



EXCELERATE '22

NO LIMITS

As pressures mount for better profitability and faster turn-around times, there are FOUR major areas that stand out for significant improvement in Aerospace, Nuclear, Medical and Complex Industrial Equipment Industries.

Top Opportunities:

The Model-Based Enterprise

The Industrial-Internet-of-Things

The “Connected” Supply-Chain

Next-Generation Sustainment

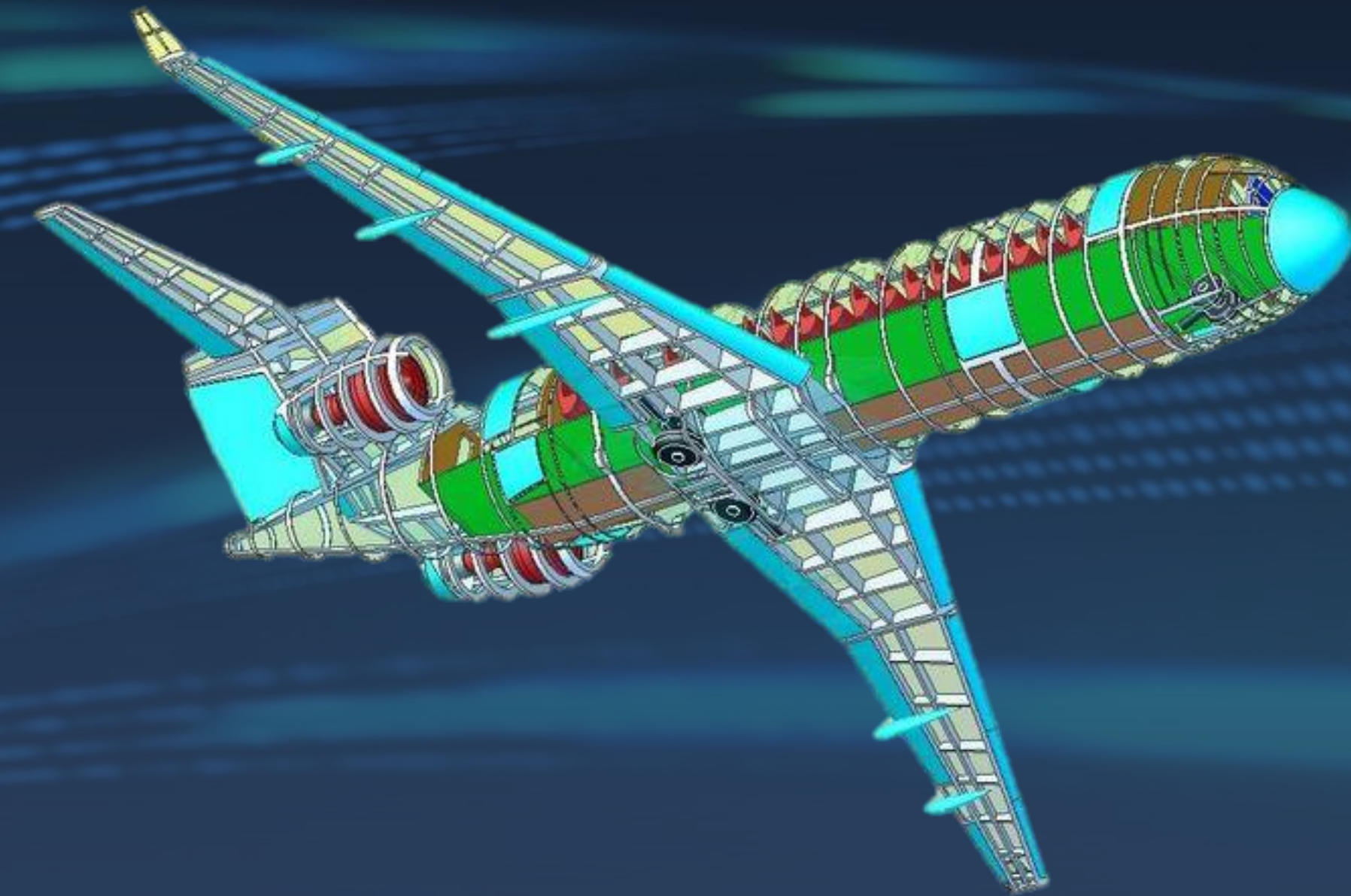
THE MODEL-BASED ENTERPRISE

Leveraging Digital-Continuity BEYOND Design Engineering

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Why is adopting an MBE practice important?

- Quality
- Velocity
- Efficiency



The ABCs of MBE

NO LIMITS

A Small Step Back...

Do you remember anyone telling you?

“ I can do it FAST. I can do it WELL. And I can do it CHEAP.”

PLEASE PICK TWO!

How do we get ALL THREE?



- **Quality:** Building it RIGHT the first time (Includes Suppliers!)
- **Velocity:** Cutting Idle-Time by 50% (then doing it again)
- **Efficiency:** Spending ONLY what needs to be spent (Eliminate Waste)

1. Design it RIGHT
2. Maintain CONTINUITY to design and configuration
3. Add to Design Data without EVER breaking continuity
4. Evolve Design/Process efficiently

NO LIMITS

3 Percent!

That's how much of a A&D Manufacturer's REVENUE gets consumed by the lack of Digital Continuity

Why are Executives rarely seen getting excited about wasting >3 percent of revenue?

- Those dollars are rarely reported as waste.
- The more profitable a manufacturer is, the less it realizes that money is being wasted.
- Entire management practices and methods characterize these activities as Costs (The Cost of Doing Business)
- What we often hear early in the discovery:
 - “This is what it costs to Design, Plan and Execute at our company”
 - “We are world-class leaders in quality and efficiency for our industry”

Model-Based-Enterprise Terms

- **The Digital Twin (All Type-Variants)**
 - Multi-Unit, Multi Variant Master Definition of Models, BOMs, Processes, Machine Software and Flight Software, Etc.
- **The Digital Twin (Unit)**
 - A complete Digital Definition (see above) for a single, targeted Unit
- **The Cyber Asset (Delivered Unit)**
 - The Actual, As-Built Digital data including Multi-Tier Supplier Data with Defects, Waivers, ECOs, Dim & Test Results, Signatures, FRACAS and CAR Reports, Open Issues (Squawks). Certificates

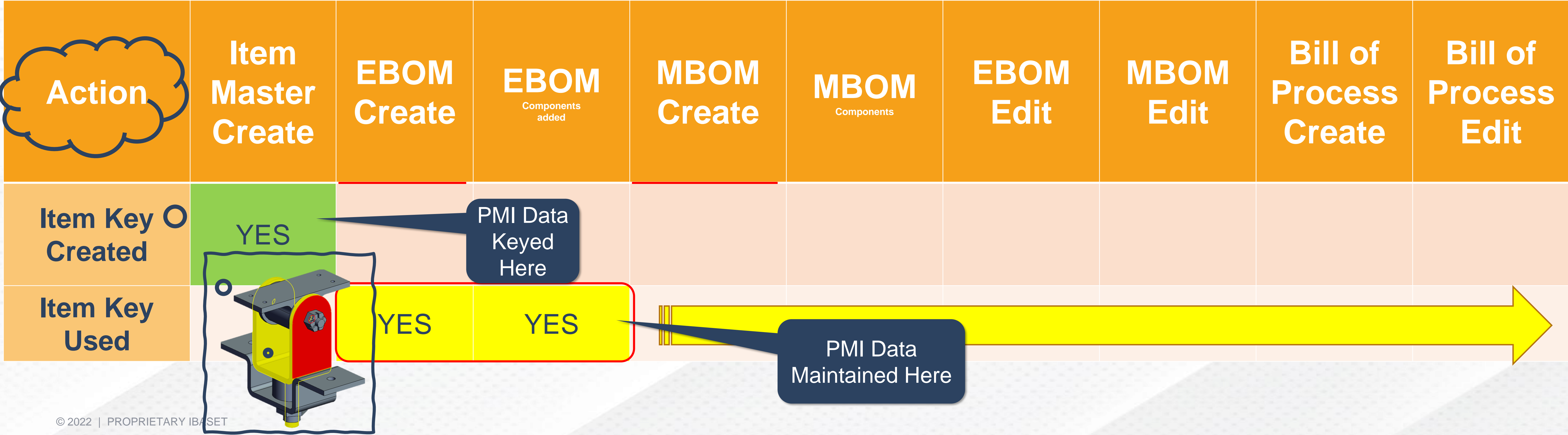
What Happens after Units Hit the Field?

■ The Cyber Asset Data Grows

- Operational Data (Run/Flight Hours, Cycles, Days)
- Removals (Planned and Non-Planned)
- Installations (Planned and Non-Planned)
- Time-Mandated Inspections
- Test Results
- Certificates
- For Lower-Level Modules and components, the same data elements are affected and recorded
- Squawks
- Repairs

ALL THIS IS ADDED TO THE CYBER ASSET!

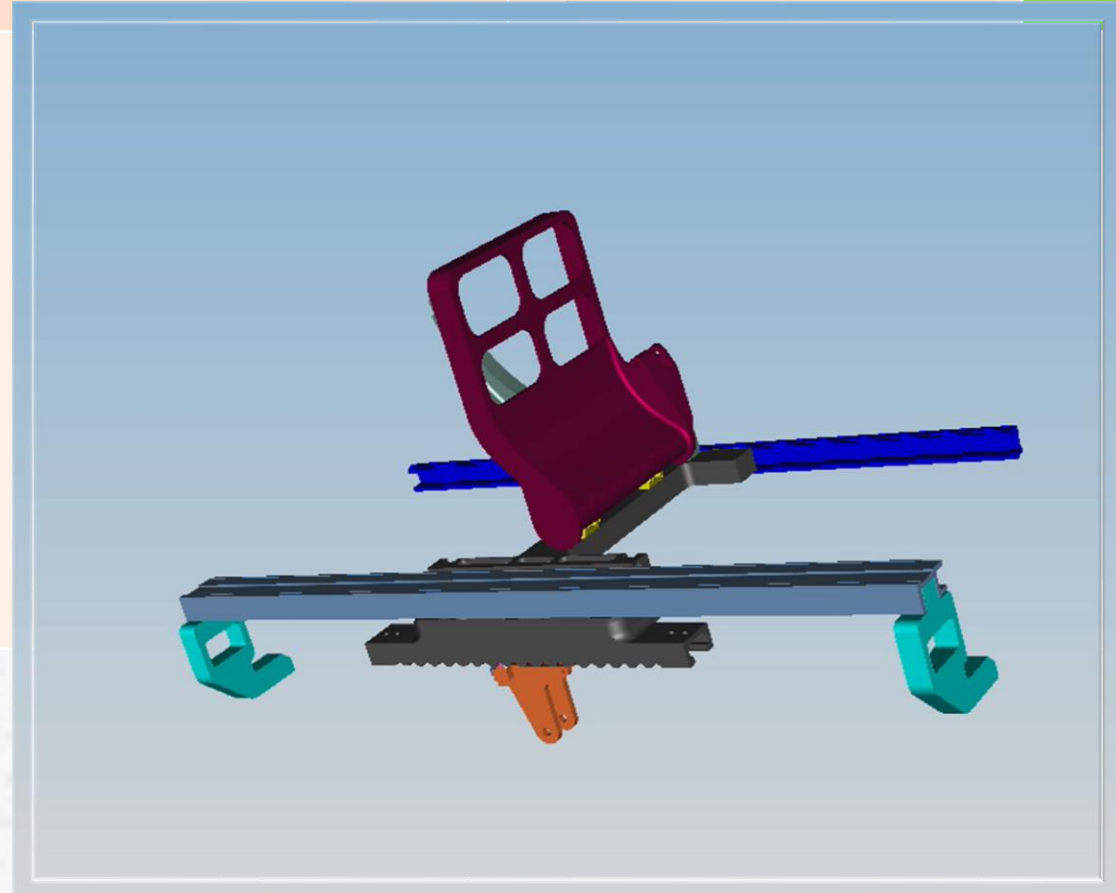
The Digital Thread Critical-Data-Trace (Part 1)



The Digital Thread Critical-Data-Trace (Part 2)



Action	Item Master Create	EBOM Create	EBOM Components added	MBOM Create	MBOM Components	EBOM Edit	MBOM Edit	Bill of Process Create	Bill of Process Edit
Occurrence Number (ID) Created			YES						
Occurrence Number Used				YES	YES	YES	YES	YES	YES



BOMs
 Routings
 Defects
 As-Built
 ALL Keyed Here

What Is The Key To This Digital Thread Link? The Occurrence ID!

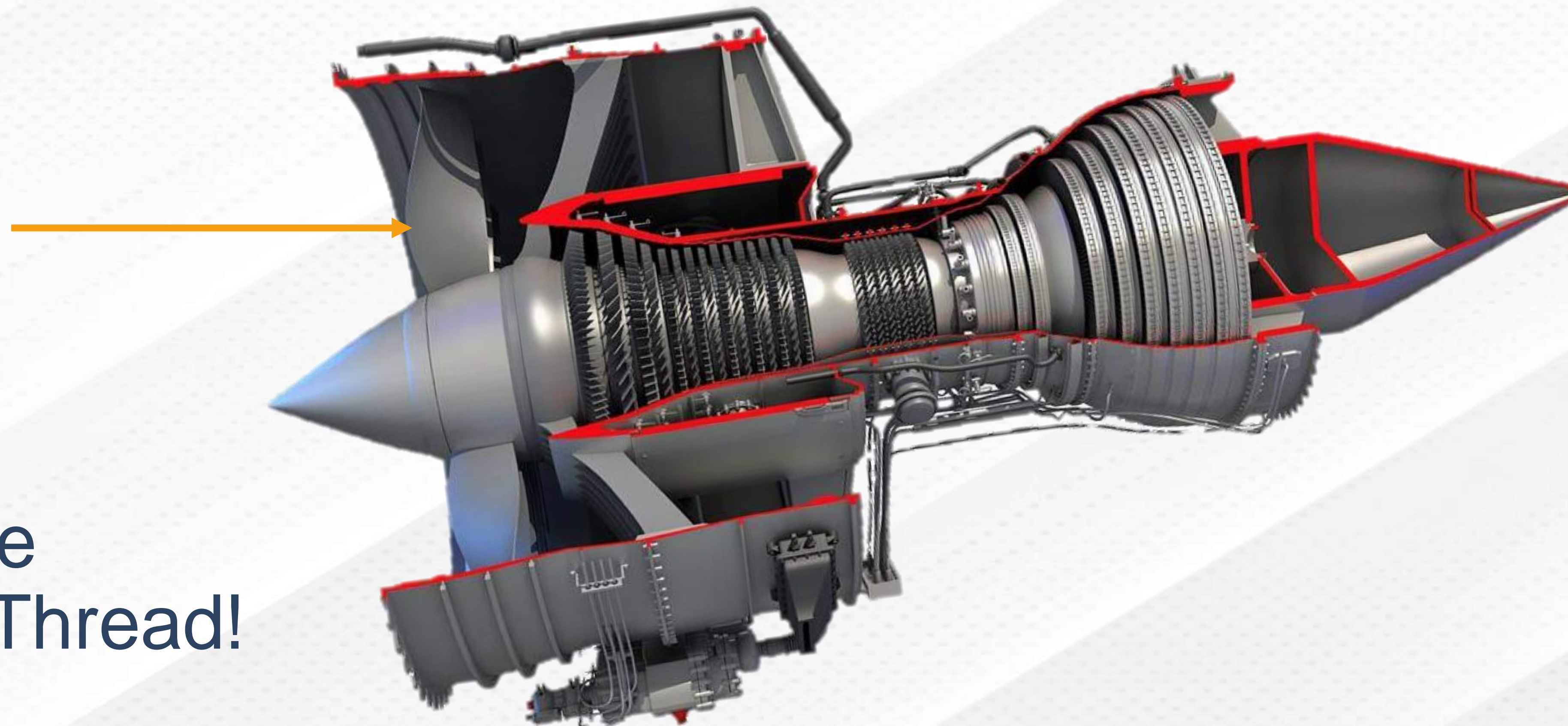


THE
OCCURRENCE ID!

de7a8e65-ff17-447a-8b33-7a27e4f37bac

We fetch and store it for
every single item listed in a
Bill of Material

The Occurrence ID is the
backbone of the Digital Thread!



What Does A Digital Thread Compliant BOM Look Like?

<u>PART NUMBER</u>	<u>REV</u>	<u>BOM LINECAD ID</u>	<u>...</u>
4545-24313-1	F 001	de7a8e65-ff17-447a-8b33-7a27e4f37bac	
4545-24313-1	F 001	84365289-16c9-4621-bb20-346ffd81bd82	

What Does A Non-Digital Thread Compliant BOM Look Like?

<u>PART NUMBER</u>	<u>REV</u>	<u>QTY</u>	<u>BOM LINE...</u>
4545-24313-1	F	2	001

What's Changing in Defense Acquisition Requirements



- Many new Programs now have Contract Elements that refer specifically to the delivery of a Digital or **Cyber Asset** that COMPLETELY describes the Model-Based As-Designed, the reconciled As-Built (with necessary waivers) and the Quality history (including test results) of the asset.
- Gone are the days where delivering functioning hardware was the **only** trigger for payment.
- These Digital artifacts need to be created and validated in real-time as each vendor produces their sub-assemblies and as each facility performs the final integration.
- Within 5-7 years, we believe that All Major Programs will have Digital Twin (Cyber Asset) requirements that make-up a tangible portion of the payment and Acceptance trigger.

Classifying Your Level of Digital Thread Adoption by Program



- F** — 2D Drawings, Paper Work Instructions, Manually-generated Visuals, Separate Data Collection Sheets, Separate Inspection Sheets, Receiving Inspection, Paper QA System, Paper As-Built Documentation.
- E** — 2D Drawings, **Paper on Glass** Instructions, Manually-generated Visuals, Separate Data Collection Sheets, Separate Inspection Sheets, Receiving Inspection, Paper QA System, Paper As-Built Documentation.
- D** — **3D Model Drawings**, **Paperless Instructions**, Manually generated Visuals, Separate Data Collection sheets, Separate Inspection Sheets, Receiving Inspection, **Electronic QA System**, Paper As-Built Documentation.
- C** — **3D Model Views**, Paperless Instructions, **3D-Derived Visuals**, **Integrated Data Collections**, **Integrated Control Plans**, **Supplier Source Inspection**, **Integrated QA System**, **Integrated As-Built Documentation**
- B** — **3D Model Views**, **3D Bills of Resources**, Paperless Instructions, **3D-Derived Visuals**, Integrated Control Plan, **Integrated Sampling**, Source Inspection, Integrated QA System, Integrated As-Built Documentation.
- A** — **3D Model Views**, **3D Bills of Resources & Bills of Process**, **Integrated Execution**, **Shop Quality**, **Supplier Source Inspection**, **As-Built Data** and **Process Capability Data** (Heat Maps) returned to PLM System.

The 4 Incremental Steps (Stages) to Getting on the Digital Thread for a Program

■ MBE Stage 1

- Item Master and Default 3D Visuals
- Engineering Bills of Materials with Occurrence ID Links

■ MBE Stage 2

- Electronic Engineering Changes Keyed to CAD ID
- All Data Collections linked to Occurrence ID & Characteristic ID

■ MBE Stage 3

- Supply Chain Receiving DT Compliant Requirements & Returning data Electronically
- E-BOM to MBOM Management in Model Based Space
- Enhanced Engineering Changes to include FULL Bill-of-Resources (BOR)

■ MBE Stage 4

- Process Management leveraging Model-Based Views for Visuals Creation.
- 3D-PMI-Data feeds the Control Plans (Drawings are eliminated)






What is the Opportunity?

Where the dollars are going (an example)?

Elements	Baseline \$	Consumed each year by a lack of Digital Continuity \$
Annual Revenue	1.2 Billion	36 Million (3%)
Engineering Change Costs	24 Million	6 Million
Cost of Managing MBOMs	4 Million	2 Million
Cost of Managing Visuals	6 Million	5 Million
Cost of Updating Control Plans	4 Million	2 Million
Cost of Poor Quality	105 Million	21 Million



What will Solumina
do for you?

Solumina is Prioritizing 2 MBE Capabilities

■ **Intelligent Solid-model Views**

- Auto-generated from Models and BOMs for EVERY Op/Step
- Shows what has been Completed
- HIGHLIGHTS what to Install NEXT
- Identifies SHORTAGES and DEFECTS right on the 3D View

■ **Automated Engineering Change Incorporation**

- Links Part and Document Changes to Instructions & Orders
- AUTO-updates Process Plans, Supplier Inspection Plans and Work Orders where no rework is required.



Intelligent 3D View Proof of Concept

Work Order: CAL0000887, Operation: 010, Order Qty: 1

Part: ASSEMBLY2, Rev: A, Unit: S1

Parts Needed:

- BRACKET DWG 1 - 10 Qty: 1/1
- U SUPPORT DWG1 - 9 Qty: 0/1
- BUSHING - 7 Qty: 0/1
- WASHER - 3 Qty: 0/1
- CASTLE NUT - 4 Qty: 0/1
- HERAGONAL BOLT - 5 Qty: 0/1
- PIVOT DWG1 - 8 Qty: 1/1
- SELF LOCKING NUT ... Qty: 0/1

Buy-Offs and Certifications Needed: MFG

3D Model Callouts:

- All Elements Cross-Linked (pointing to the yellow castle nut)
- All Elements Cross-Linked (pointing to the entire assembly)

Next Part: Yellow

Model Tree:

- assembly
- assembly
- SELF LOCKING NUT; reset MODEL
- body
- WASHER; reset MODEL
- body
- CASTLE NUT; reset MODEL
- body
- HERAGONAL BOLT; reset MODEL
- body
- BUSHING; reset MODEL
- body
- BUSHING; reset MODEL
- body
- PIVOT DWG1; reset MODEL
- body
- U SUPPORT DWG1; reset MODEL
- body
- BRACKET DWG 1; reset MODEL
- body

Part Details:

- BUSHING - 6
- BUSHING - 7
- CASTLE NUT - 4
- HERAGONAL BOLT - 5
- SELF LOCKING NUT - 2

Key Takeaways

- 3% of Revenue is at Stake
- Quality, Velocity, Efficiency Can Co-exist!
- Involves Process Change from Engineering to Supply Chain and Operations
- The Customer Will Demand It

NO LIMITS

Looking for more information?

**Talk to our Knowledge Services Team
about MBE material and seminars.**



THANK YOU

QUESTIONS?