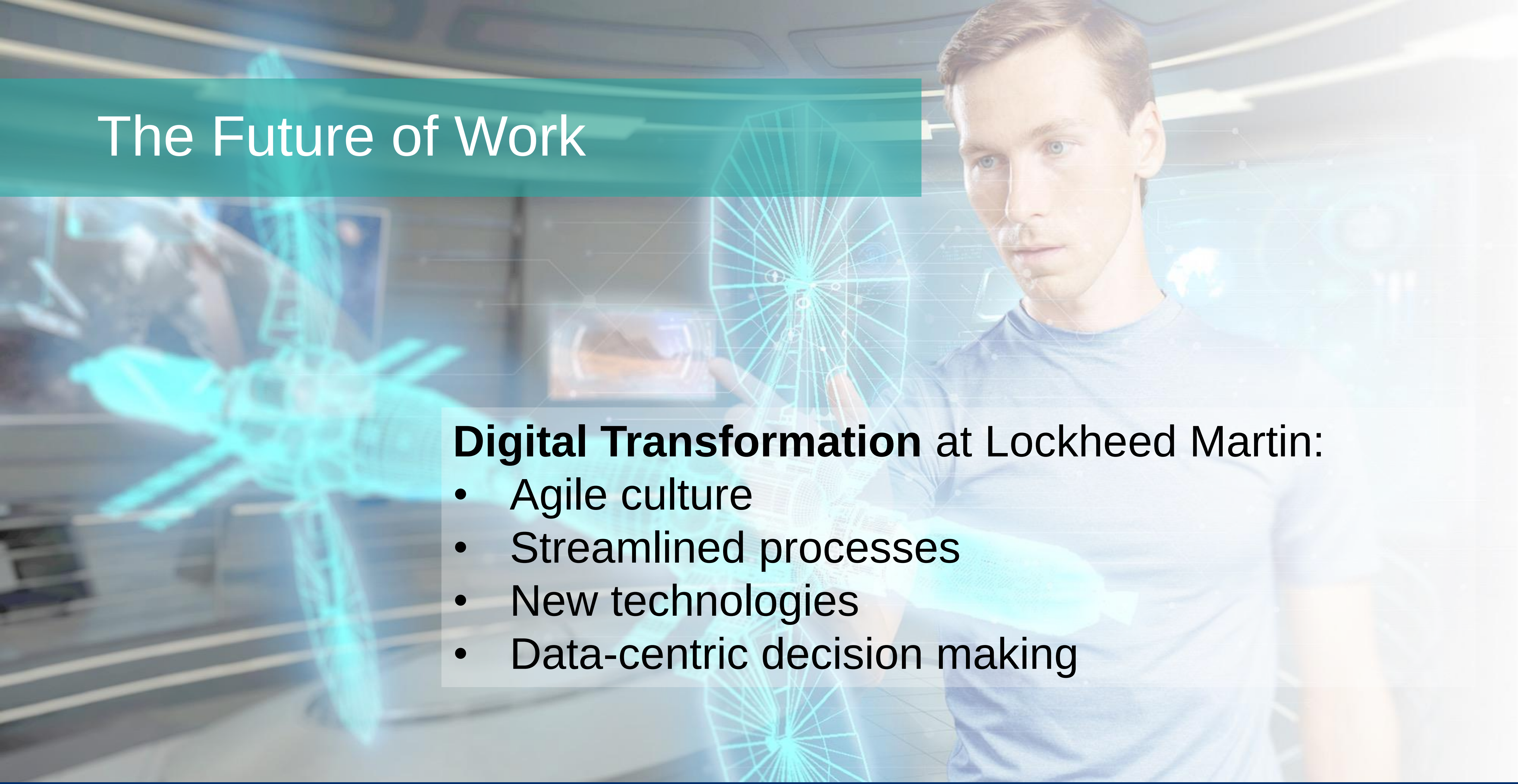
Digital Transformation

Paula Hartley
Vice President, Enterprise Performance

LOCKHEED MARTIN



The Future of Work

Digital Transformation at Lockheed Martin:

- Agile culture
- Streamlined processes
- New technologies
- Data-centric decision making

Our Vision: Transformational Outcomes

Speed

Accelerate program timelines to deliver new capabilities from the factory to the field faster than ever

Agility

Respond to rapidly-changing customer needs and stay ahead of a dynamic technology landscape

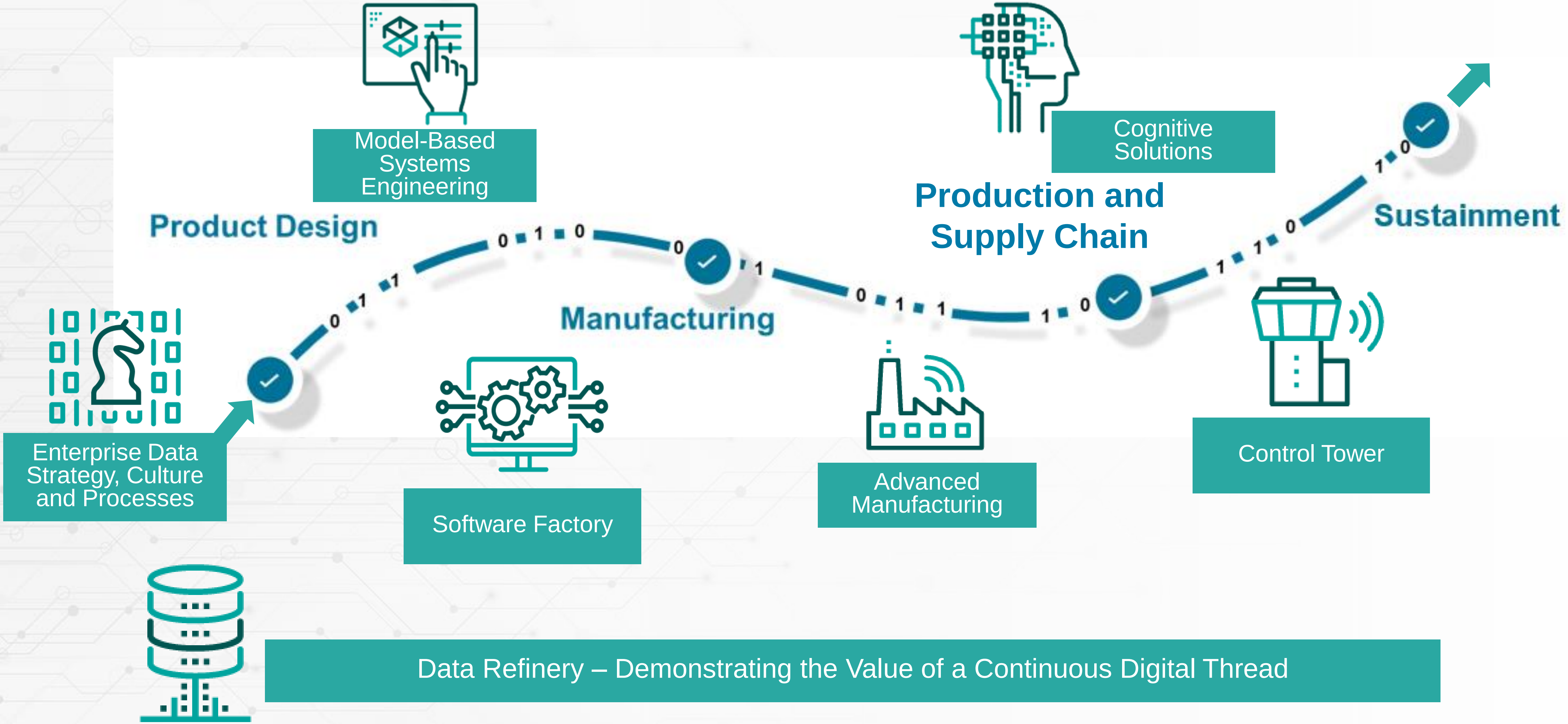
Insights

Build a data-centric enterprise that collects, integrates, and analyzes data to continually improve performance

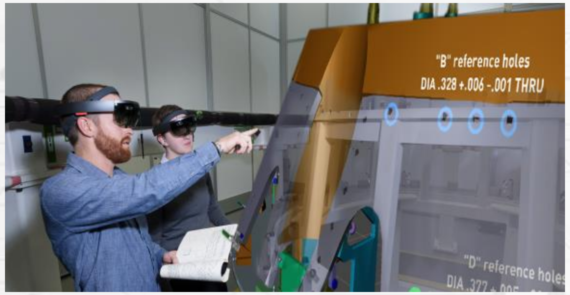
Mission Value

Drive customer mission impact through cost-efficiency, innovation, and streamlined processes

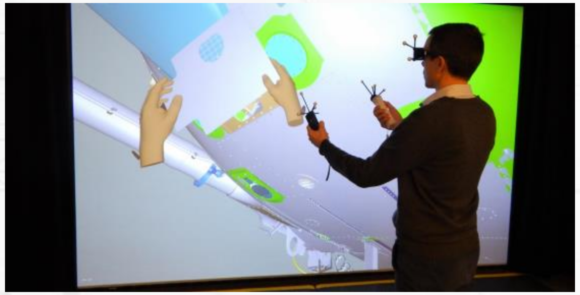
Enterprise Leverage of the Digital Thread



Transformation is Already Underway



The Orion spacecraft program used augmented reality tools to accelerate a complex assembly process from 8 hours to just 45 minutes – with even better quality.



Sikorsky's Combat Rescue Helicopter team integrated a virtual reality lab to validate maintenance tasks prior to aircraft build, saving time and reducing costs.

Intelligent factory innovations have been instrumental in driving cost savings and efficiencies on F-35.

The data analytics and AI tool FORCE processes petabytes of data, predicts factory bottlenecks and improves analysis of program cost, schedule and delivery risks.

LOCKHEED MARTIN

NORTHROP GRUMMAN

Digital Transformation at Northrop Grumman

Presented at the NDIA Air Armament Symposium

Eric Reinke

Vice President, Strategy & Program Development

27 October 2020

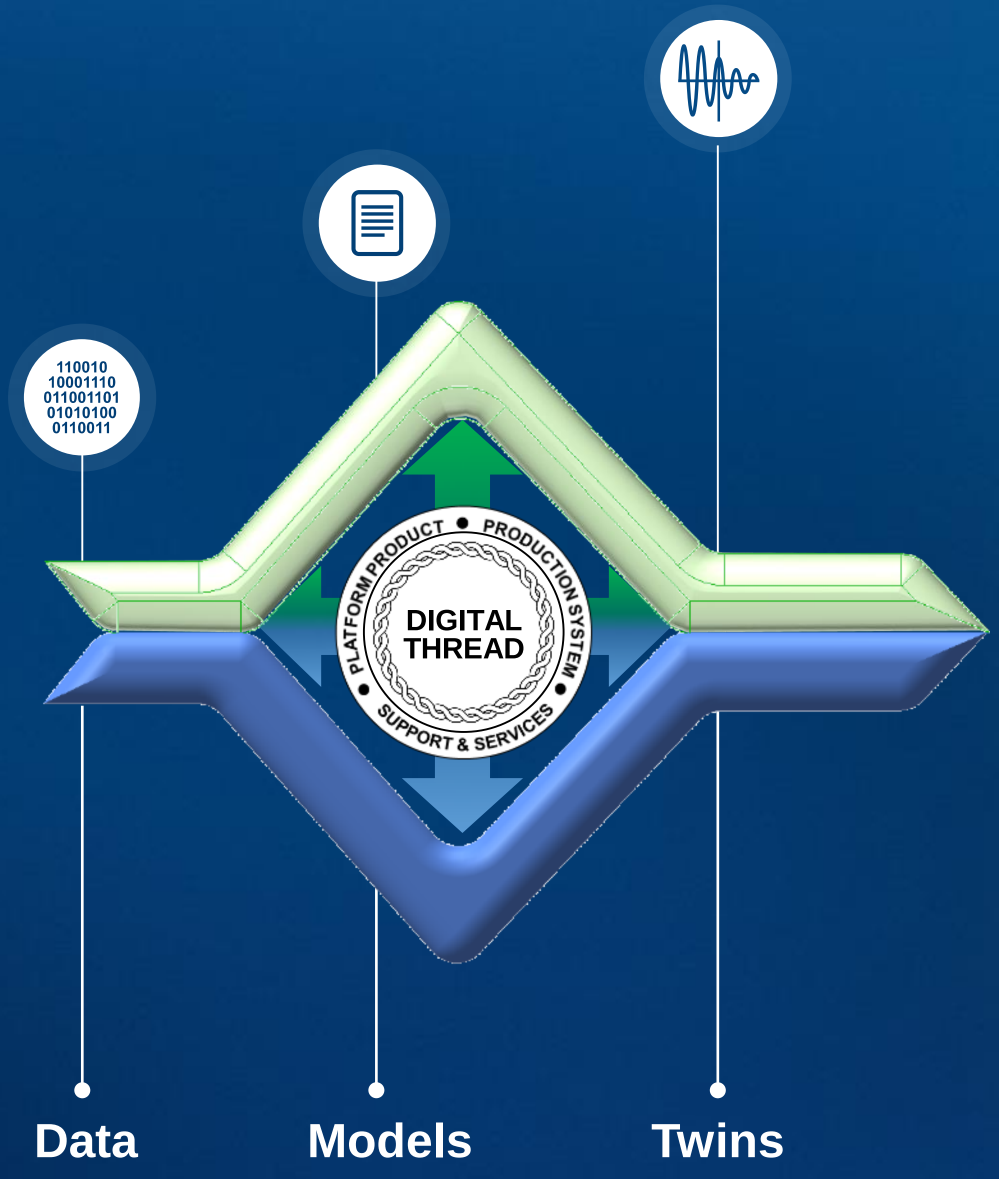
The Model-Based Engineering (MBE) Diamond

A Framework for Digital Transformation

NDIA Air Armament Symposium Panel

October 27, 2020

Jason Hatakeyama
Chief Architect and Sr. Director, PLM
Defense, Space & Security
jason.hatakeyama@boeing.com



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DATA-DRIVEN DECISION MAKING

DATA ANALYTICS (INSIGHT)

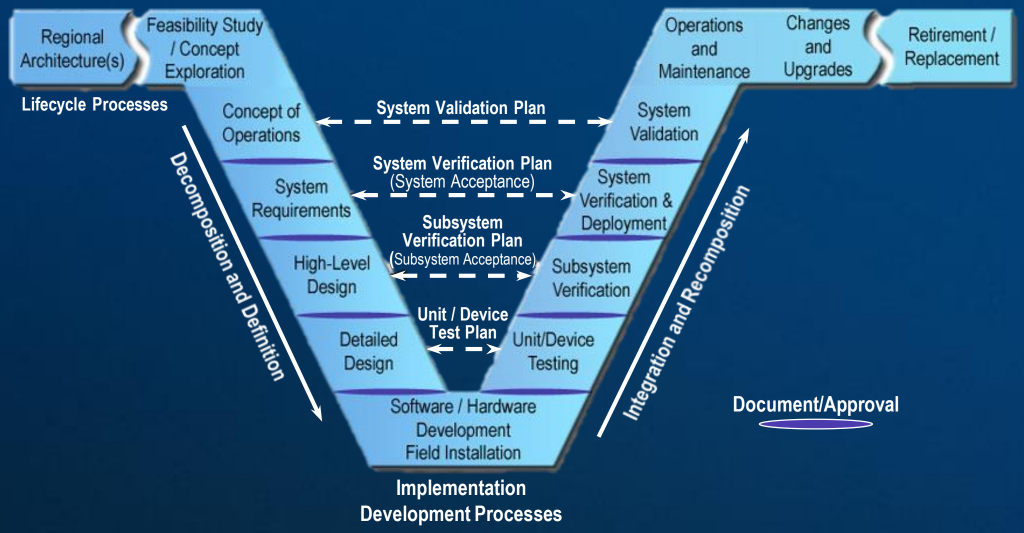
DIGITAL TWINS (INTELLIGENCE)

DIGITAL THREAD (CONNECTIVITY)

The Digital Value Chain

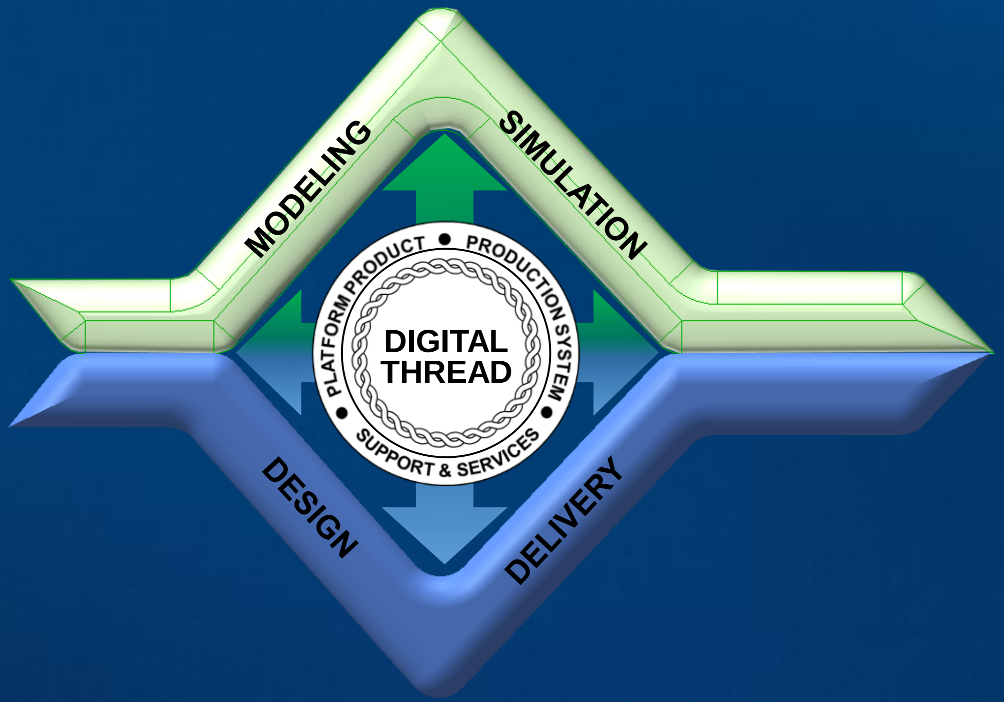
Transforming Systems Engineering to an MBE Environment

1990s SE V



SOURCE: US Department of Transportation Federal Highway Administration

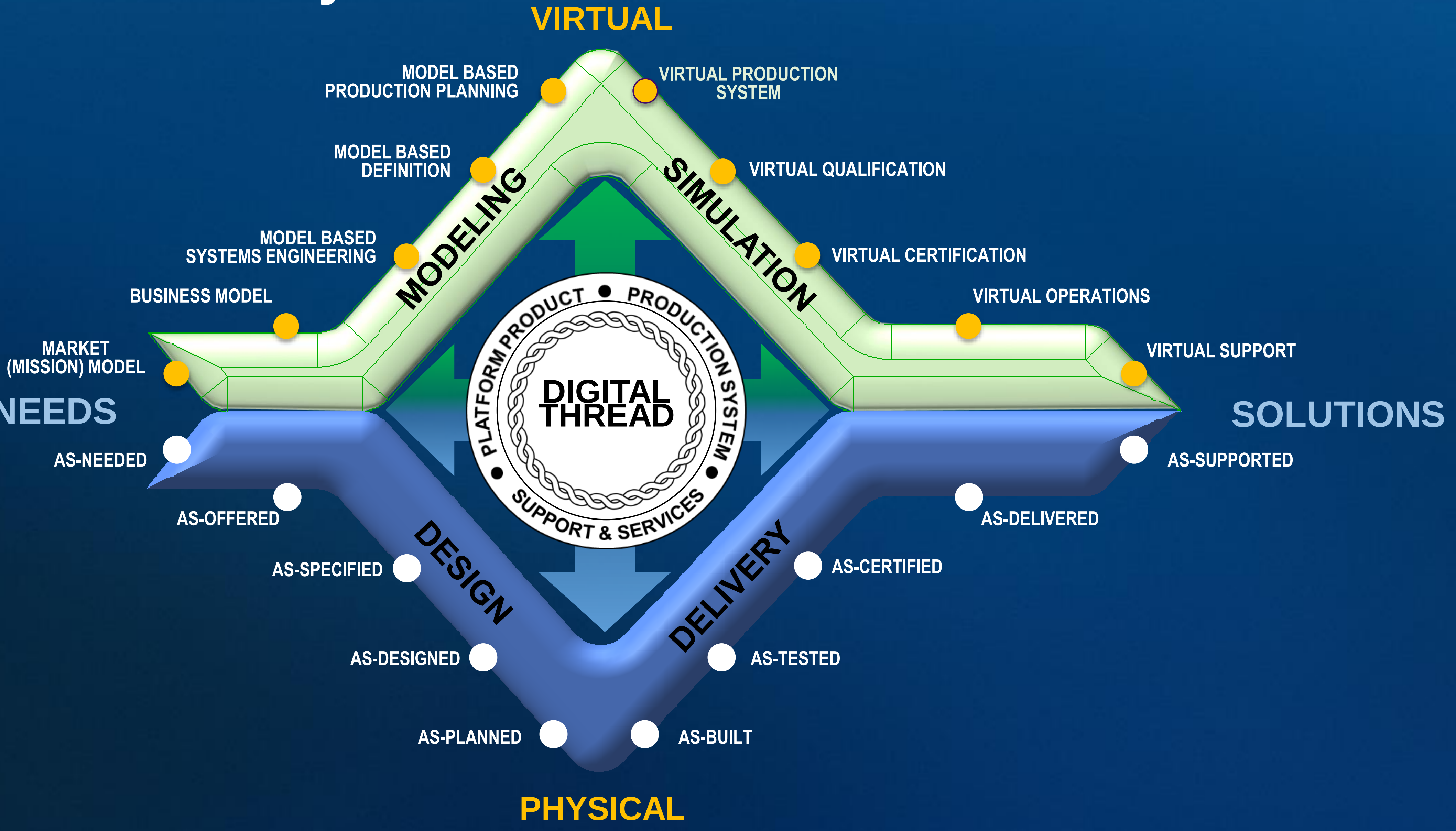
2020s MBE Diamond



Source: Boeing

Moving from a document era to a digital engineering era with information flow across the lifecycle

MBE Diamond Symbol



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Boeing's Model-Based Lexicon - *A Common Language*

Model-Based Enterprise

AN ORGANIZATION that applies modeling & simulation technologies to integrate and manage its technical and business processes (NIST)

TRANSFORM BOEING to a Model-Based Enterprise (Industry 4.0)

DIGITAL Boeing Business Capabilities

Model-Based Engineering

AN APPROACH to product development, manufacturing, and lifecycle support that uses a digital model and simulation to drive first time quality and reliability (NIST)

CONNECT VALUE-STREAMS for digital lifecycle data-flow (Digital Thread)

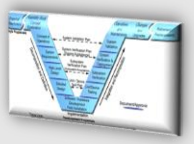
ARCHITECTED digital work/ info-flow

Model-Based Systems Engineering

EXECUTION OF DISCIPLINE (Systems Engineering) using digital model principles for system level modeling & simulation of physical and operational behavior throughout the system lifecycle (INCOSE)

EMPLOY System-level modeling & simulation (Digital System Model)

SIMULATED digital work/ info-flow

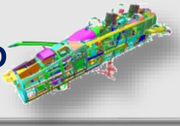


Model-Based Definition

A PART'S DEFINITION using a 3D model. May define feature and part characteristics within the 3D model. Industry format standard: ASME Y14.41. Boeing format: BDS-600

DEFINE product using 3D model standards

FULLY DIMENSIONED definition



Model-Based Instructions

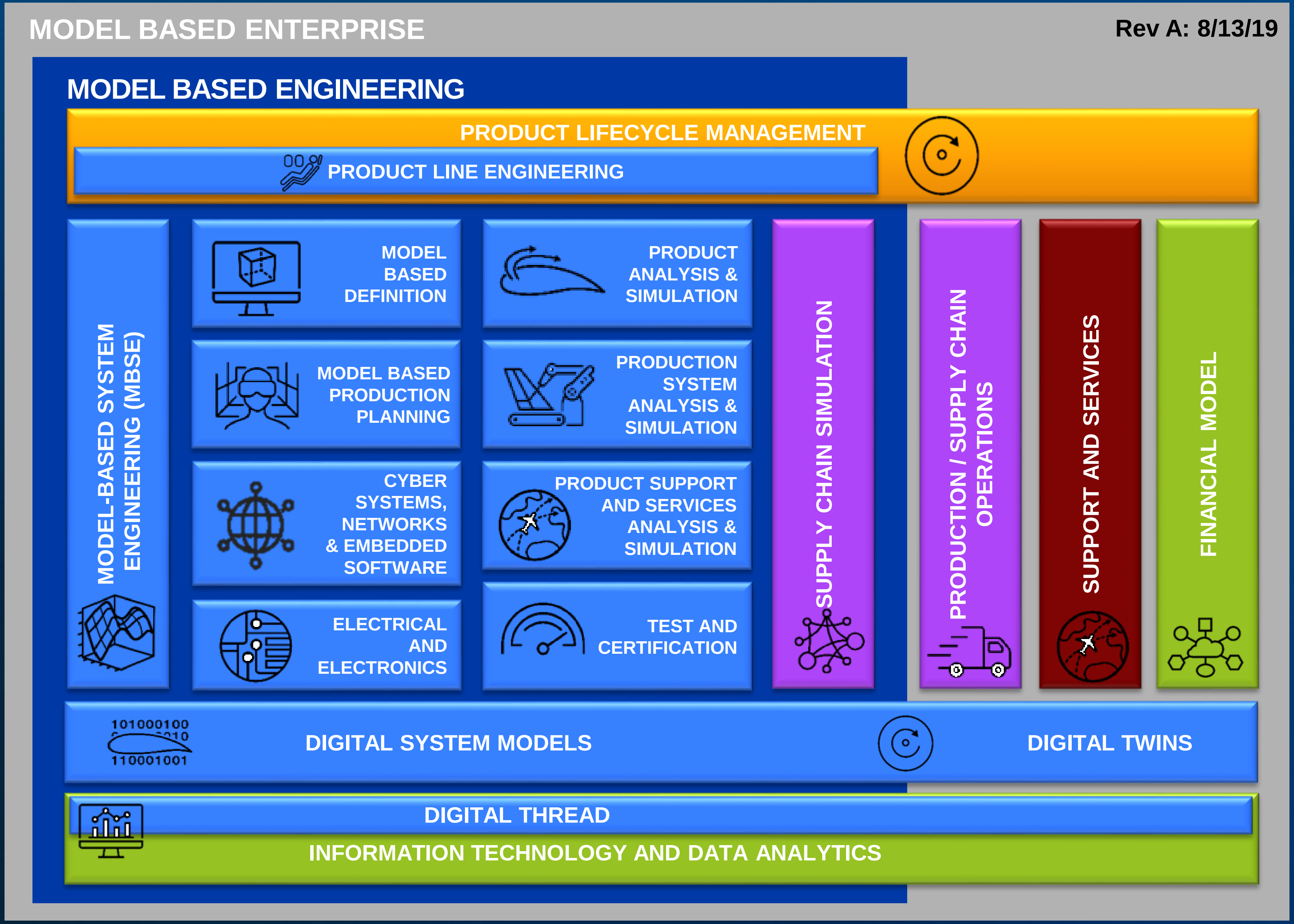
GRAPHICAL DISPLAY of information necessary for build/assembly, including MBD engineering intent (process specs, geometric dimensions & tolerances, etc.) (NIST)

BUILD product using 3D model standards

FULLY DIMENSIONED product

Source: Boeing

Boeing MBE Taxonomy - *an Enterprise MBE Framework*



Legend

- Product Lifecycle Mgmt
- Domain Engineering
- Operations Mgmt
- Support & Services
- Enterprise Services

BOEING