

# Lockheed Martin Digital Transformation and Advanced Manufacturing

## ATEC Conference 2022

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Lockheed Martin Aeronautics



# LOCKHEED MARTIN BUSINESS AREAS



## Aeronautics

- Tactical Fighters
- Tactical /Strategic Airlift
- Advanced Development
- Sustainment Operations



## Missiles and Fire Control

- Air and Missile Defense
- Tactical Missiles
- Fire Control
- Combat Maneuver Systems
- Energy



## Rotary and Mission Systems

- Maritime Solutions, Radar and Surveillance Systems
- Cyber & Electronic Warfare
- Aviation Systems and Rotorcraft (Sikorsky)
- Training and Logistics Solutions



## Space

- Surveillance and Navigation
- Global Communications
- Human and Deep Space Exploration
- Strategic and Defensive Systems

# PEOPLE

**110,000**  
Employees



**58,000**  
Scientists and  
Engineers



**395+**  
Facilities  
Worldwide



Operating  
in over  
**54**  
Countries with  
**7,800**  
Employees





# LOCKHEED MARTIN AERONAUTICS

- 28,000+ employees
- Ten locations
- Global partnerships





# AERONAUTICS PRODUCTION LINES

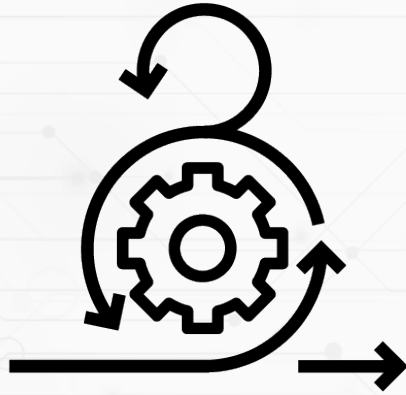


# DIGITAL TRANSFORMATION – WHY?



## Speed

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



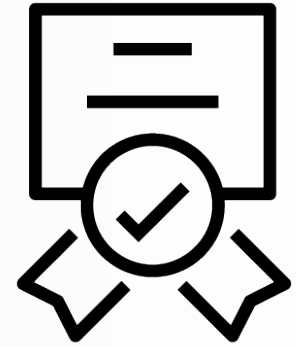
## Agility

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



## Insights

Build a data-driven enterprise that collects, integrates and analyzes information for strategic advantage



## Competitiveness

Drive efficiency and customer mission value through innovation, competitive pricing and streamlined processes

*Not just engineering and operations – every function is crucial to our transformation*



# DIGITAL TRANSFORMATION GOALS



**Reduced product development span/cost as well as T1 and floor support costs**



**Discriminating materials, manufacturing, and sustainment capabilities.**



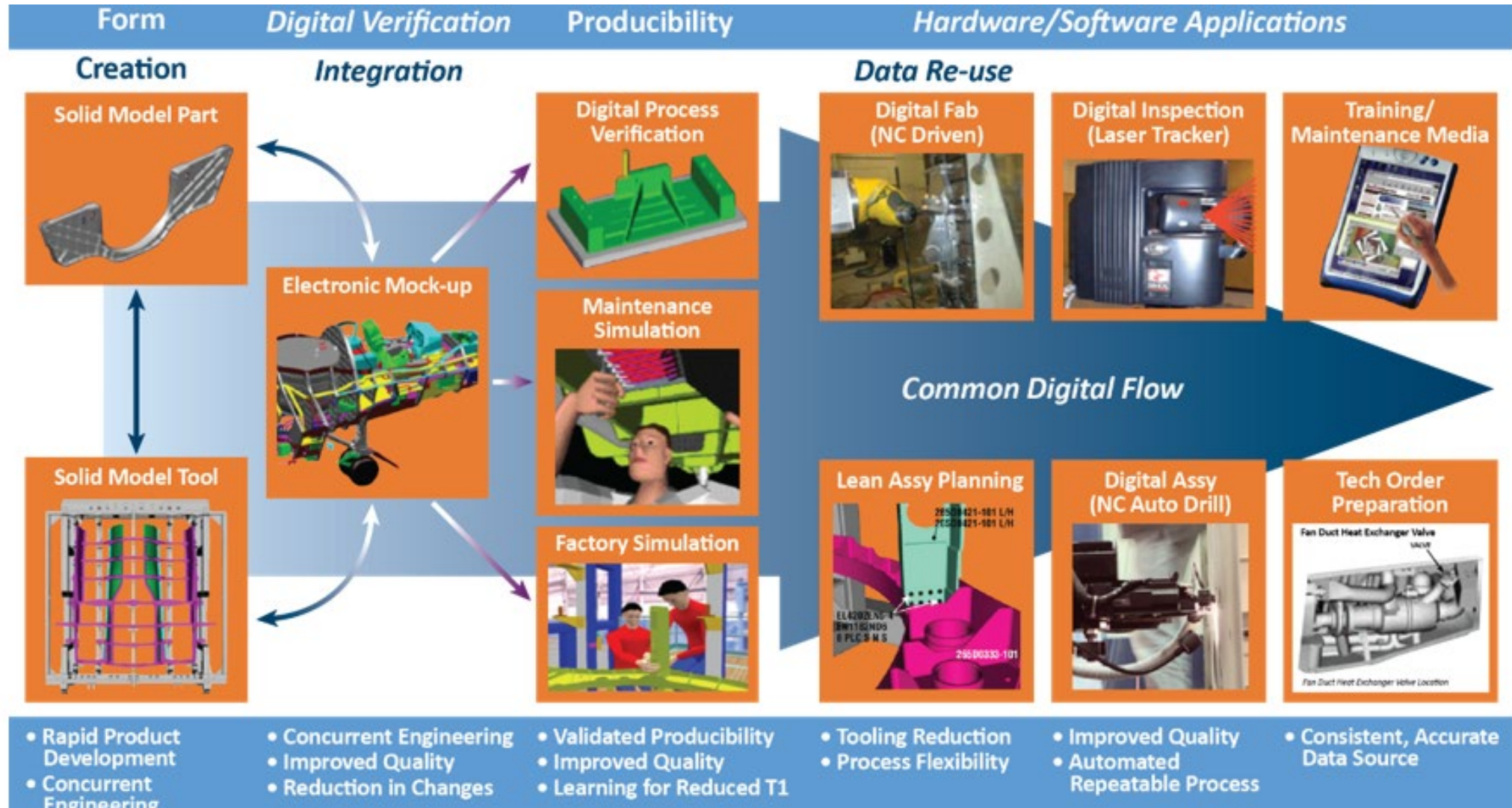
**Automated enterprise data collection and management with AI/ML enhanced visibility and productivity.**



**A robust supply chain and efficient materials flow for Production and Sustainment**

***Delivering Customer Capability – Affordability With Speed***

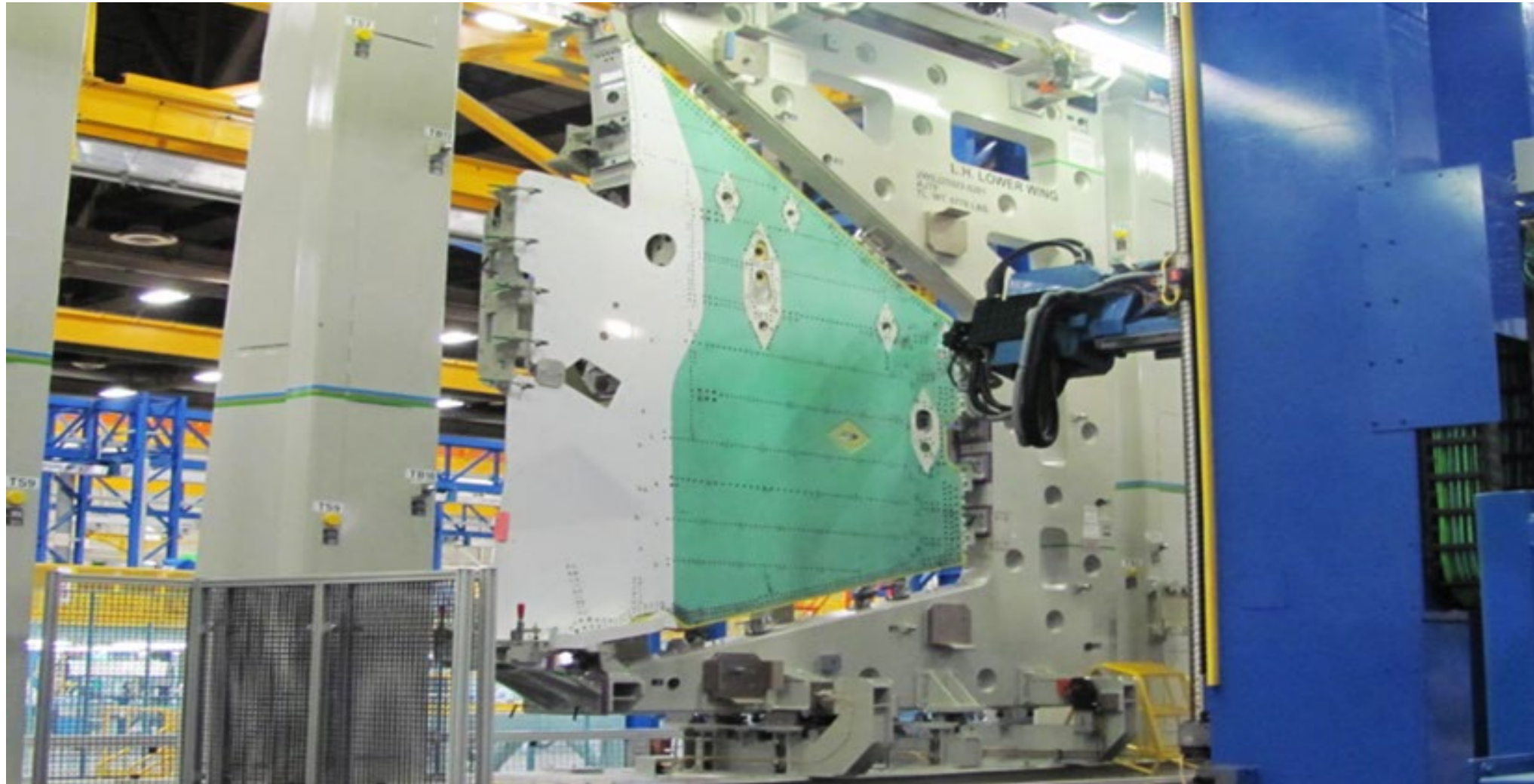
# THE DIGITAL THREAD (AKA MBE)





# ADVANCED MANUFACTURING WITH THE DIGITAL THREAD

# AUTO-DRILLING





# ROBOTIC COATINGS APPLICATIONS

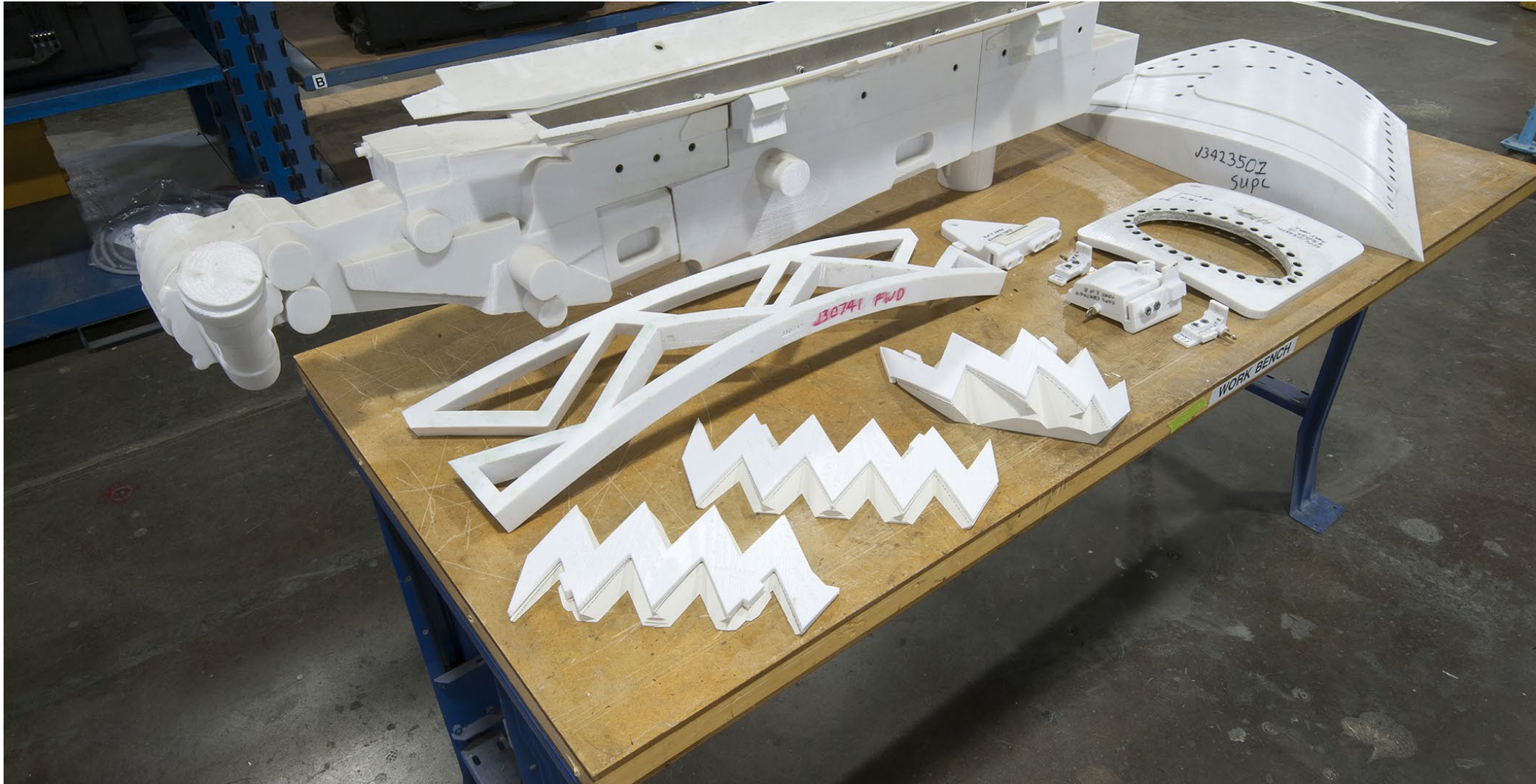


## Aircraft Final Finishes (AFF)

*In the AFF, robots are used for the application of stealth coatings to completed aircraft. Only automation can cost effectively control the process to the required engineering tolerances.*

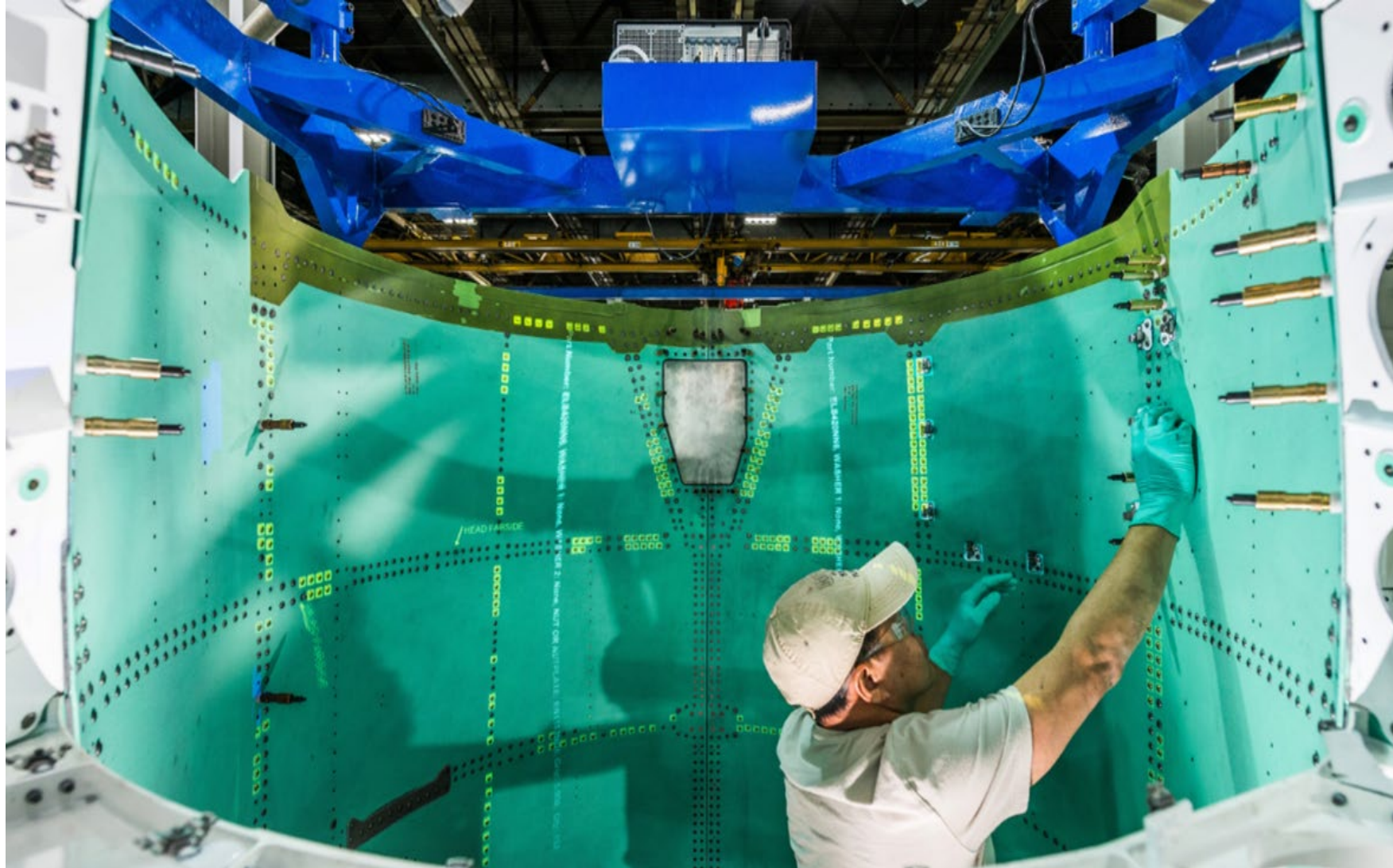


# 3D PRINTED TOOLING





# OPTICAL PROJECTION OF WORK INSTRUCTIONS





# NON-CONTACT METROLOGY – TYING THE KNOT IN THE DIGITAL THREAD

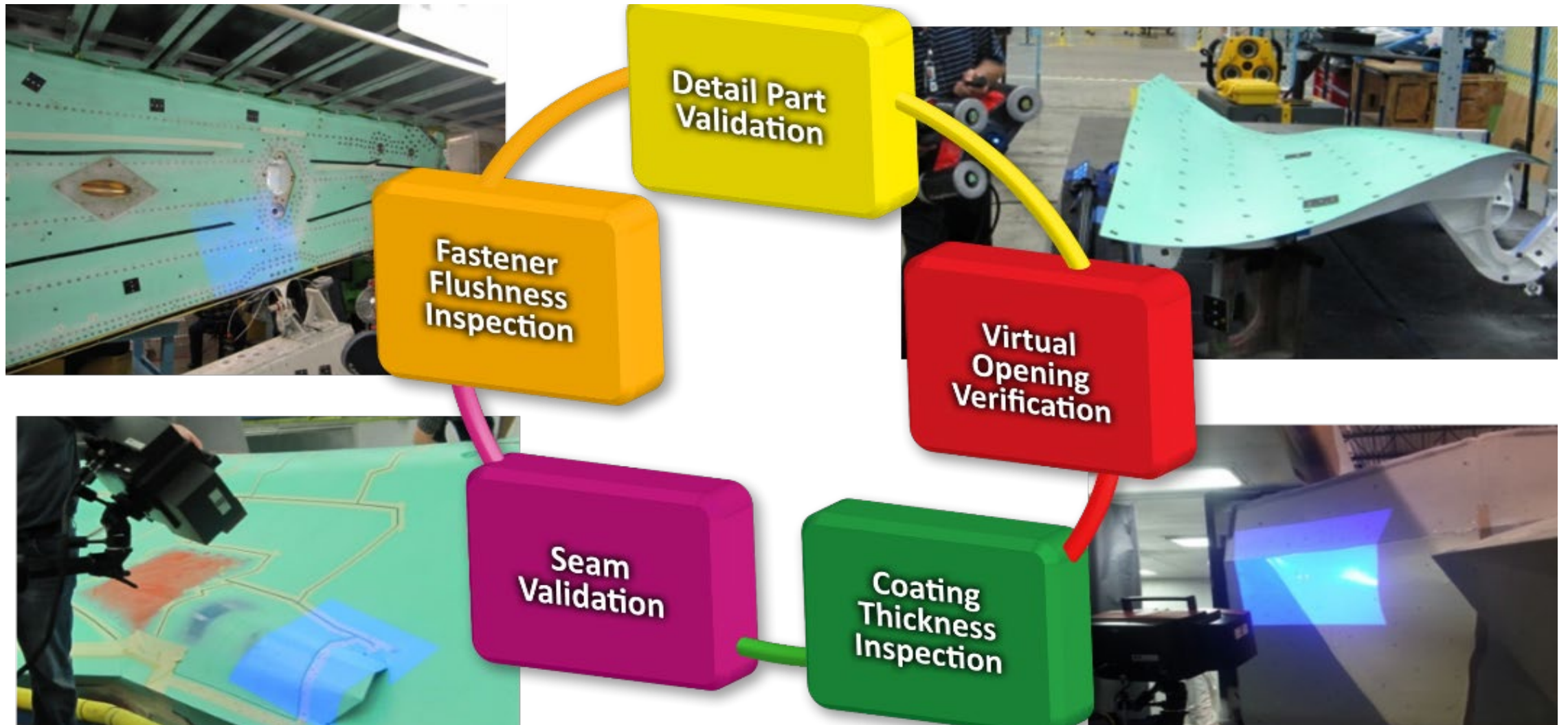


## Non-Contact Metrology

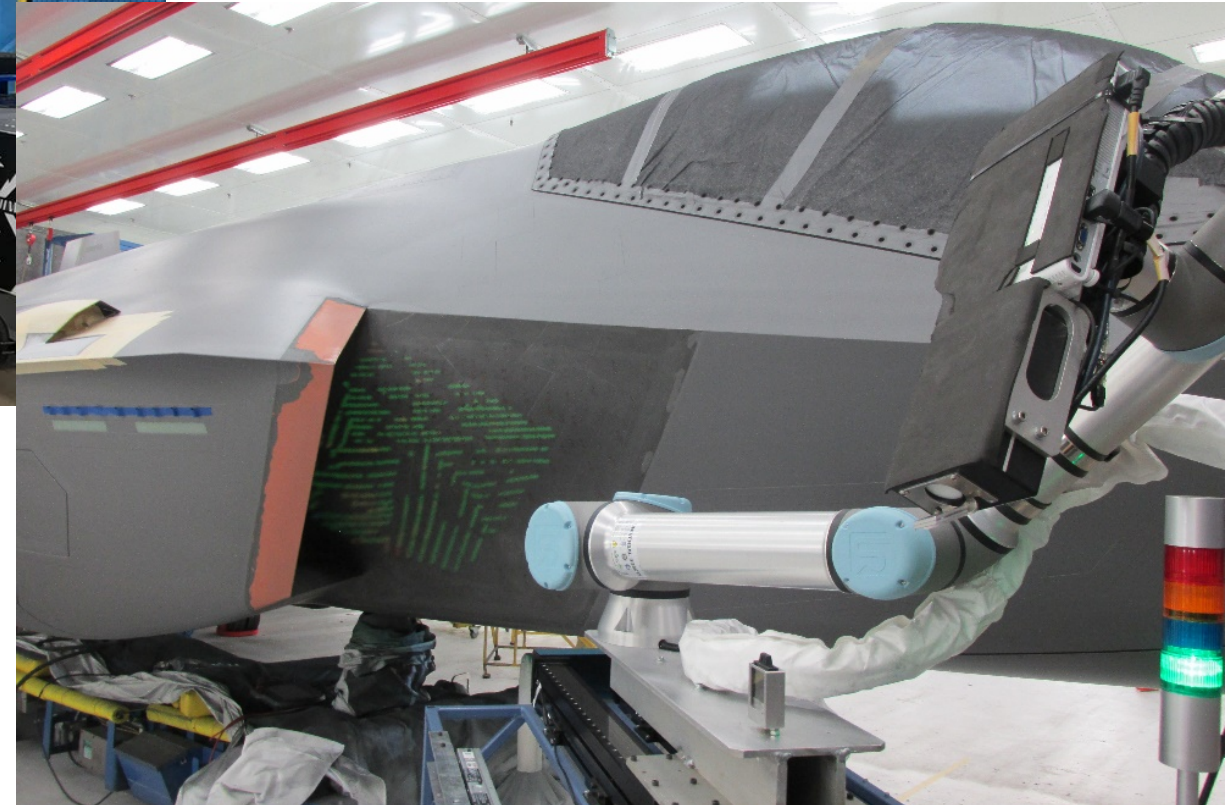
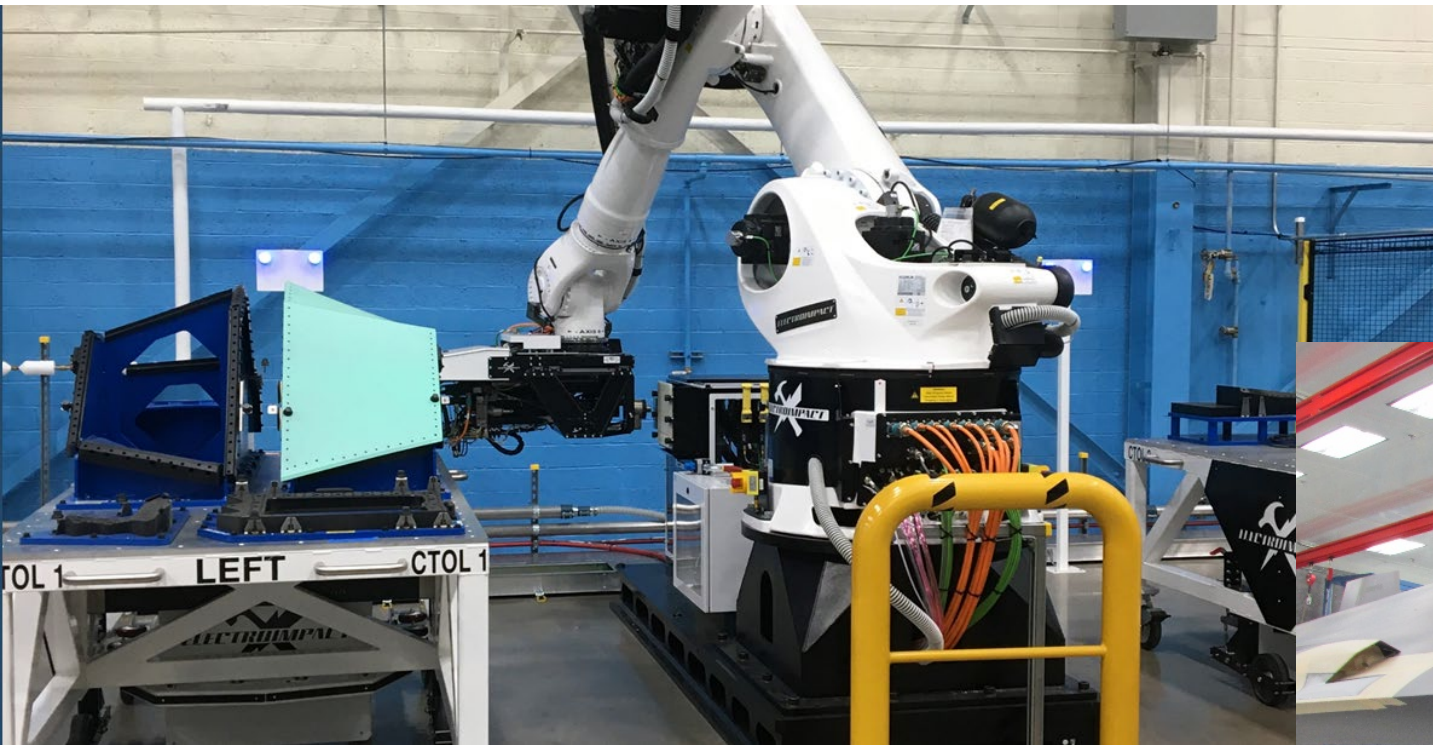
Non-contact Metrology systems use structured light to measure the "as-built" configuration of the part or assembly. These images can then be directly compared to the engineering 3D model for validation.



# AS-DESIGNED TO AS-BUILT VALIDATION



# RECENT ADDITIONS TO ADVANCED MANUFACTURING



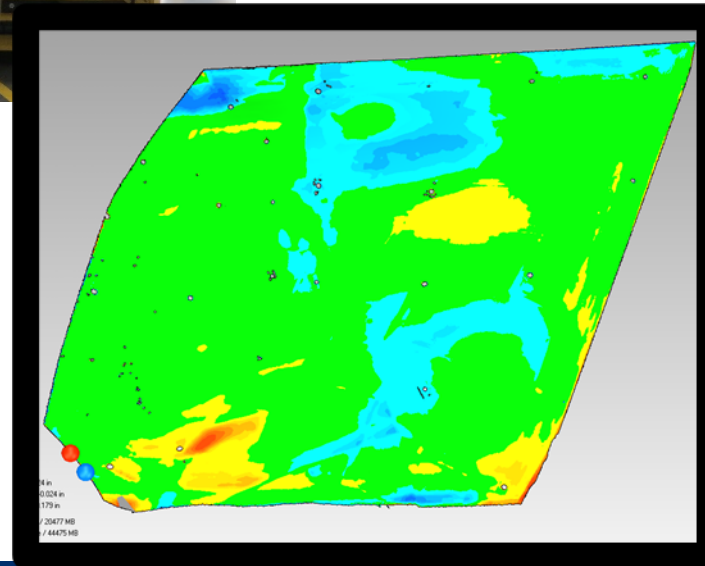


# MOBILE AUTOMATION - MOLD IN PLACE ROBOTS



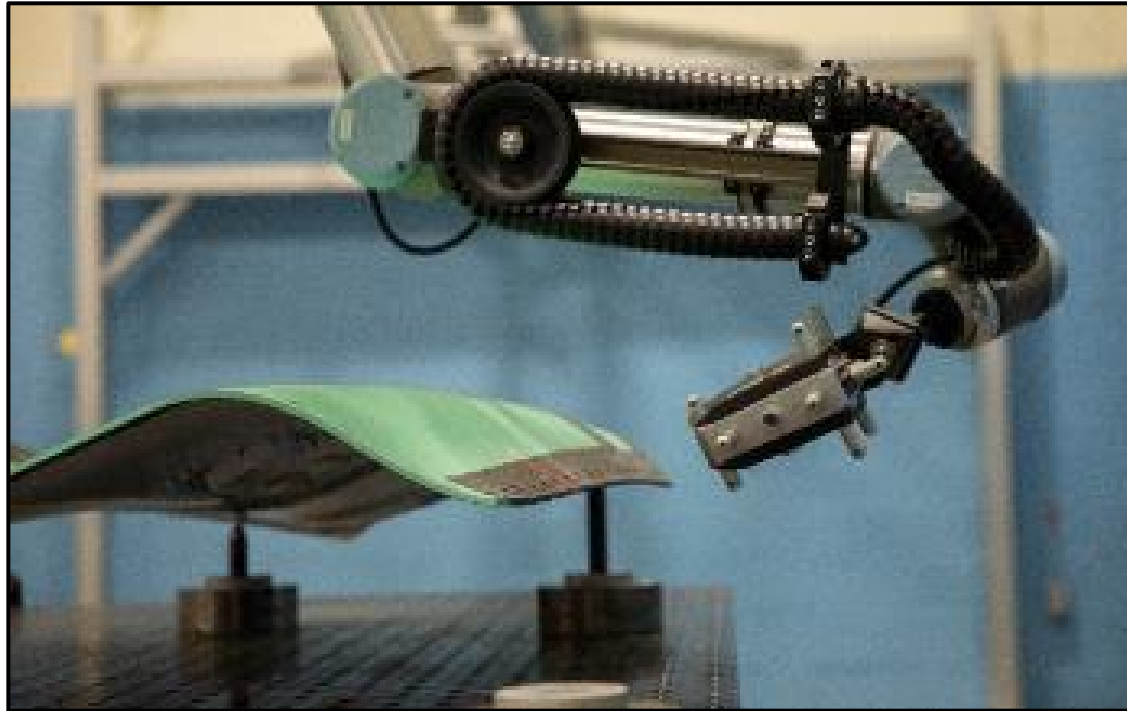
Final finishes utilized a mold in place robot to apply inlet finishes outside of an expensive spray booth in less time.

Real Time structured light measurements guide mechanics to sand the red till it's green

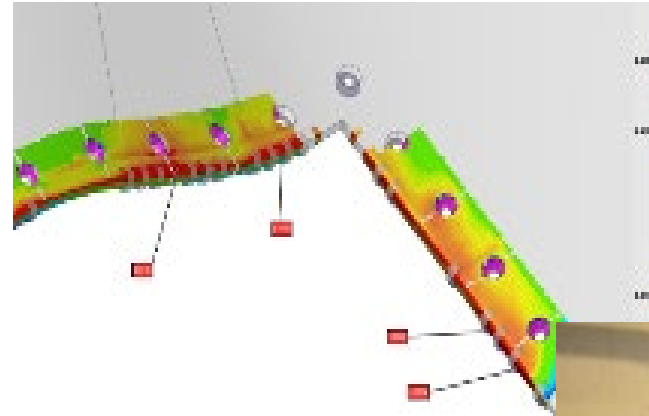


A project is aimed at eliminating manual sanding by machining coatings to desired configuration

# AUTOMATED SCANNING OF COATINGS



**Non-contact metrology scans are now used to validate coatings**



**The scans identify areas of nonconformance quickly and facilitate rework if necessary so that we save time in final assembly.**



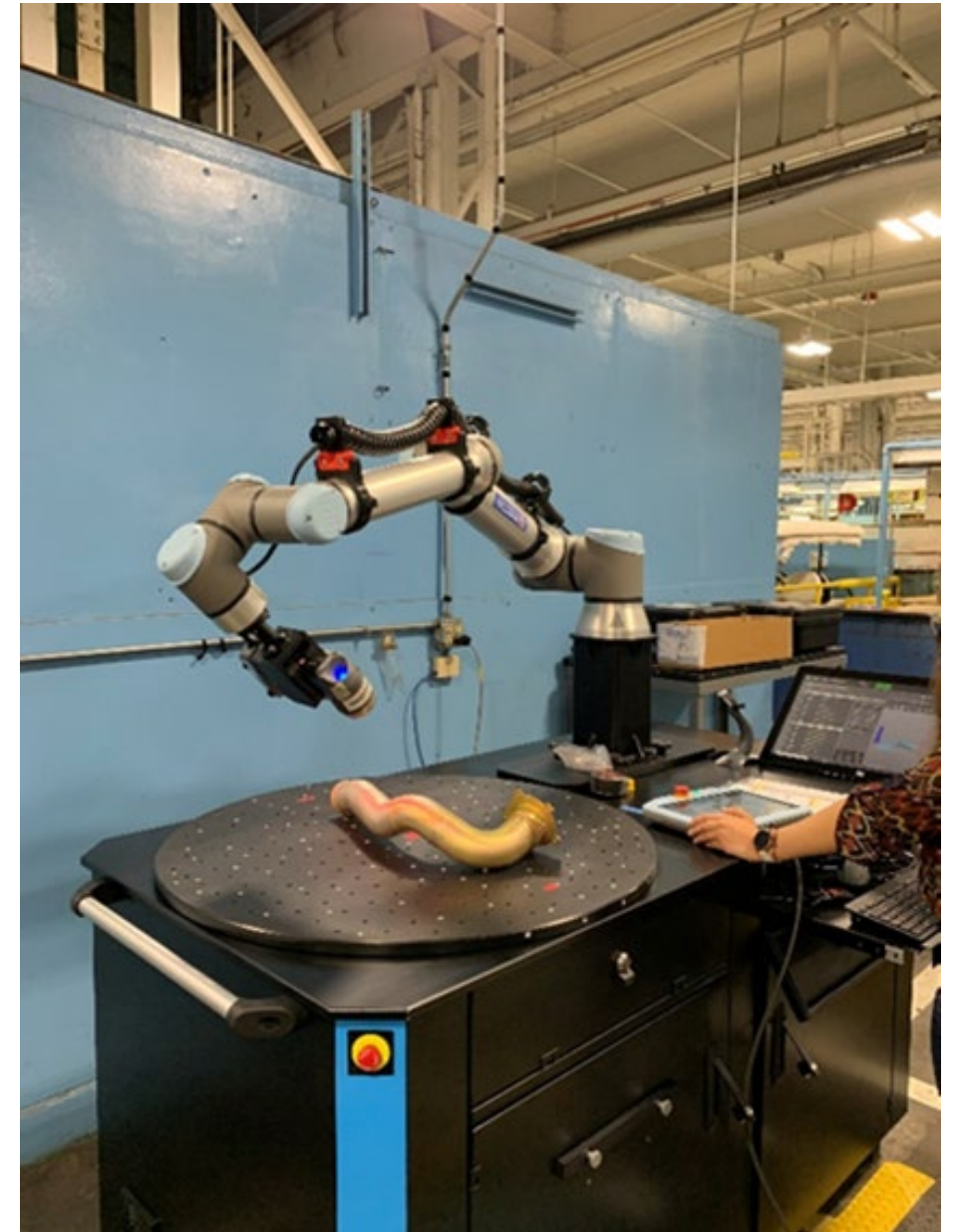


# AR APPLIED TO HARNESS INSTALLATIONS





# TUBING AUTOMATION





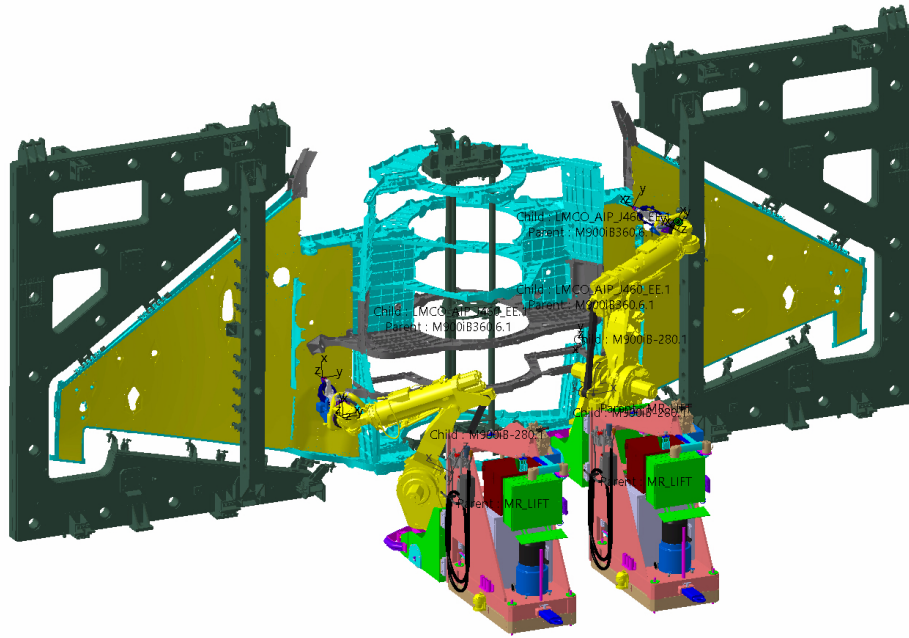
# NOW IN PRODUCTION



**Fastener Fill Robotic System**



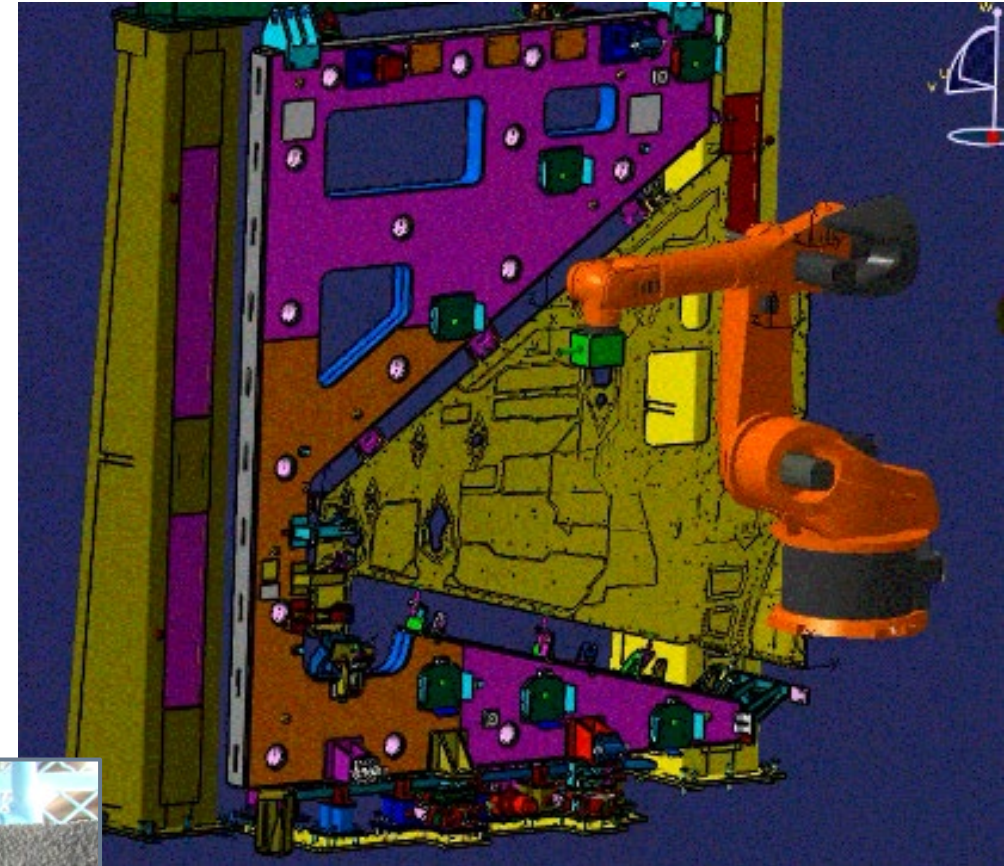
# COMING SOON



## Wing Mate Autodrilling



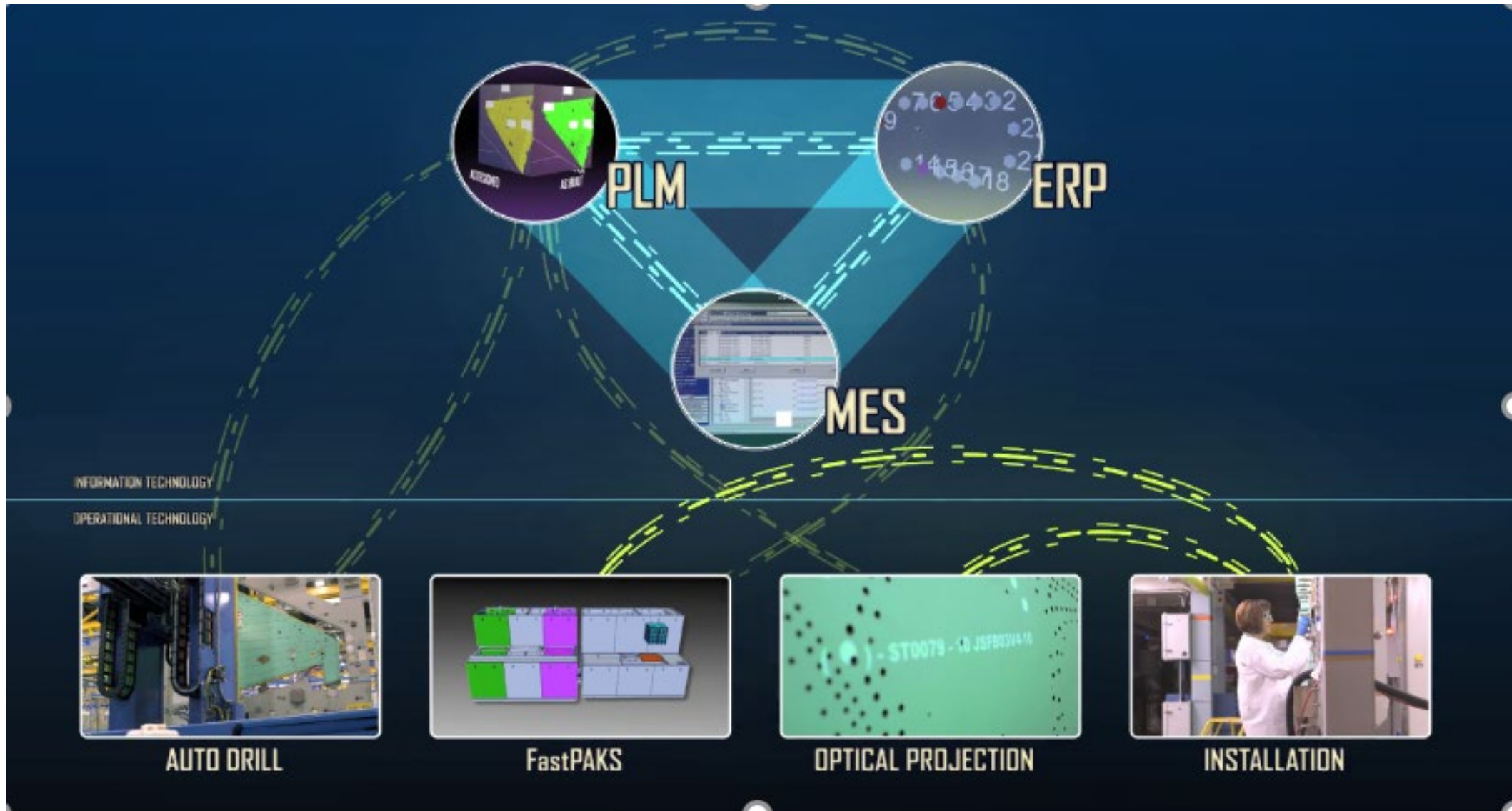
## Auto-deburring



## Automated Setup Bolt Drilling



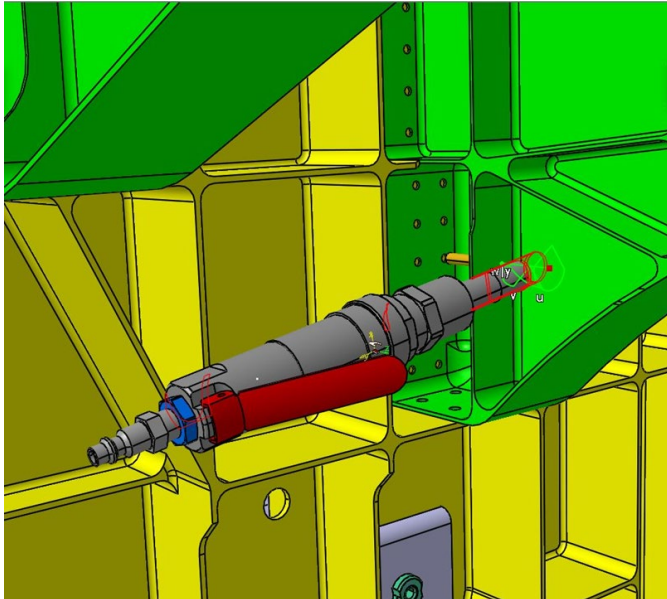
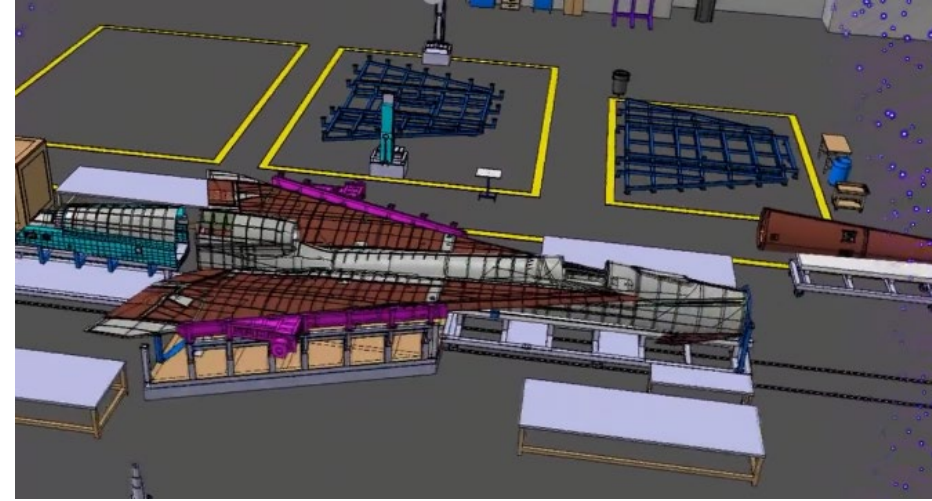
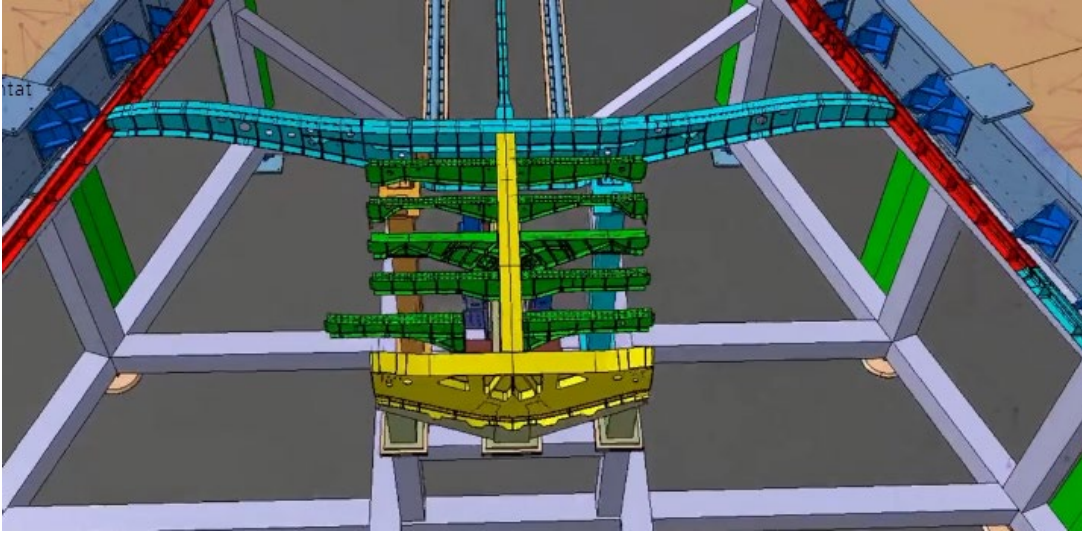
# IOT ISN'T JUST FOR MAINTENANCE ANYMORE



# THE STARDRIVE FUTURE

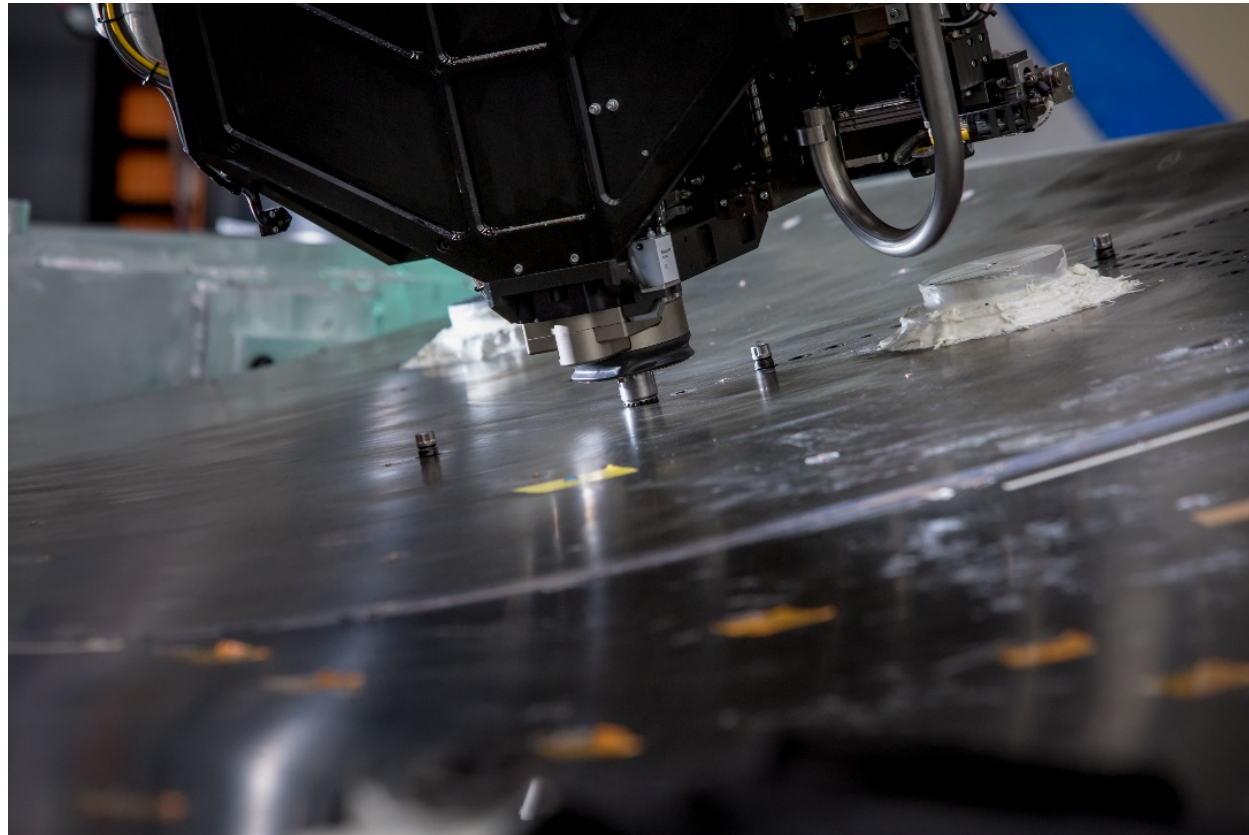
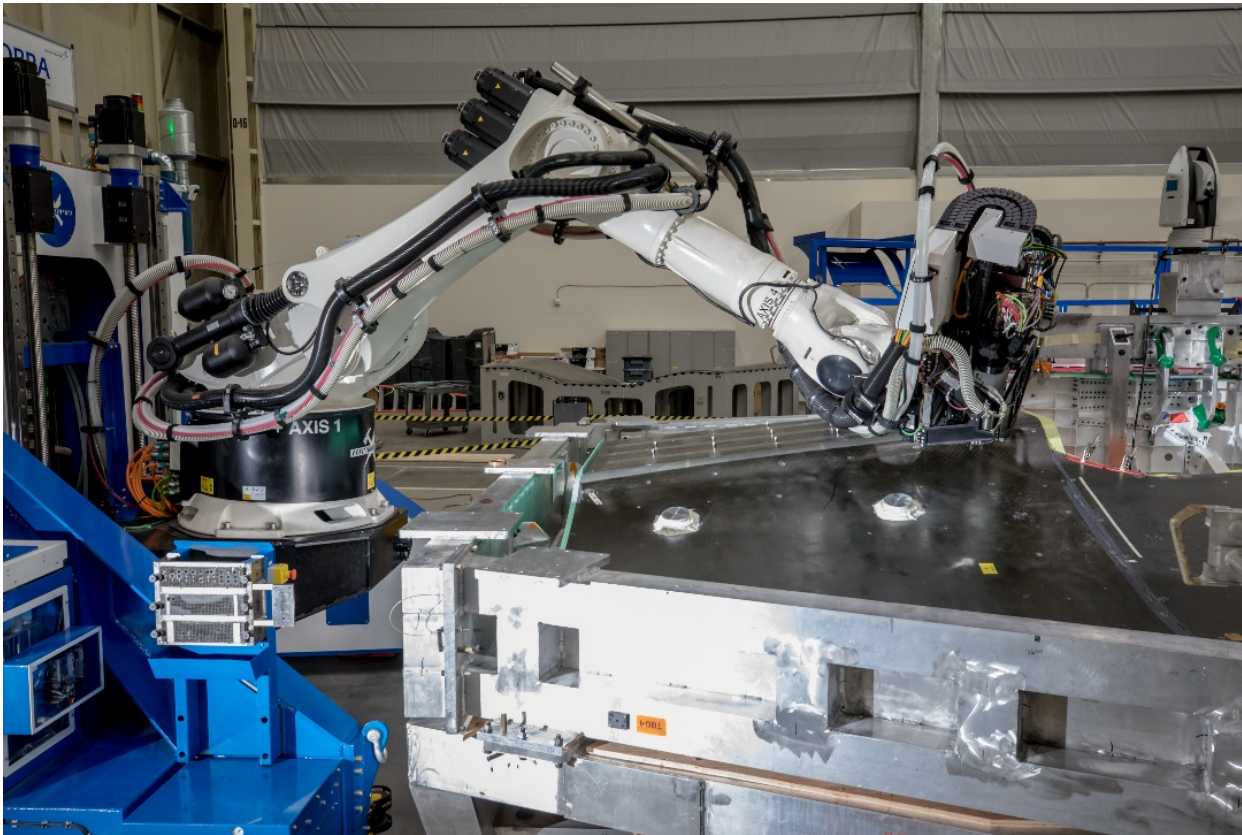


# MANUFACTURING SIMULATIONS



- **Simulation technology is frequently used to identify Engineering and Manufacturing issues during product development.**
- **Development of advanced simulation technology is one of the foundations of our Digital Transformation effort.**

# MOBILE AUTOMATION



*Lockheed Martin Leveraged Large Composite Fiber Placement Machines and COBRA Auto-Drilling Technologies*



# FLEXIBLE ASSEMBLY



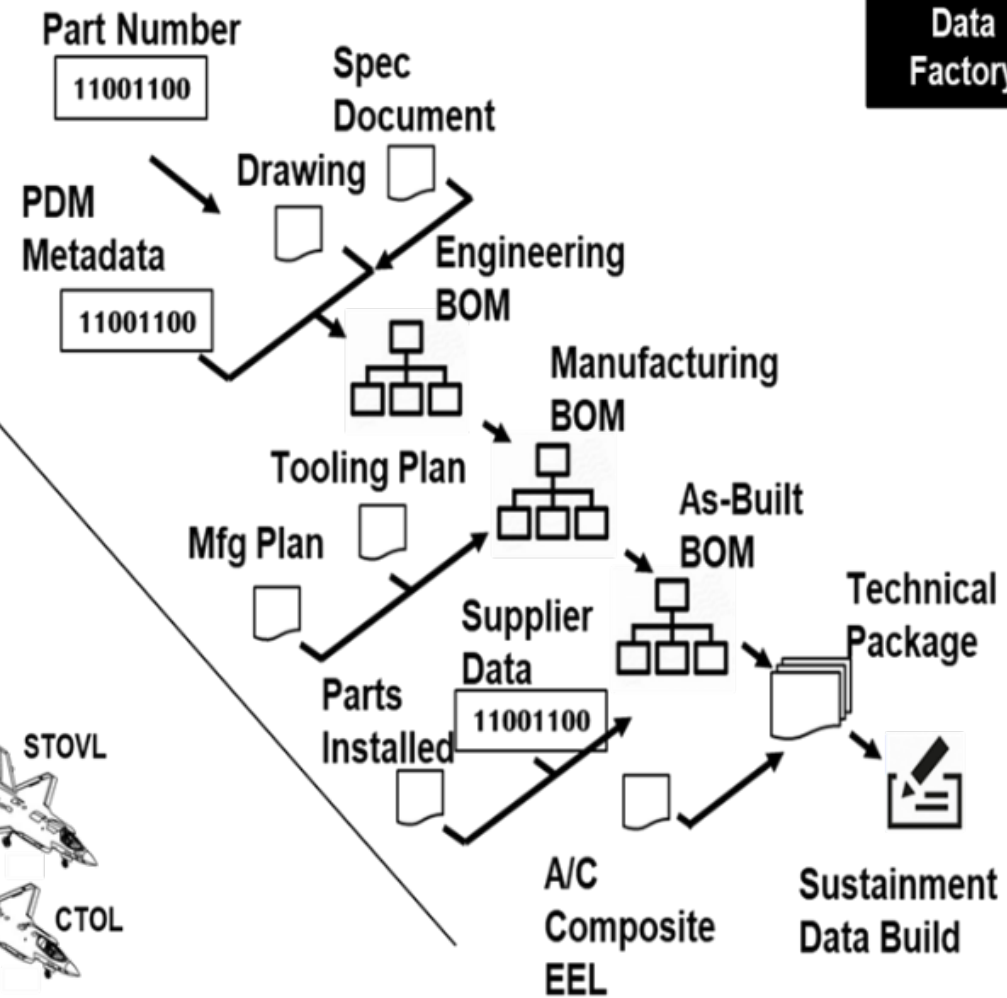
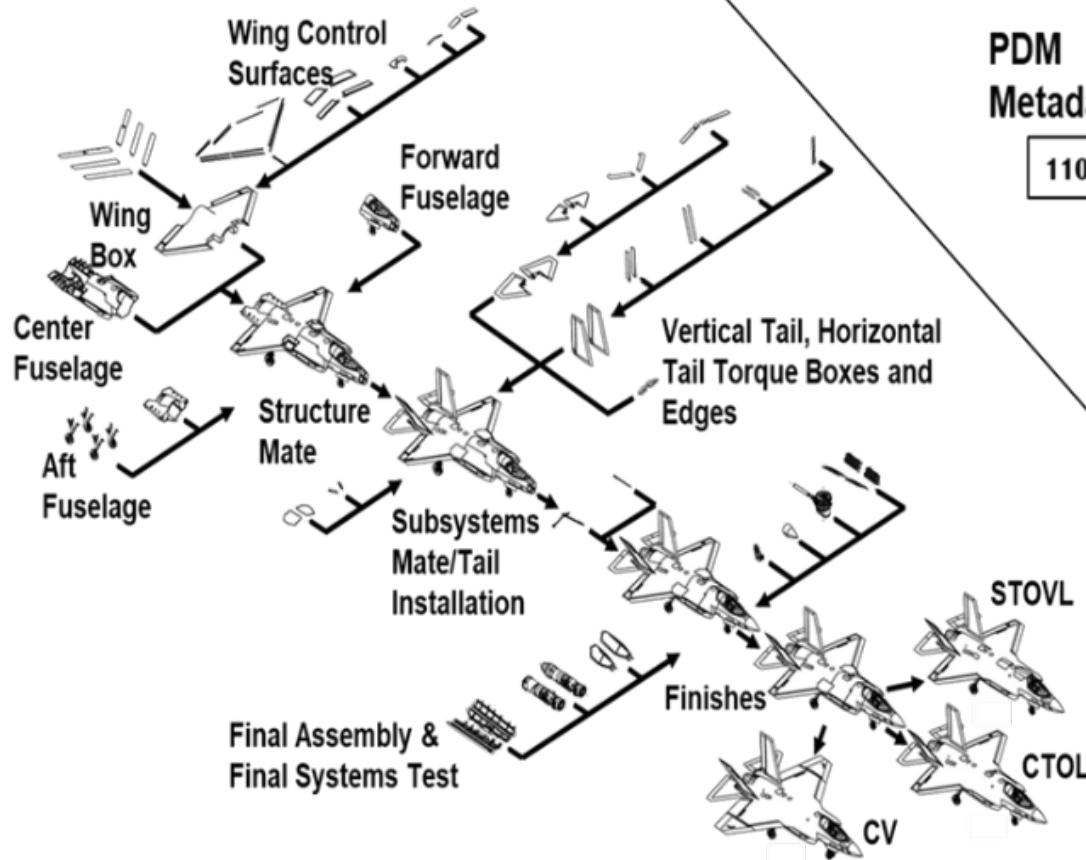
# INDUSTRY 4.0 – THE INDUSTRIAL REVOLUTION OF DATA



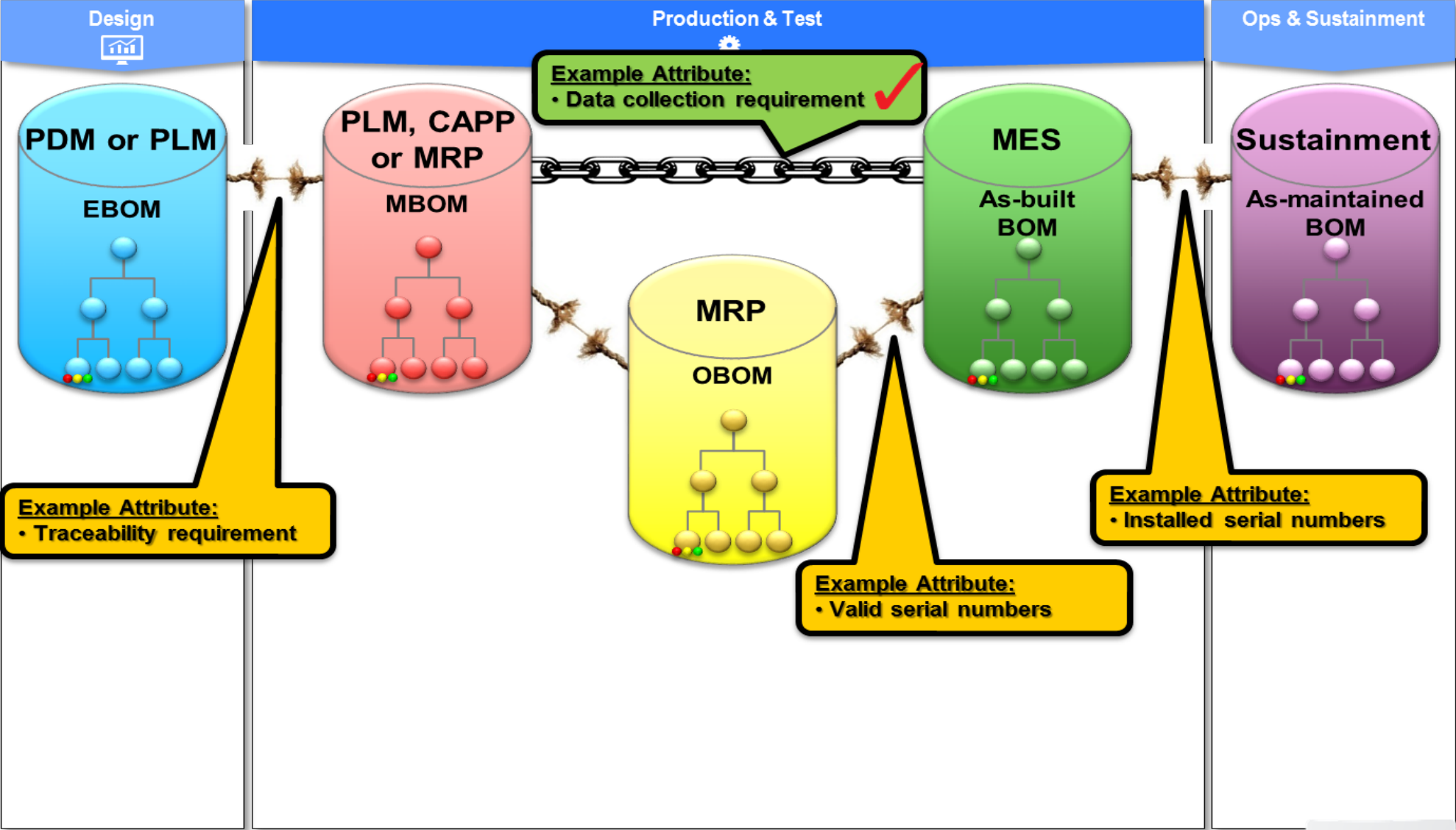
# THE DATA FACTORY

Aircraft  
Factory

Data  
Factory



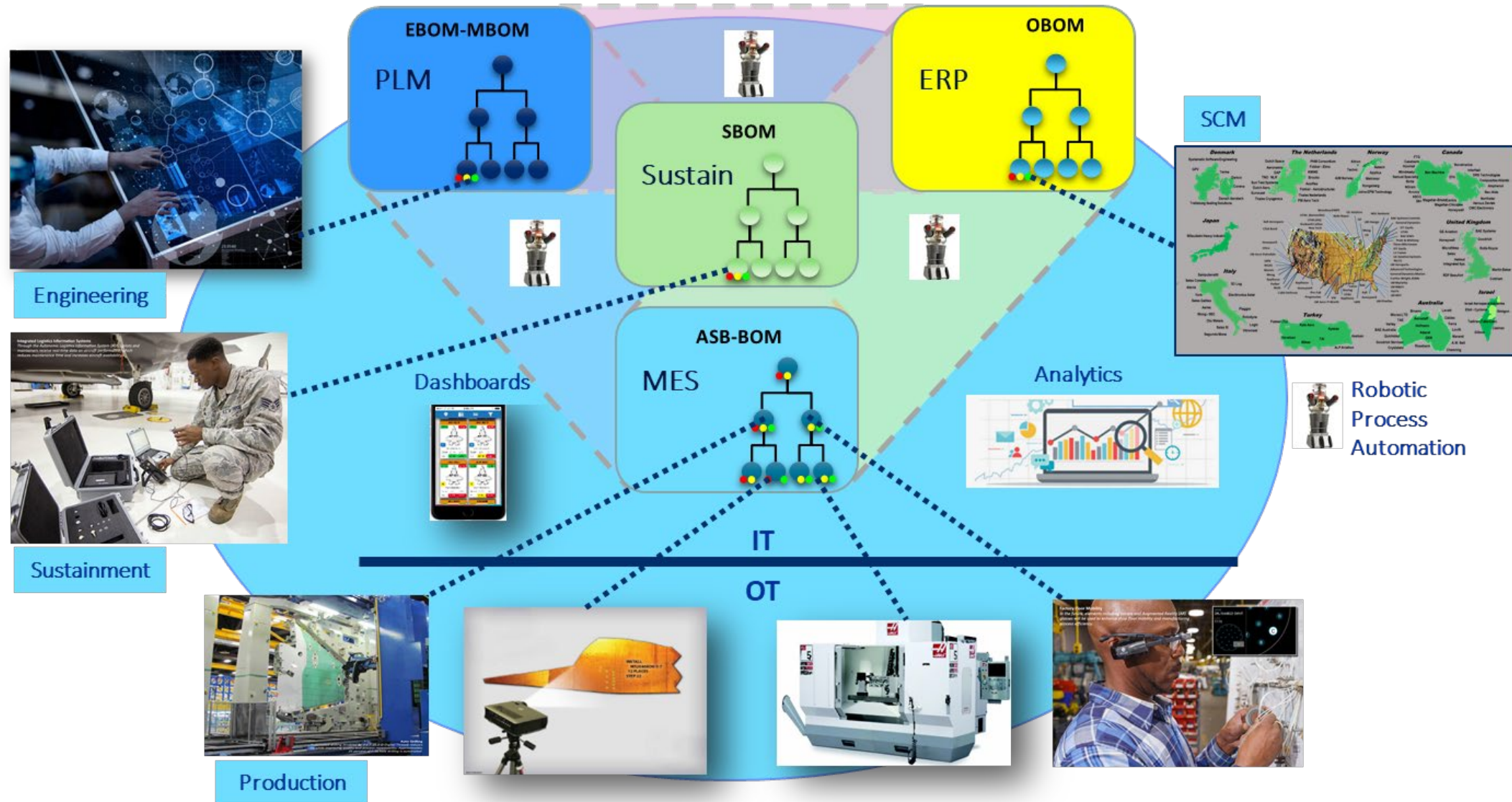
# BOM IS THE GOLDEN THREAD



Respect the BOM  
★ BILL OF MATERIALS ★



# THE INTELLIGENT ENTERPRISE SYSTEM – INDUSTRY 4.0



# WORK FORCE OUTLOOK



# SUMMARY

- The digital thread is used to support design, manufacturing, and sustainment development by the creation of digital and data twins and the implementation of advanced manufacturing technologies such as autodrilling, robotic coatings, optical projection, additive manufacturing, and noncontact metrology.
- StarDrive is the continuing advancement of Digital Transformation, Advanced Manufacturing, and Data automation across the Aeronautics enterprise.
- Industry 4.0, the next industrial revolution, is coming. Data integration and automation will bring improved system visibility and allow descriptive, predictive, and prescriptive data analytics to improve overall system performance.

# QUESTIONS?



**Technology**

**Tactics**

**Talent**

## DIGITAL TRANSFORMATION



***LOCKHEED MARTIN***

