MBD Readiness

Enabling the Full MBE Loop for OEMs and the Supply Chain

Frank Popielas, Capvidia

GLOBAL PRODUCT DATA

INTEROPERABILITY

SUMMIT 2025

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

Frank W. Popielas

- COO of Capvidia
- 2016-2025: Managing Partner and Co-founder of SMS_ThinkTank™ focusing on systems modeling and simulation
- Over 20 years at Dana Corporation
  - Global experience in engineering and R&D, IP management, CAE, HPC and systems engineering
  - Created and managed the global Systems Modeling and Simulation Governance for Dana.
- NAFEMS
  - Chair-Elect of the NAFEMS Americas Steering Committee 2024
  - Member of the NAFEMS Americas Steering Committee since 2011
- INCOSE
- Founding chairman of the joint System Modeling and Simulation Working Group (SMSWG) between NAFEMS and INCOSE in 2013 and continues his leading role in the SMSWG as Co-chair since August 2016.
- COE: Chairman of the Analysis and Simulation Division since 2022 & BJ Fries Award of Merit 2024
- Member of the Jinfiniti Precision Medicine Advisory Board September 2020 – September 2022
- Over 35 granted patents globally on the areas of sealing, shielding and fuel cells
- Over 40 publications globally

Agenda

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Capvidia
- Who we are
- What we do

MBD/MBE

QIF Standard

OEMs & Suppliers
- Current Approach
- Current Pain Points
- Proposed Solution

Success Stories

Conclusions


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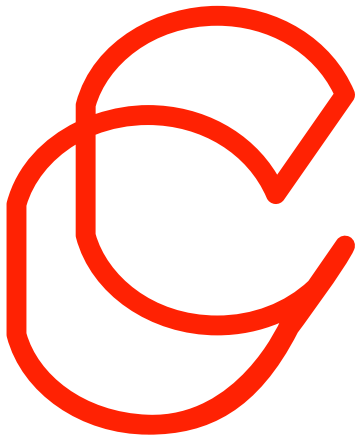
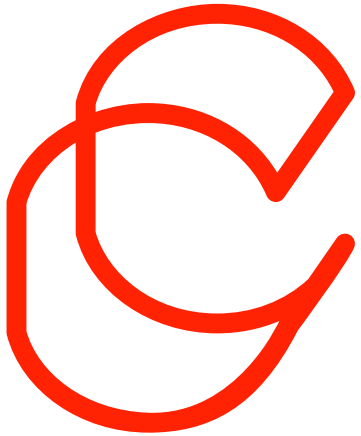


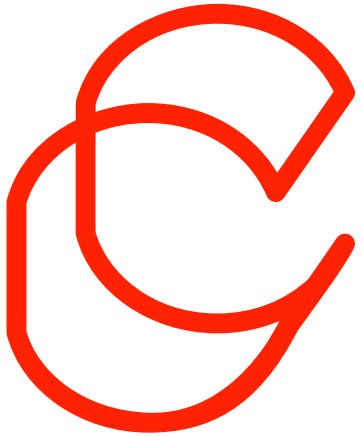
2D to 3D
Transformation



CAP

2D to 3D
Transformation

Capture



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2D to 3D
Transformation

Capture

Knowledge
(in Sanskrit)

CAPVIDIA

30+ years of Expertise

- CAD Translation
- CAD Validation
- MBD Solutions

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Specialists

- Interoperability
- Compliance
- Digital thread enablement

Capvidia 4.0
Holistic Approach

Powering Model-Based
Enterprise Success

Driving Accuracy,
Efficiency & Compliance
in the Digital Thread

Trusted by Industry Leaders

- Aerospace & Defense
- Automotive
- Medical
- Appliance
- Others

MBE

MBD

MBE

Enterprise

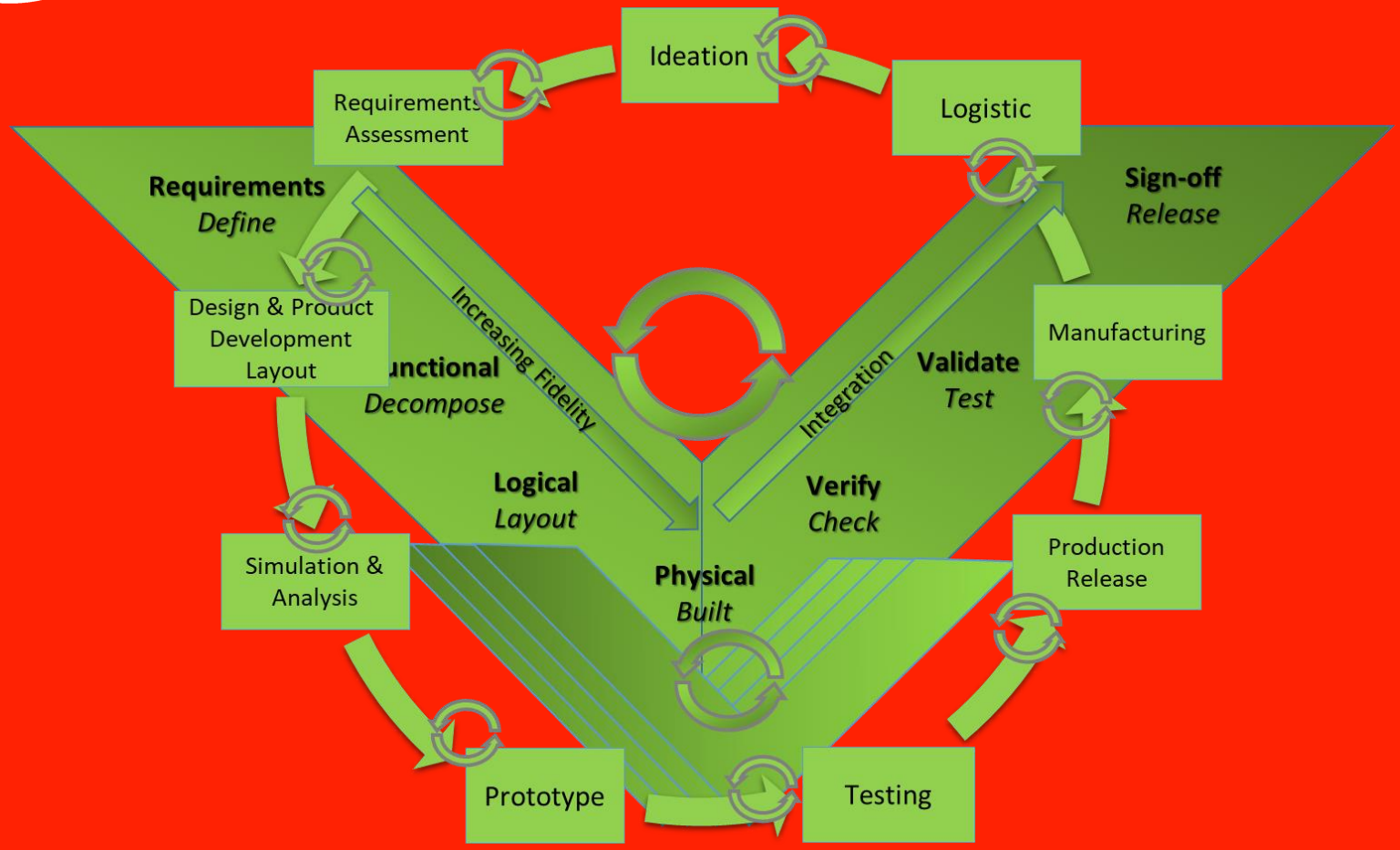
MBE

Enterprise
Engineering

MBSE

System Engineering

MBSE


Ideation
Requirements Assessment
Logistic
Requirements
Define
Sign-off
Release
Design & Product Development Layout
Increasing Fidelity
Manufacturing
unctional
Decompose
Validate
Test
Integration
Logical
Layout
Verify
Check
Simulation & Analysis
Physical
Built
Production Release
Prototype
Testing

MBD

Design

MBD

Design
Definition

Model-Based Definition (MBD)

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Definition — MBD

The practice of using 3D models (such as solid models, 3D PMI and associated metadata) within 3D CAD software to define (provide specifications for) individual components and product assemblies.

The types of information included are geometric dimensioning and tolerancing (GD&T), component level materials, assembly level bills of material, engineering configurations, design intent, etc. *

MBD is

- A foundational element of any Digital Transformation
- An essential part of Model-Based Engineering
- An enabler of a functioning Digital Thread for Model-Based Enterprises (MBE)

MBD — A practical Guide: MBD (Model-Based Definition): 2021 Edition (capvidia.com)

* NAFEMS - Terms & Definitions

MBE is Iterative

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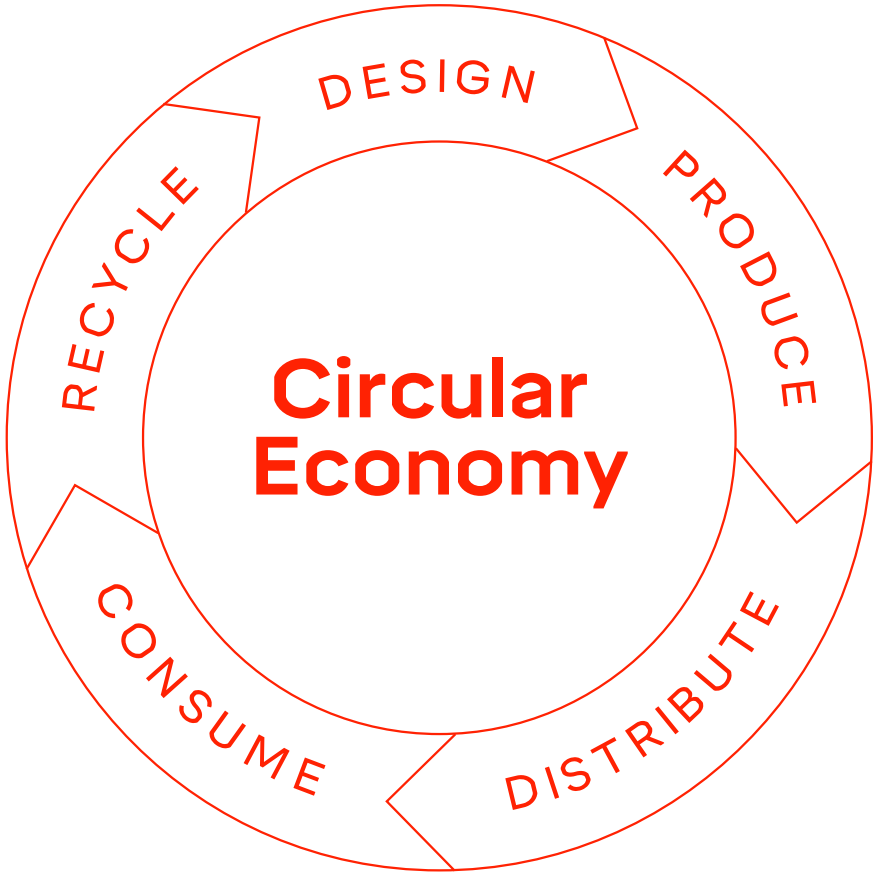

The core MBE tenet is that models are used to drive all aspects of the product lifecycle and that data is created once and reused by all downstream data consumers.

Data reusability requires computer interpretability, where an MBD can be processed directly by downstream applications, and associativity of PMI to specific model features within the MBD.

Current Approach in Industry

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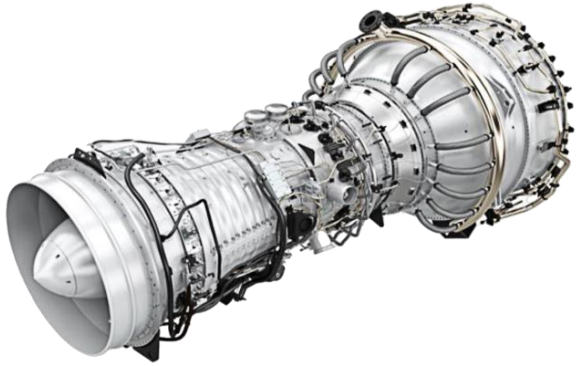
Quote requests & Drawings

OEM



Supplier

Bids & Finished parts

Traditional OEM—Supplier Communication

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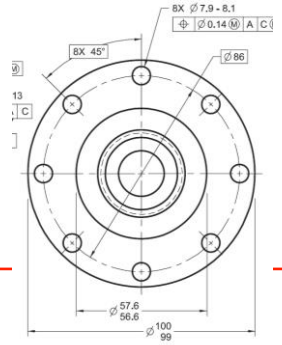
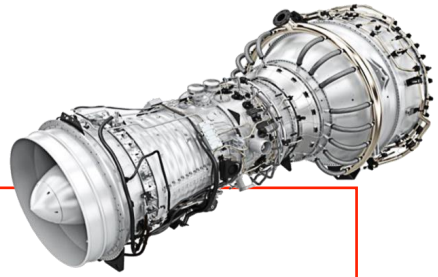
MBDVIDIA
2D/3D Ballooning
Excel FAI
HTML5 visual

.pdf



2D drawing —
human readable

MBDVIDIA
2D Ballooning



OEM

TDP — Technical Data Package:
- Native 3D CAD and STEP file
- PDF 2D drawing
- Other documents, text, images, Excel, etc.
- FAI in Excel format, HTML5 visual

.xls etc

Limited or no
feedback

Supplier

- Visualization and inspection of 3D model
- Reading and ballooning 2D drawings
- CNC programing based on 3D STEP
- FAI generation based on 2D drawing
- Quoting the part (3D model +PMI)
- Saving metrology results
- Analyzing metrology results

The Complexity Issue

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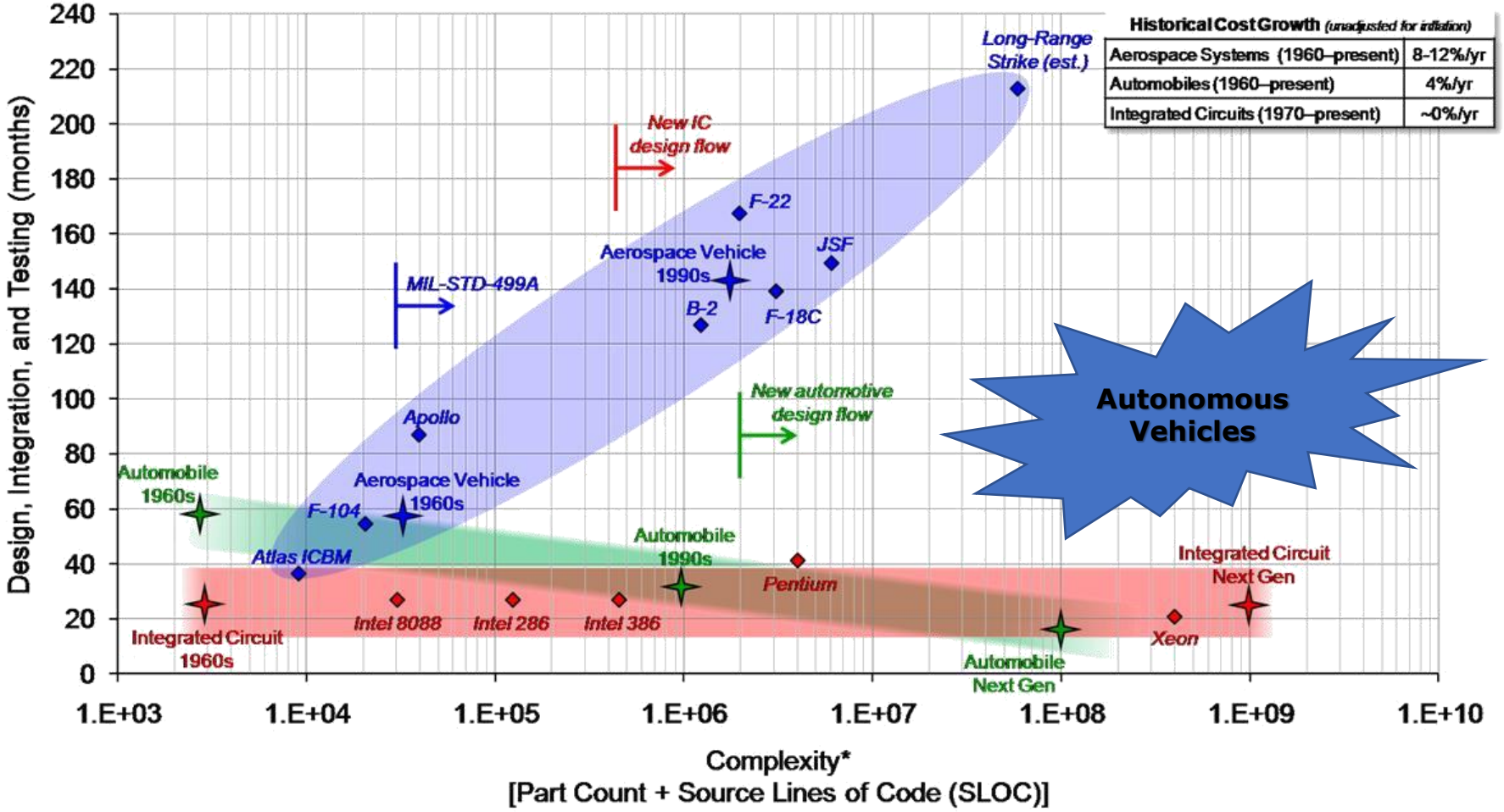

- System complexity increases
- Required time to market decreases (most industries)
- Without disruptive changes, an impossible equation to solve
- The main culprit: (embedded) software complexity

Source: DARPA AVM pres. 2008

Complexity.
Communication.
Control.

ASML Example

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- Cost $380 Million
- Delivery time 1.5 year
- 50.000 unique parts/systems
- 80% parts are outsourced
- 2000 suppliers

Most advanced photolithography scanner
EXE:5000 printing 8nm transistors

Current Pain Points

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Data Incompatibility
CAD data not translating cleanly between OEMs and suppliers

Quality Escapes
Missing or incorrect PMI leading to costly rework

Onboarding Delays
Suppliers struggling to meet MBD compliance quickly

Traceability Gaps
Incomplete digital thread for audits and legal requirements

Why MBD?

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Eliminate 2D drawings
Embed all Product Manufacturing Information (PMI) directly in 3D CAD

Ensure Data Integrity
No loss of design intent through translations

Enable Digital Thread
Seamless flow of validated product data from design to manufacturing

Support Industry Standards
STEP AP242, QIF, ASME Y14.5, ISO 10303

Problems that need to be solved

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Data Incompatibility
CAD data not translating cleanly between OEMs and suppliers

Quality Escapes
Missing or incorrect PMI leading to costly rework

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Suppliers struggling to meet MBD compliance quickly

Traceability Gaps
Incomplete digital thread for audits and legal requirements

Outcomes that Matter

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Automation

Cost Reduction

Traceability

Data Intelligence

QIF

QIF Standard: Main Objectives

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Support Digital Metrology

Replace traditional 2D drawings with machine-readable semantic 3D Model-Based Definition (MBD) models.

- Improve efficiency and accuracy
- Eliminate manual workflows
- Minimize human error

QIF Standard: Main Objectives

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Support Communication with the Supply Chain

Enable transition from 2D drawings to machine-readable 3D MBD models to ensure unambiguous engineering content communication.

- Reducing lead times
- Eliminating unnecessary discussions
- Automating workflows
- Promote interoperability by adopting standardized communication formats, enabling seamless collaboration within the supply chain

QIF Standard

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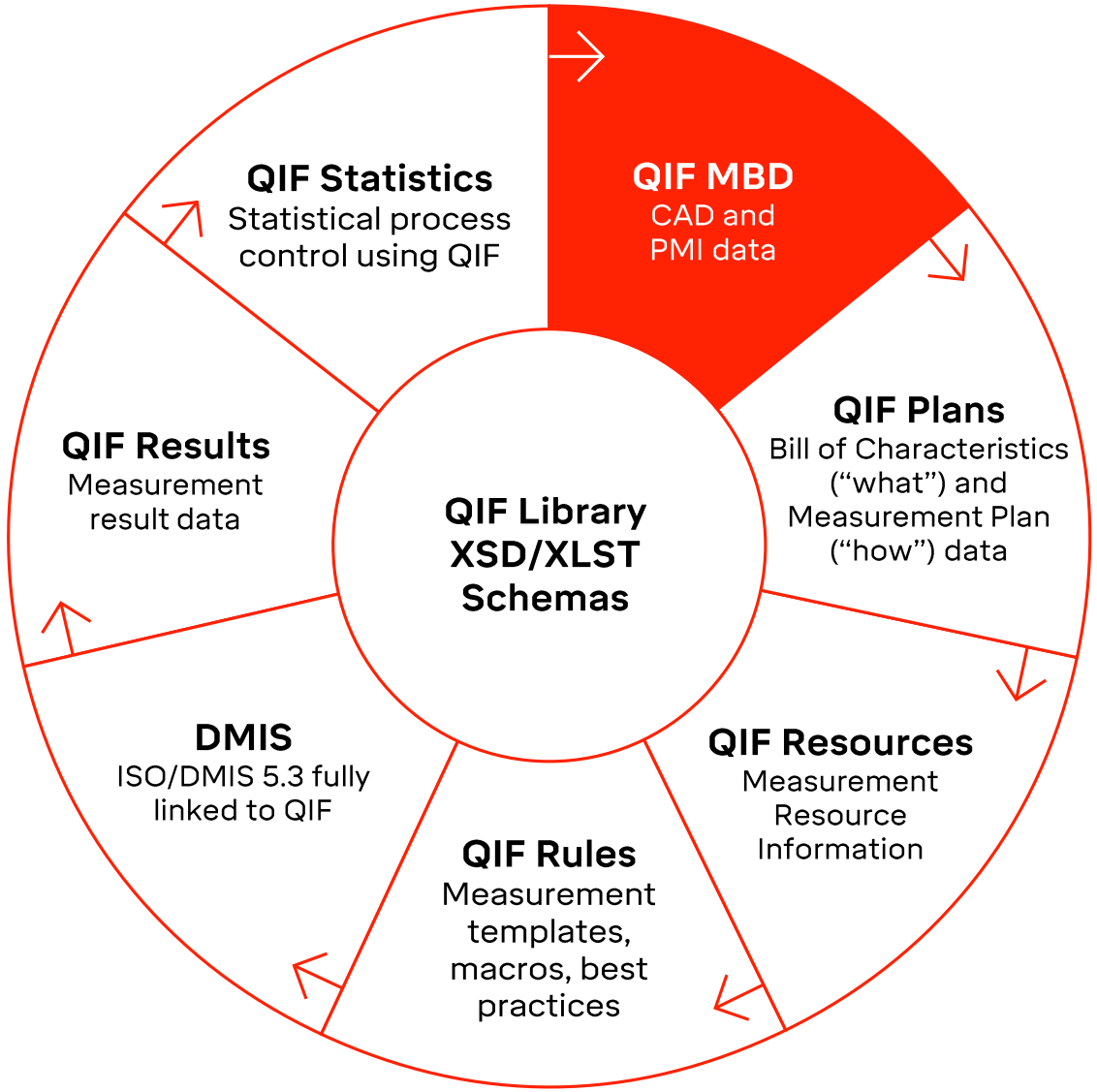
- ANSI & ISO
- Digital metrology
  (3D semantic CAD models)
- Seamless communication
  between OEMs and suppliers



QIF Standard: Main Characteristics

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QIF — Standard

Machine-readable, unambiguously defined engineering content

QIF — MBD data container

Maintaining revision changes outside PLM system

QIF — MBD

Communication Platform

MBD Ready Approach

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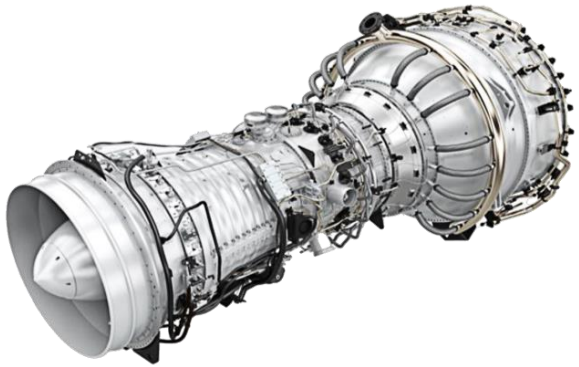
TDP (Technical data Package)

OEM



Supplier

MV CV

MV

QIF (Quality Results/QIF Revisions

MBD Ready based Communication

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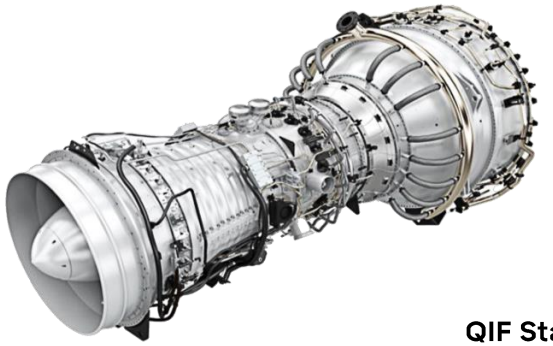
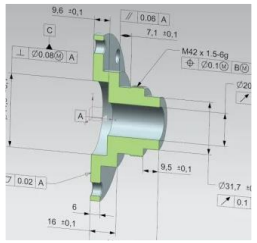
OEM

- Native CAD — QIF conversion
- MBD Ready 3D Model
- Validation of native CAD derivative
- Creation of FAI for metrology

MBD Connect
MBDVidia
CompareVidia



QIF



3D Model — machine readable

QIF

QIF Standard — ISO23952
- Standard CAD Format (ANSI/ISO)
- Data Container (TDP)
- Standard Communication Platform

Full feedback to OEM based on QIF standard

Supplier

- Consuming QIF
- CAD formats visualization (STEP AP242)
- Quoting the part (3D model +PMI)
- CAD translation to MBD ready models
- Documenting revision changes
- Automatic CMM process
- Saving metrology results
- Analyzing metrology results

MBDVidia

Recognized Leader in MBD & QIF

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Aerospace

Reduced supplier onboarding time by 60%

Automotive

Eliminated 95% of PMI-related errors

Defense

Created audit-ready digital thread for 100% of parts

Recognized Leader in MBD & QIF

CAPVIDIA

Proven at Scale

Supporting leading OEMs and hundreds of suppliers worldwide

Unmatched Accuracy

Industry-leading validation engine trusted by top OEMs (Boeing suppliers DPD D6 651991)

Vendor of Choice

Selected as a vendor of choice by Lockheed Martin

Partnering for your Success

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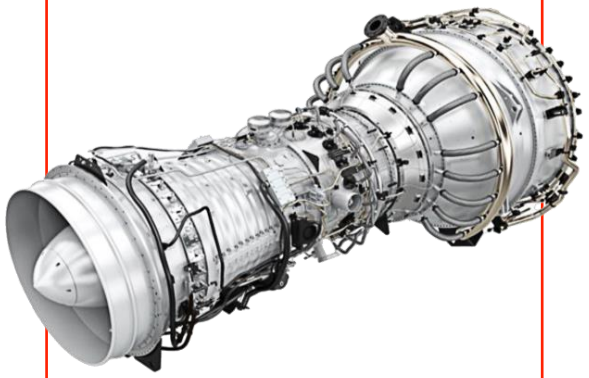
OEM



MBD Gateway

(QIF based)

Communication Platform

OEM-Supplier-OEM

Supplier

Supplier Quality Dashboard

Collecting and Monitoring Quality Control Results

MBD Gateway — Data Exchange Platform (OEM-Supplier-OEM)

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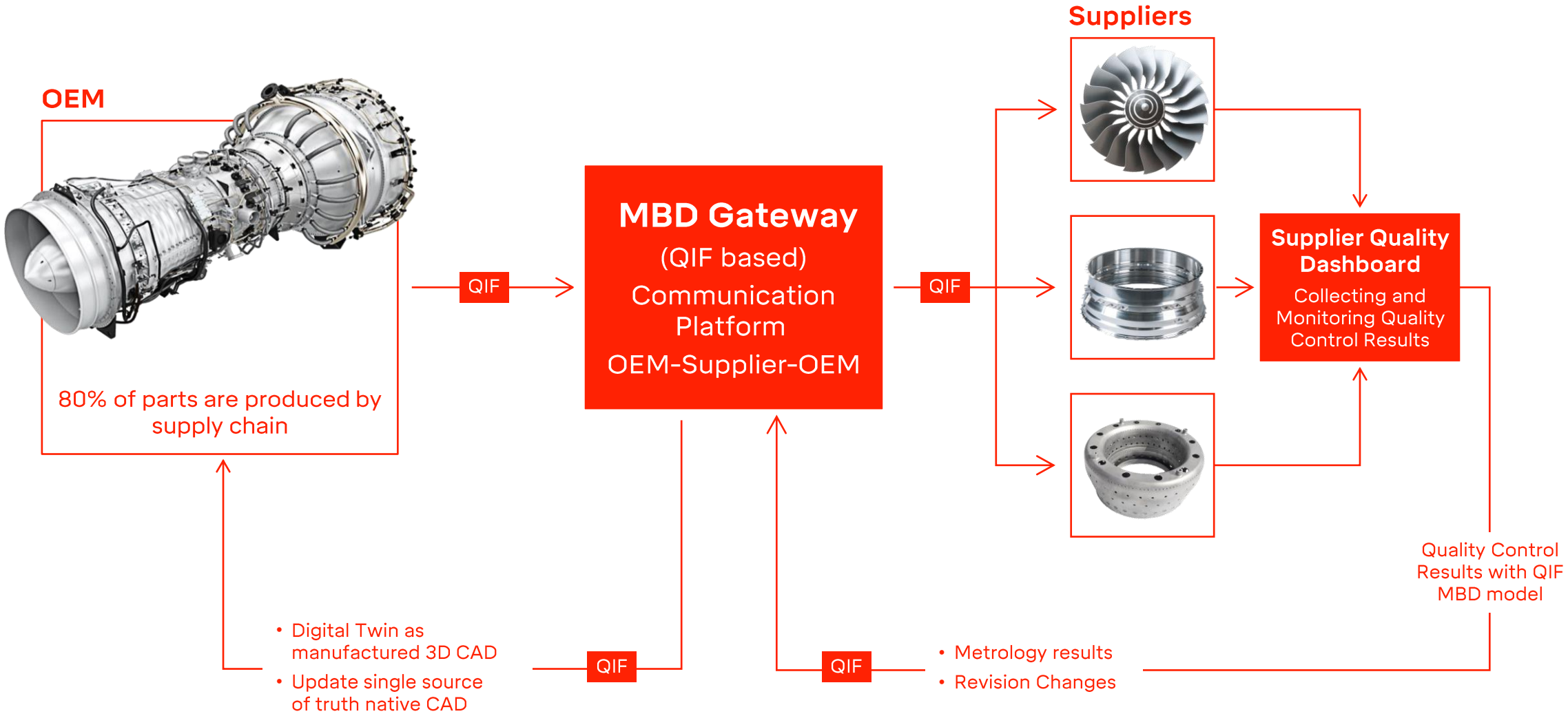

Conclusions: MBD/MBE Benefits

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Automated Workflows

Removed Ambiguity

Improved Accuracy

Less Time to Manufacture

More Time to Innovate

Increased Revenue

Conclusions: MBD/MBE Benefits

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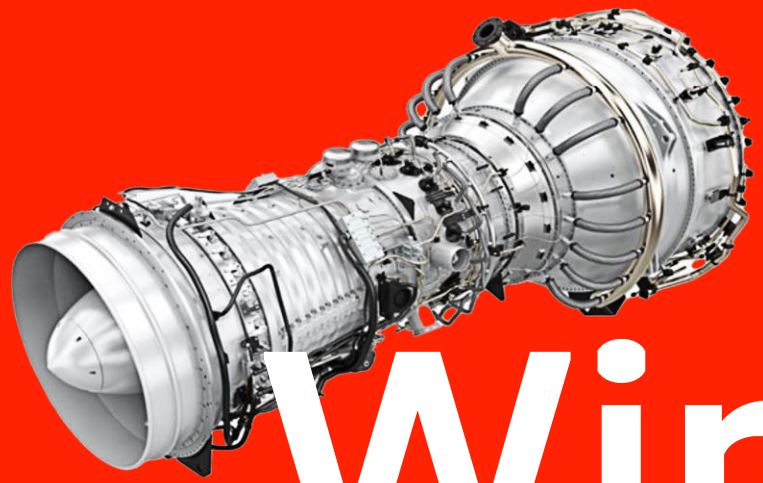

Win

Win

CAPVIDIA

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Lockheed Martin
MBE Playbook