MB-DMI collaboration in the Supply Chain, RTX Vision & Business Unit Progress

GLOBAL PRODUCT DATA

INTEROPERABILITY

SUMMIT 2025

BOEING ELYSIUM LOCKHEED MARTIN NORTHROP GRUMMAN Parker PDES, Inc.® Connecting the Digital Enterprise

Christopher Scott, Pratt & Whitney
Samuel Yang, RTX T&GE, MBDT-PCC

Abstract & Presenter Bio

Abstract: The future in the Aerospace and Defense industry demands faster product delivery and increasing product capability resulting in increased complexity in product design. U.S. government contracts and programs have begun to require digital engineering capabilities from implementation of DoD Instruction 5000.97 released in late 2023. RTX has been working on a multi-year Model-Based Enterprise (MBE) transformation initiative to leverage digital capabilities throughout the way in which we conduct our business and provide our products and services to customers, including how we design, build, and maintain our products and services and operate our facilities. Model-Based Definition, Manufacturing, and Inspection (MB-DMI) project focus on developing capabilities to,

- Reuse of validated MBD models to enable automation in manufacturing, quality, process planning and programming
- Leverage interoperable data standards to exchange data across heterogenous CAx applications
- Build the feature level digital thread with semantic data connectivity across DMI domains to uncover knowledge from production data

In-house demonstrations of these new digitalization capabilities have shown the value of cycle-time & cost reduction, and product quality improvement. The supply chain plays a key role in all of RTX's product composition, our success in this MB-DMI transformation requires close collaboration with our suppliers on this journey.

Pratt & Whitney highlights lessons learned with MB-DMI deployments from pilots to full program execution while leveraging industry resources to upskill and prepare businesses for the Digital Transformation Journey. We offer an approach to assess and plan supplier's Model Based Maturity advancement with a key focus on Awareness, Capability, Readiness, and Adoption while leveraging Continuous Improvement.

Samuel Yang

Samuel Yang is a Sr Principal Engineer at Model-Based Digital Thread Process Capability Center within RTX Corporate Technology & Global Engineering group. He is currently developing digital thread capabilities to enable MB-DMI and to capture insights from existing production data for design producibility assessment. Prior to RTRC, he has 18 years of design and test engineering experience in space propulsion.

Chris Scott

Chris Scott is a Senior Manager with Pratt & Whitney's Global Supply Chain focused on MB-DMI Integration and Maturity Advancement with the Supply Base. He has held various roles in Pratt & Whitney over the last ten years with Engineering and the GTF™ product line. Previous experience includes five years of design and manufacturing engineering with custom emergency vehicles.

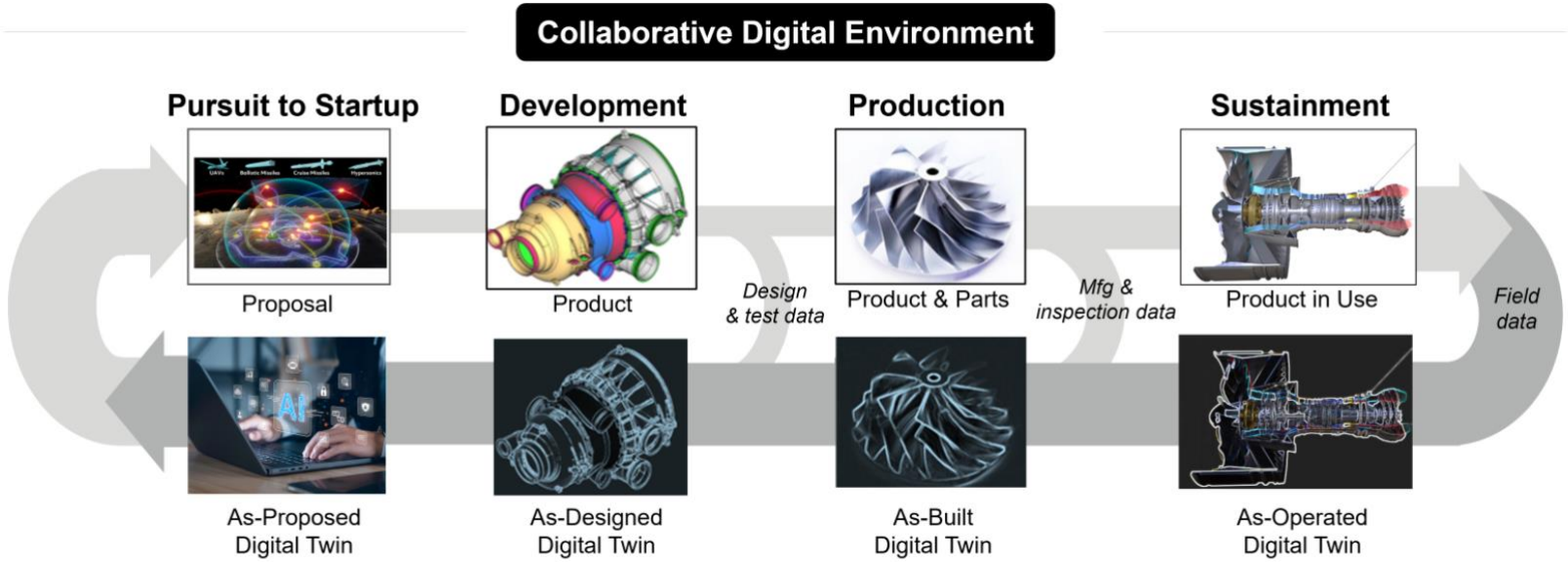
Agenda

- **RTX Model-Based Enterprise (MBE) Overview**
- **What is Model-Based Definition, Manufacturing, and Inspection (MB-DMI)**
- **Value Proposition of MB-DMI**
- **MB-DMI Plays**
- **Supplier MBE maturity assessment approach**
- **MB-DMI in Pratt & Whitney (P&W) Supply Chain**
- **Initial Survey Result of P&W Suppliers**
- **Call to Action**

RTX Model-Based Enterprise (MBE) Vision

What is the Model Based Enterprise?

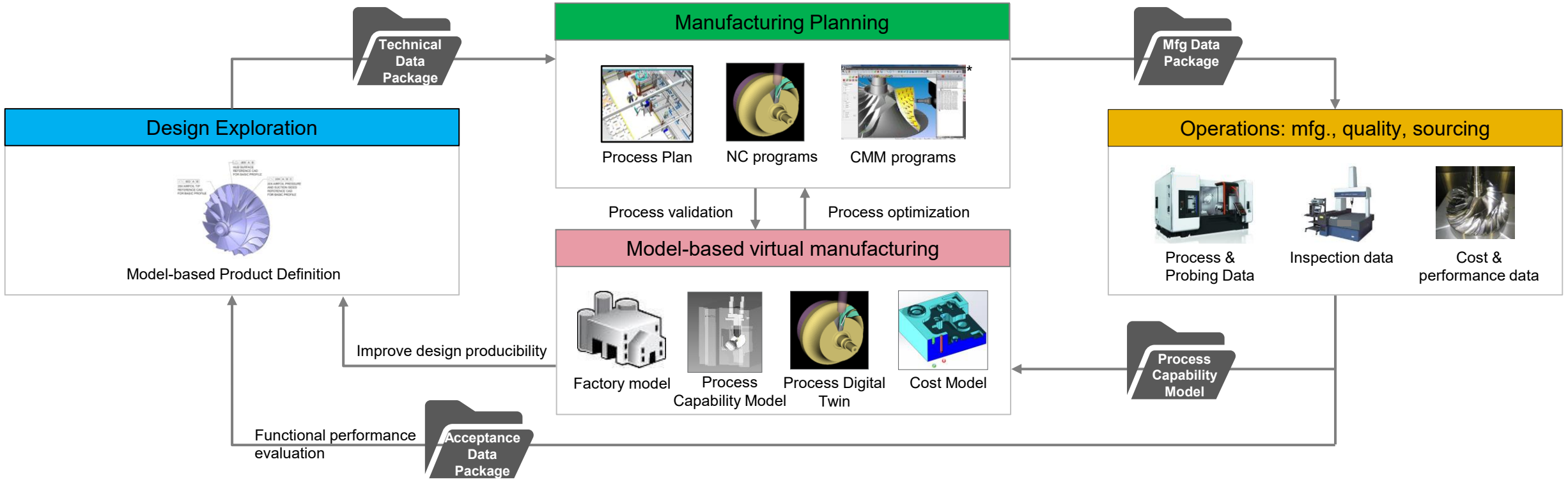
A Model-based Enterprise (MBE) is an organization that applies **modeling**, **simulation technologies** and **data analytics** to integrate and manage its technical and business processes related to production product lifecycle support.



At RTX, we are digitalizing the product lifecycle processes to become a Model-Based Enterprise (MBE), substantially **reducing the time and cost** of product development and delivery while ensuring **product quality**, **safety**, and **reliability**.

Model-Based Definition, Manufacturing, and Inspection (MB-DMI) Overview

Reuse of Model-Based Definition models to enable automation



Mfg models and production data to enable design exploration, improving producibility and cost

Planning Automation

Reuse MBD to automate process planning and NC programming code generation

Process Validation

Perform DFMA assessment to trade design and mfg options & improve producibility, process simulation to validate mfg plan feasibility

Process Optimization

Analyze and correlate as-executed process data to as-built variation, and optimize process control parameters

Performance Evaluation

Simulate product digital twin to obtain as-built functional performance

CMM: Coordinate Measuring Machine
NC: Numerical Control
Mfg: Manufacturing

Model-Based Definition, Manufacturing, and Inspection (MB-DMI) Value Proposition

RTX

Key Transformation Principles

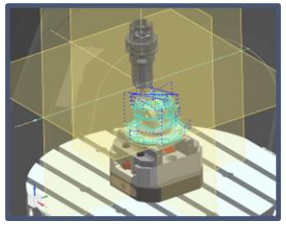
Retire Blueprints

Validated Models

Single Source Of Truth

Standard Data & Reuse

Interoperability



Manufacturing planning with MBD

Tooling design, Computer-Aided Manufacturing (CAM) toolpath programming, and Manufacturing work instruction, with Model-Based Definition (MBD) model.

↓ NRE cycle-time

↓ engineering design changes

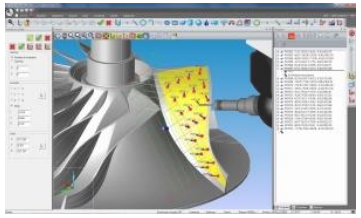
Virtual Product Development

Use of MBD in virtual manufacturing process analysis and simulation to validate production plan, programming and tooling design

↓ product development time

↓ product development cost

↓ mfg planning hours



Model-Based Quality Planning

Computer-Aided Inspection (CAI)/Coordinate Measuring Machine (CMM) programming using Quality Information Framework (QIF) derived from MBD.

↓ CMM programming time

↓ FAI planning and reporting hours

Design for Manufacturing and Assembly (DFMA) with MBD

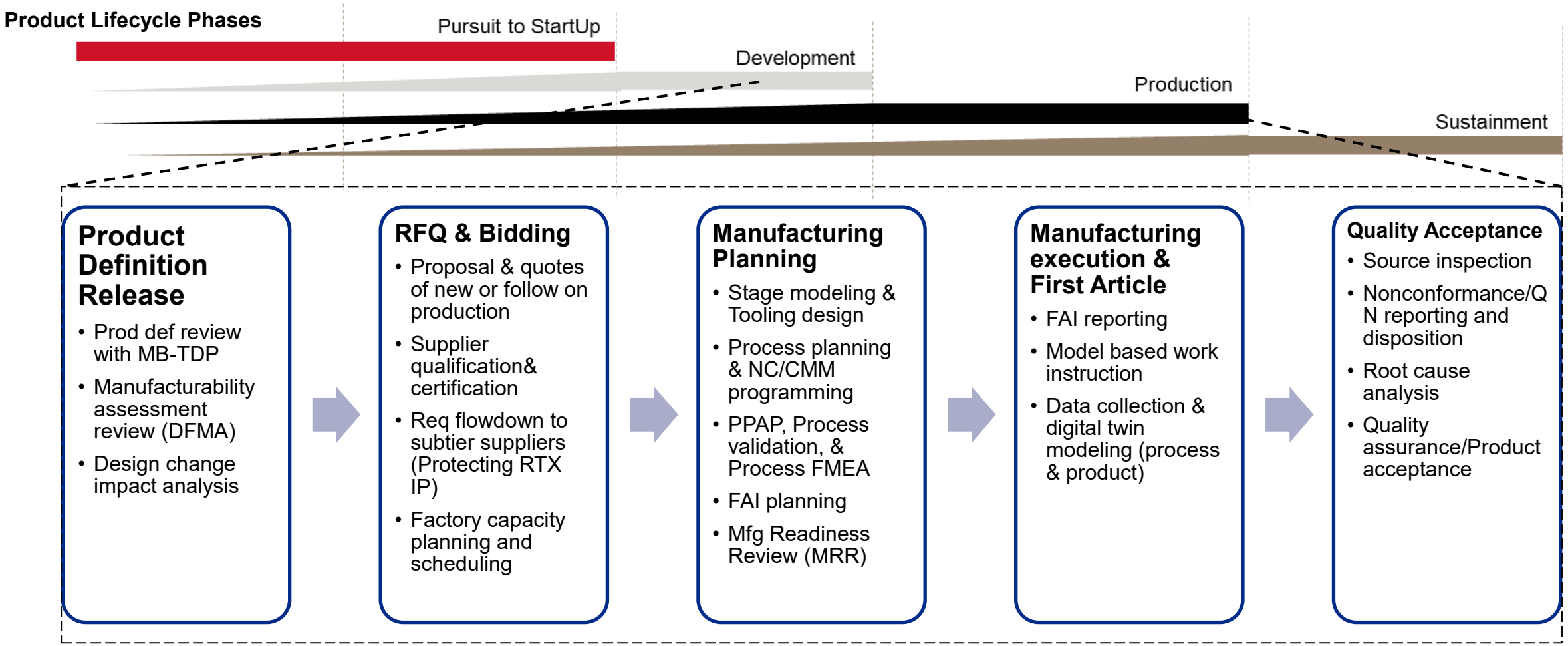
Assess new design for manufacturability against process capability, streamline the assembly process, increase standard part reuse in assembly design.

↓ part number count

↓ product assembly time

↓ part scrap

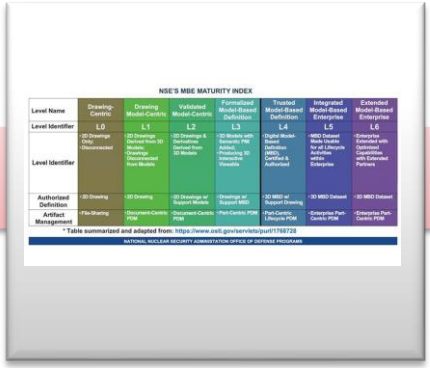
Model-Based Definition, Manufacturing, and Inspection (MB-DMI) Plays



CMM: Coordinate Measuring Machine
DFMA: Design for Mfg & Assembly
FAI: First Article Inspection
FMEA : Failure Mode & Effect Analysis
IP: Intellectual Property
MB-TDP: Model-Based Technical Data Package
MRR: Mfg Readiness Review
NC: Numerical Control
PPAP: Production Part Approval Process
QN: Quality Notice
RFQ: Request for Quote

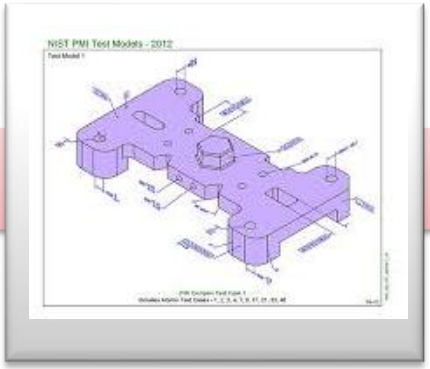
Supplier MBE Maturity Assessment Approach

Supplier self assessment



Questionnaire based on tailored MBE maturity Index criteria, to assess supplier's maturity level, and to identify development needs

Validation Test



Proof the process with a test model to validate supplier's self-assessment result, as a risk reduction prior to pilot runs

Pilot

Review supplier's readiness in each major program milestone (Bid, planning, MRR, first article) on a pathfinder or pilot program

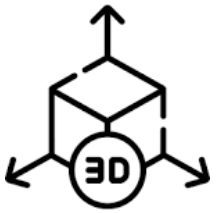
Certify & Monitor Supplier Chain Quality

- Certify suppliers at MBE level X
- Key Performance Indicators (KPIs) to track supplier capability and quality in full scale production

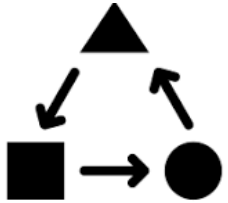
MB-DMI with Pratt & Whitney Suppliers

Guiding Principles with Suppliers

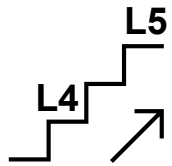
Validated Models



Interoperability



Maturity Progression



Scalable Deployment
- Self-Assessments
- L4 Target
- L5 Goal

Supplier Awareness

- Pilot Activities
  - Simple Parts
  - Complex Parts
  - Multi-Part Approach
- Mentor Protégé Program
- Supplier On-Boardings
  - 1-on-1
  - Webinars

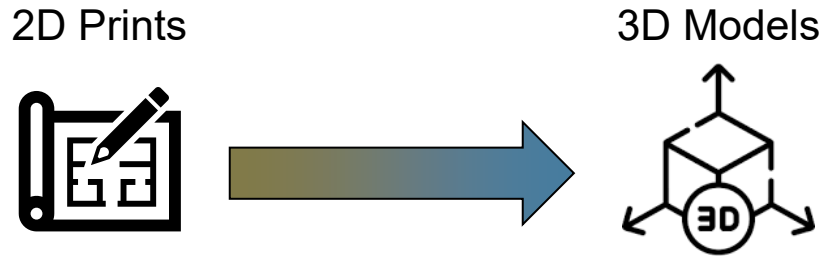
Phased Maturity

- NSE MBE Maturity Index
  - Focus on Manuf. + Quality
  - Added Quoting
- Phased Deployment
  - Focus on Tier 1 Suppliers
  - Establish Fundamentals
- Survey Deployment

Initial Survey Result of Pratt & Whitney Suppliers

Results

- Suppliers can execute MB-DMI Workflows
- Suppliers can transition to 3D Models as the Design Authority
- Mix of MB-DMI experience
  - New vs. Pilots vs. Experienced



Model Based Packages Revolutionize Supplier Capabilities

Key Findings

- Suppliers have more capabilities than they realize
  - Software capabilities continue to advance
- Fundamental Gaps Realized
  - GD&T
  - 2D approach smothered innovation

Survey Deployment

Next Steps with Pratt & Whitney Suppliers

Software Vendors

- Highlight NSE MBE Maturity Index Capability in current software
- Implement Interoperability & Industry Standards

Suppliers

- Develop MBE Maturity Roadmaps
- Execute MB-DMI with Sub-Tiers

OEM's & Design Responsible Suppliers

- Commit to Scaled Deployments
- Don't wait for MB-DMI to become a requirement
- Adopt & Improve Industry advancement
- Drive Interoperability & Industry Standards