Enabling the Tool-agnostic Digital Thread for a Digital Twin Configuration

Marc Lind | Aras
Rick Bosch | Insitu, A Boeing Company

aras
aras.com

Presenters Bio

Global Product Data Interoperability Summit | **2022**

Marc Lind

SVP Strategy | Aras

Mr. Lind drives the strategic direction at Aras for the portfolio, go to market, alliances and corporate development. His experience spans more than 25 years of disruptive enterprise software, SaaS and open source technologies for industrial manufacturers. Prior to joining Aras, Marc was president & co-founder of PartsDriver, a supply chain solution provider for the automotive aftermarket. Previously at Analog Devices, a global semiconductor company, he led business process re-engineering initiatives. Earlier in his career, Marc was a consultant in quality management, Lean enterprise, and the Toyota Production System. He holds a BBA in Operations Management from the University of Massachusetts at Amherst, is a member of the PDMA and ASCM, and presents regularly on Industrial Internet, systems engineering, and advanced technology topics.

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INSITU
A Boeing Company

Rick Bosch

Manager, Engineering Applications | Insitu, A Boeing Company

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Pace of Transformation & Disruption Accelerating

Material Advancements & Additive Manufacturing

source: rolls-royce

Smart Connected + Autonomous + Hypersonic

Industrial Internet & Industry 4.0

source: cnh

Machine Learning / Artificial Intelligence

Smart Connected Future = Even More Changes

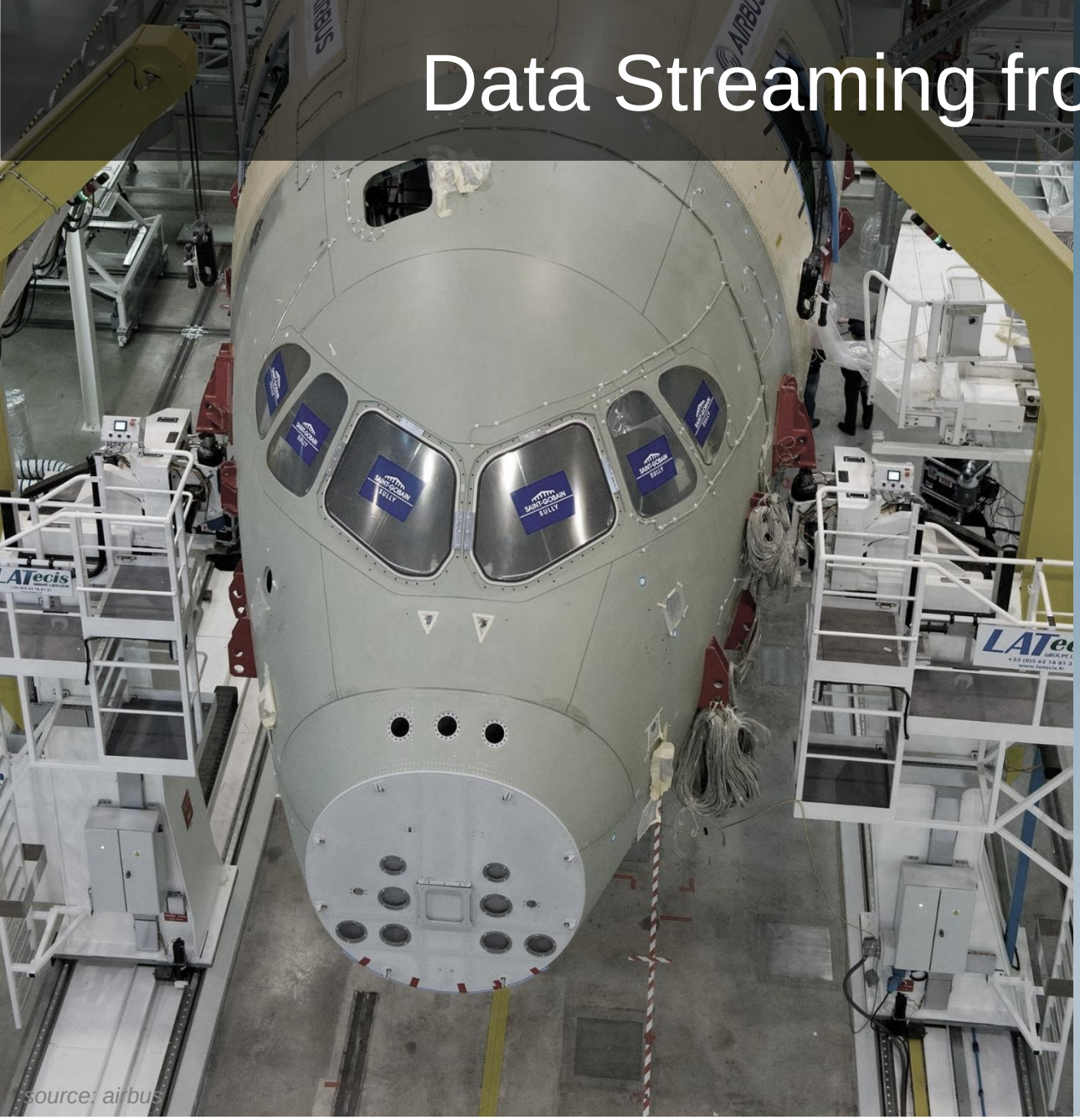
New Technologies + Next Gen Craft + New Business Models

More Systems-of-Systems & Machine-to-Machine

Introduction of Artificial Intelligence / Machine Learning

source: boeing

Data Streaming from Factory & Field



source: airbus

source: insitu

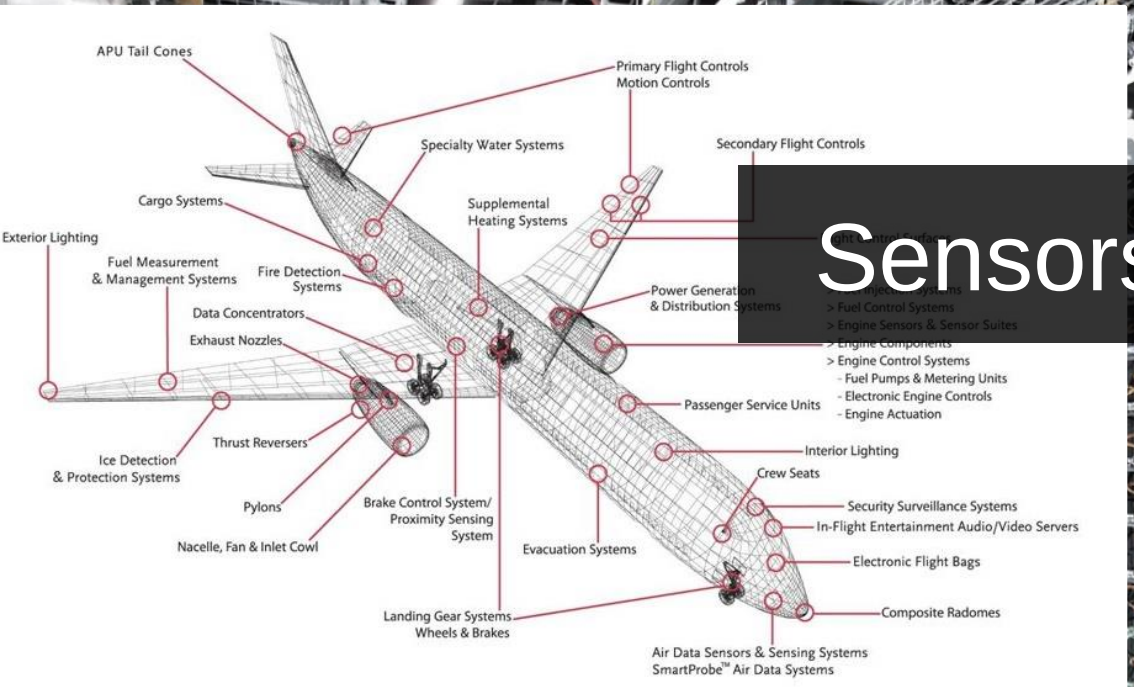
Design Improvements

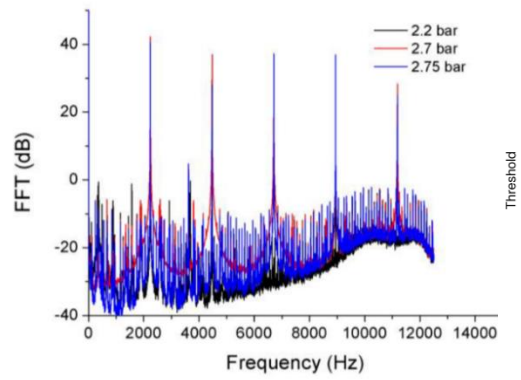
Performance Optimization

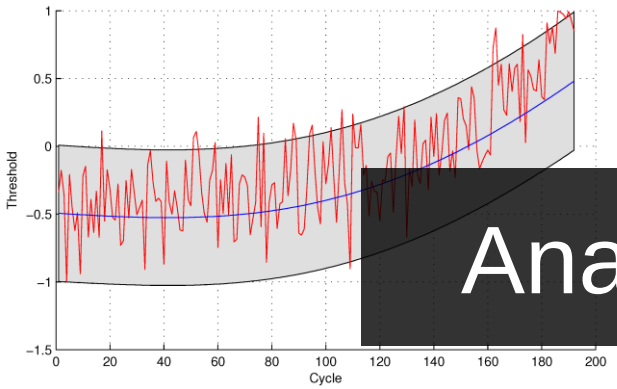
Predictive Maintenance

source: lmco

Many Initiatives Focused on Infrastructure







Sensors

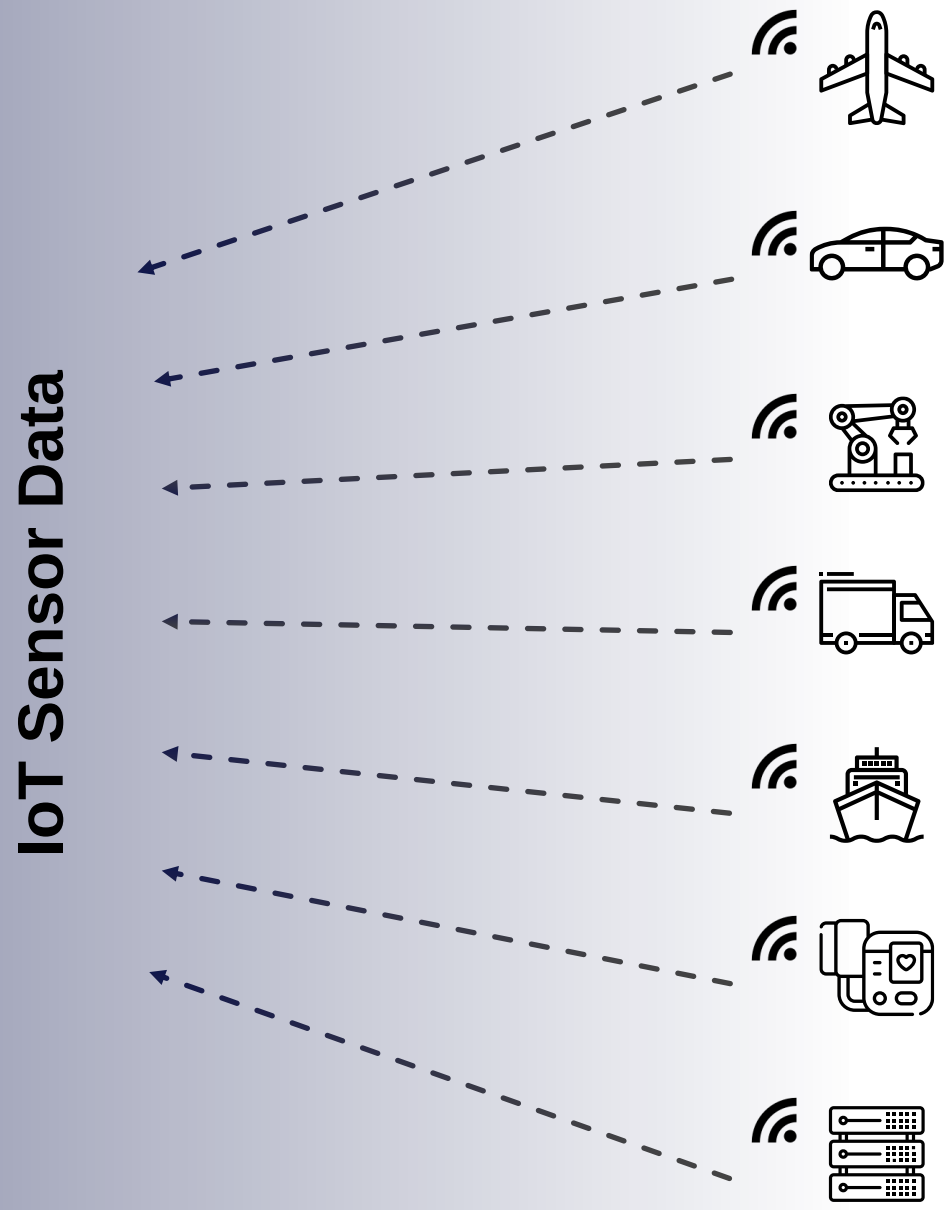
Datacenter & Cloud

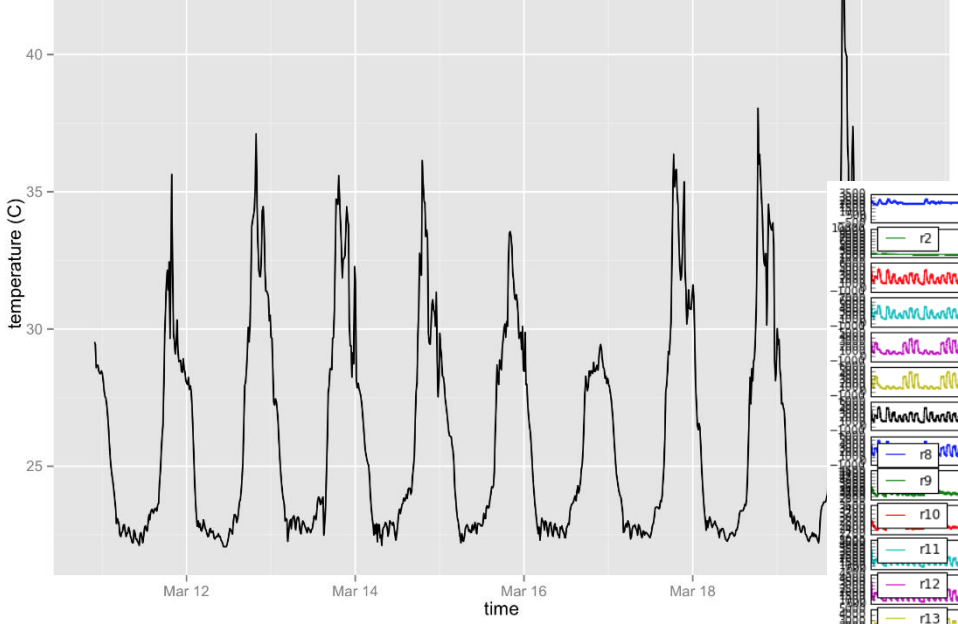
Analytics

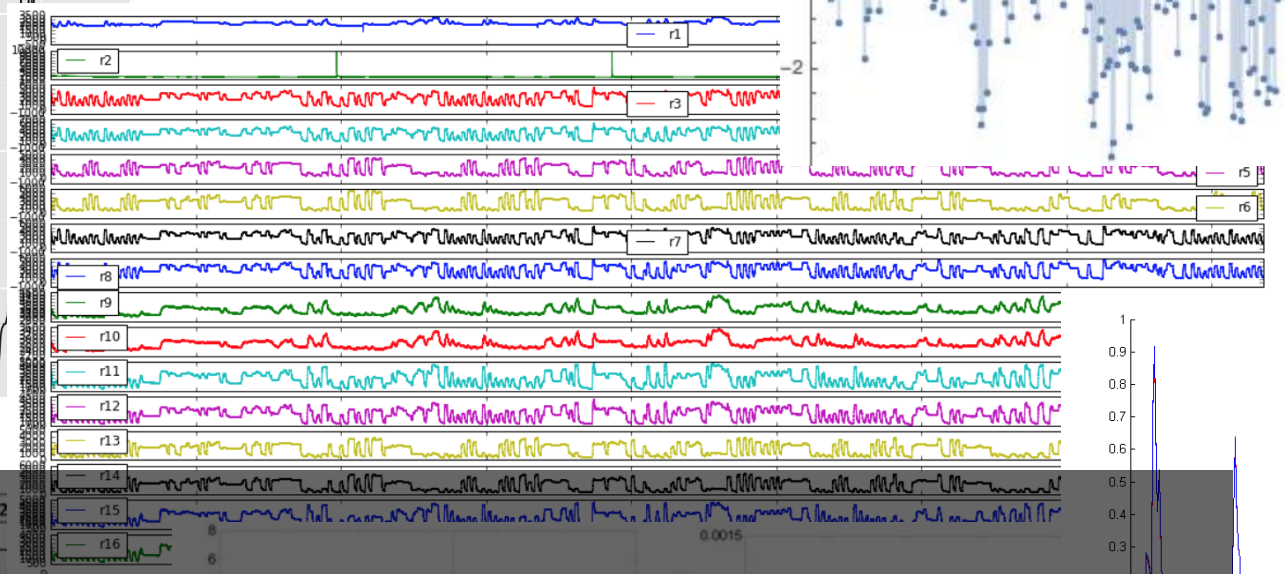
Digital Twin Performance

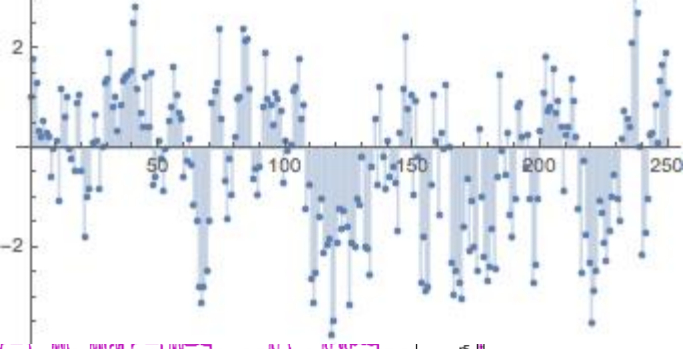
Current State Signals

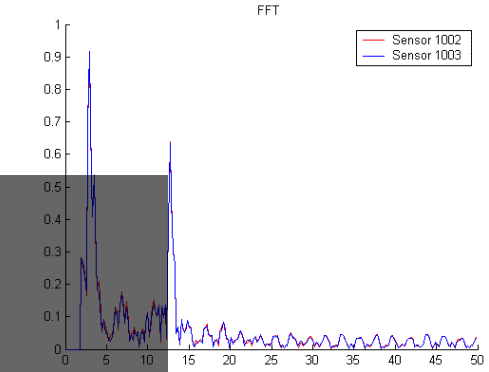
- Operating Characteristics
- Temperature
- Pressure
- Speed
- Location
- Direction
- Many more











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33	1	0	3	0	0	0	1	1	0	0	1	0	0	
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51	1	0	1	0	3	0	1	0	0	0	0	0	0	0
52	1	0	1	0	1	3	1	0	0	0	0	0	0	0
100	1	0	1	0	0	1	3	0	0	0	1	0	0	0
40	1	1	1	0	0	0	0	3	0	0	0	0	0	0
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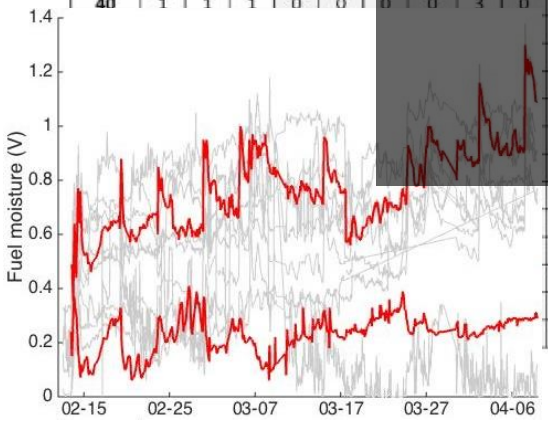
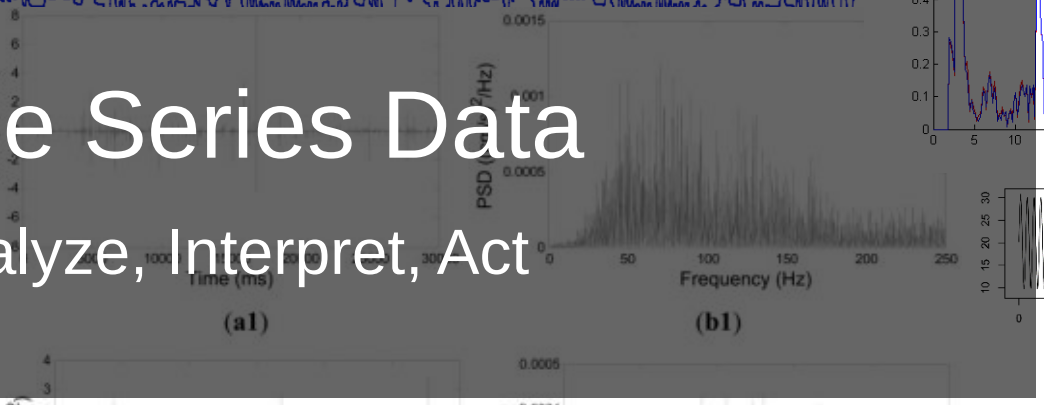
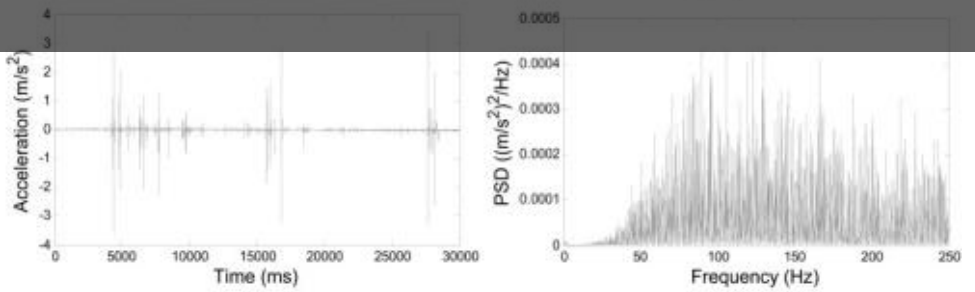
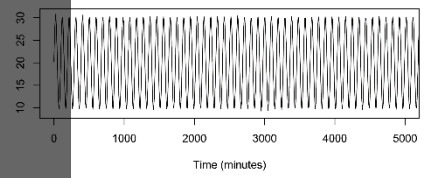
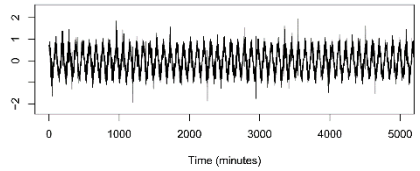






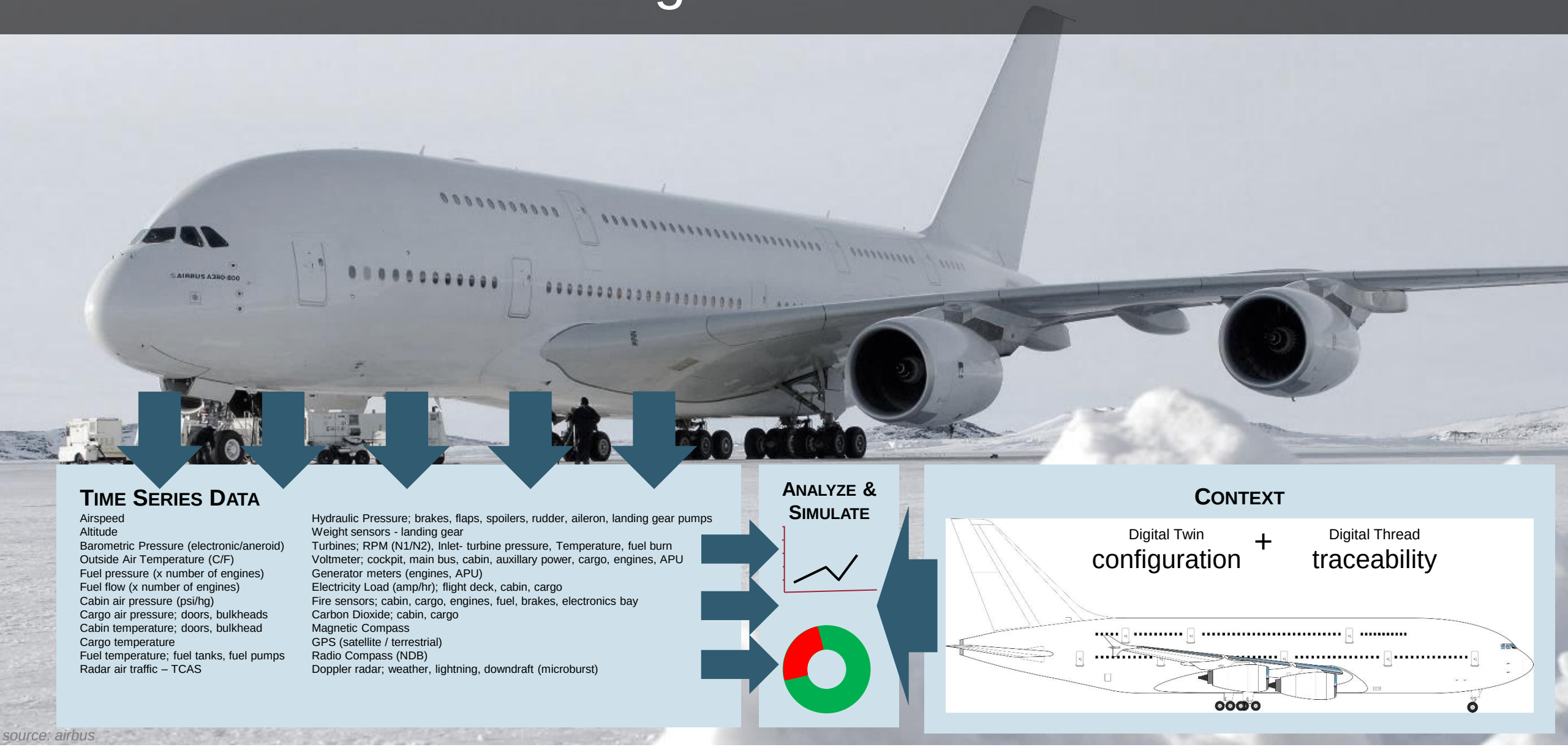




Time Series Data

Analyze, Interpret, Act

Increasing Context Problem



Time Series Data

Airspeed	Hydraulic Pressure; brakes, flaps, spoilers, rudder, aileron, landing gear pumps
Altitude	Weight sensors - landing gear
Barometric Pressure (electronic/aneroid)	Turbines; RPM (N1/N2), Inlet- turbine pressure, Temperature, fuel burn
Outside Air Temperature (C/F)	Voltmeter; cockpit, main bus, cabin, auxillary power, cargo, engines, APU
Fuel pressure (x number of engines)	Generator meters (engines, APU)
Fuel flow (x number of engines)	Electricity Load (amp/hr); flight deck, cabin, cargo
Cabin air pressure (psi/hg)	Fire sensors; cabin, cargo, engines, fuel, brakes, electronics bay
Cargo air pressure; doors, bulkheads	Carbon Dioxide; cabin, cargo
Cabin temperature; doors, bulkhead	Magnetic Compass
Cargo temperature	GPS (satellite / terrestrial)
Fuel temperature; fuel tanks, fuel pumps	Radio Compass (NDB)
Radar air traffic – TCAS	Doppler radar; weather, lightning, downdraft (microburst)

Analyze & Simulate

Context

Digital Twin
configuration
+
Digital Thread
traceability

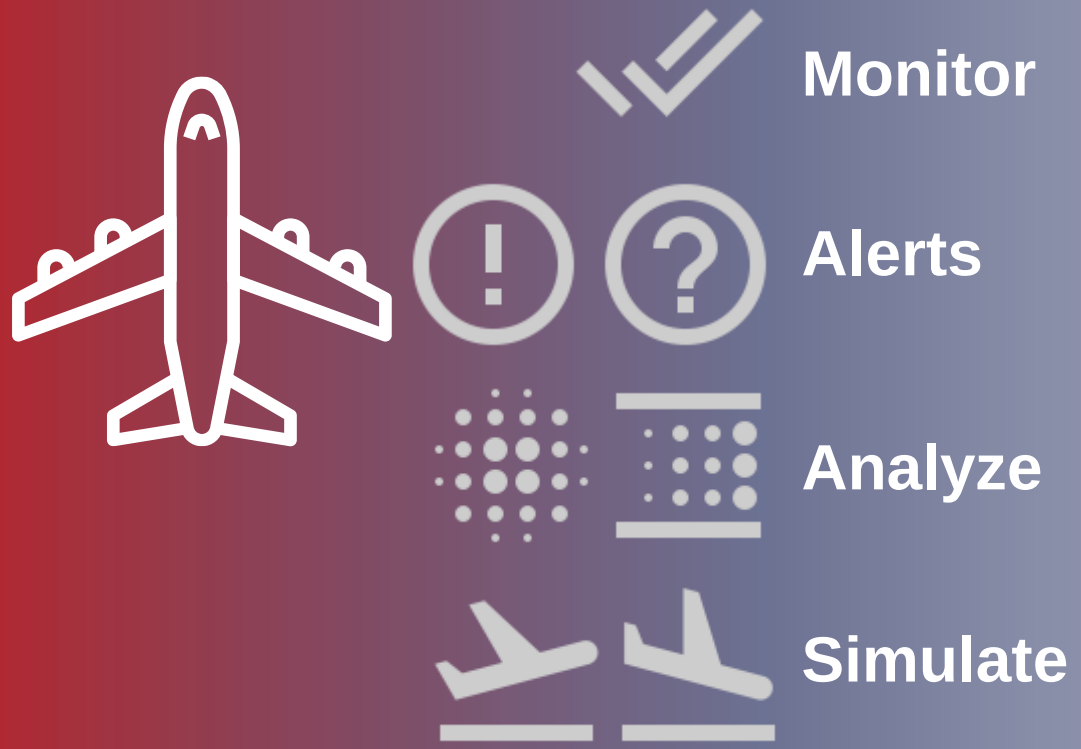
source: airbus

Knowledge = Information in Context

Stefane Gardmann
https://pro.europeana.eu/files/Europeana_Professional/Publications/Europeana%20White%20Paper%201.pdf

2 Parts to Digital Twin

Digital Twin Configuration



Digital Twin Performance

Data Lakes

IoT Sensor Data

Risks Without Digital Twin + Digital Thread Context

Ramifications	Risks
Misdirected Actions	Loss of Life Safety Issues Liability
Inaccurate Conclusions	Brand Damage Regulatory Actions Operational Shutdowns
Misinterpretations	Lost Revenues Customer Frustration Unnecessary Rework / Repairs

Risks increase exponentially with artificial intelligence

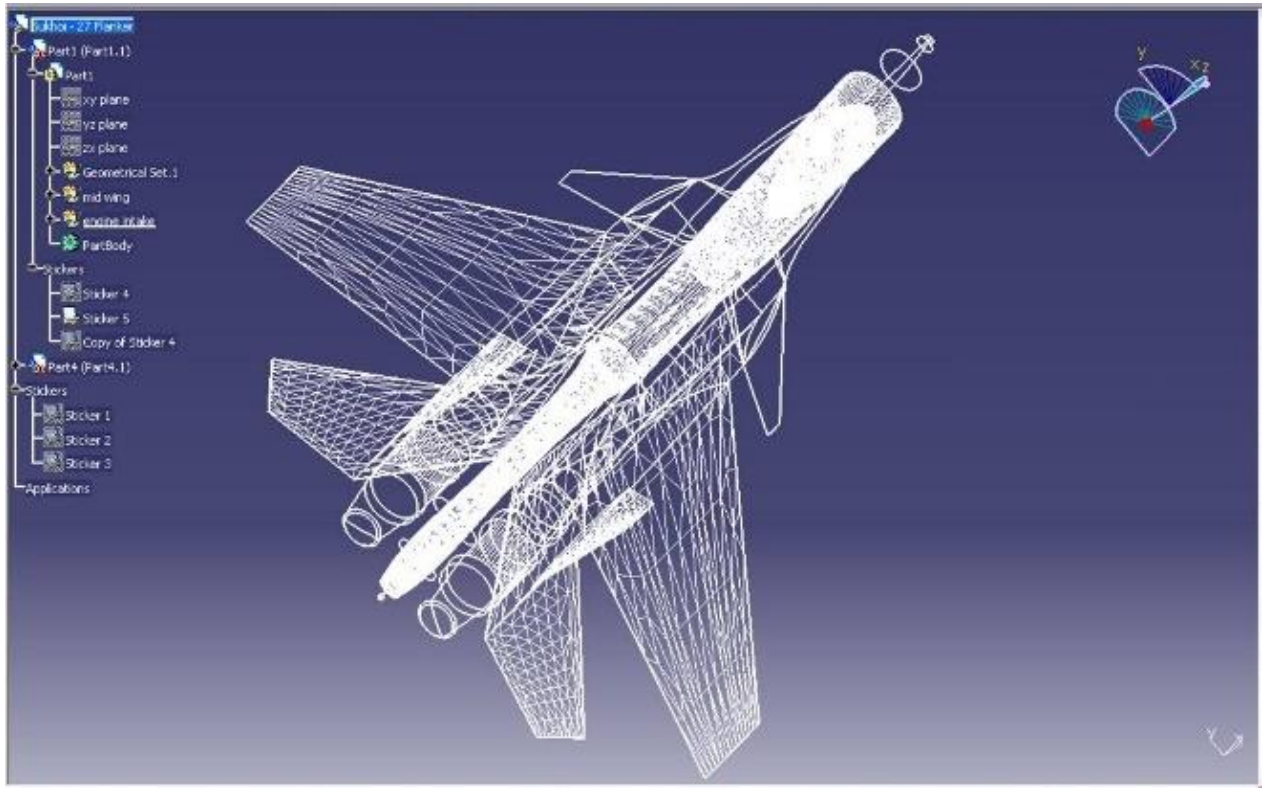
source: airbus

What is the Digital Twin Configuration?

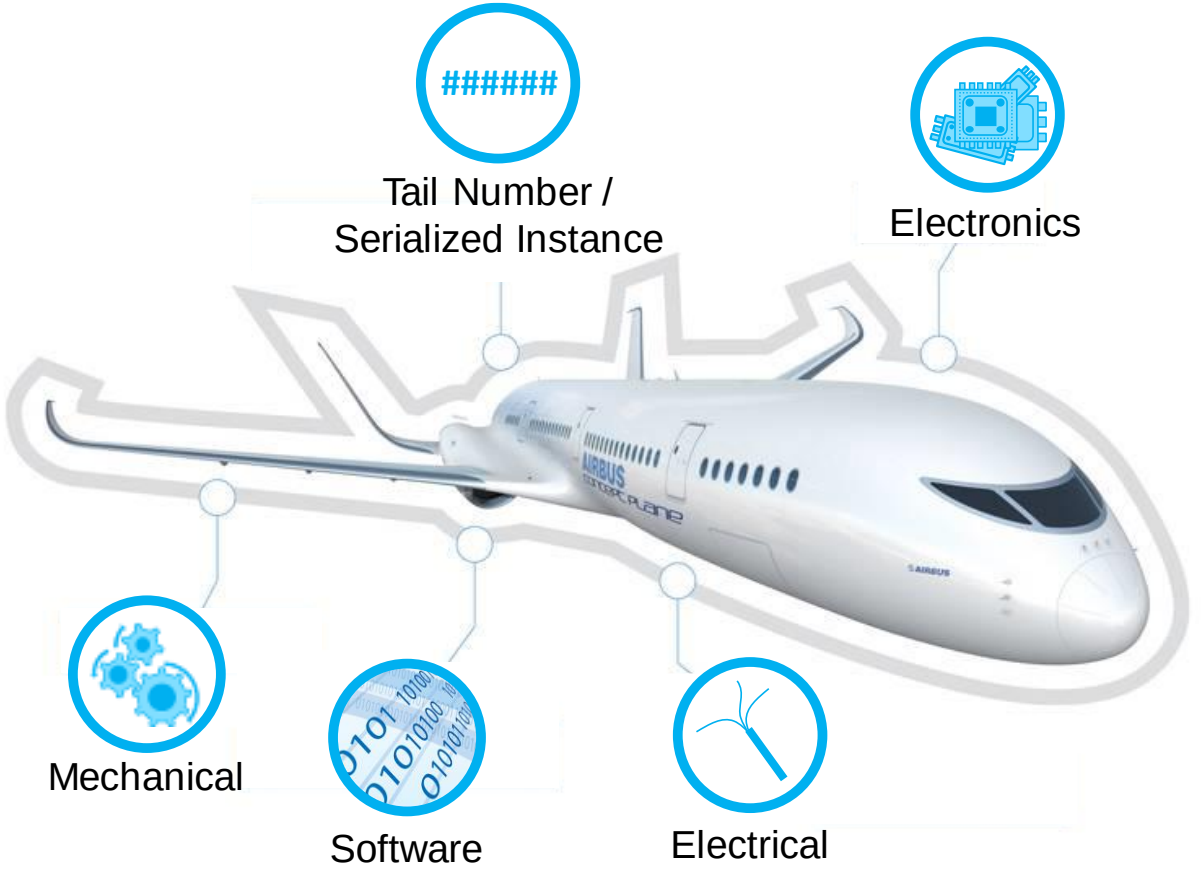
General representation of a family of products?

Just Mechanical?

As-Designed?

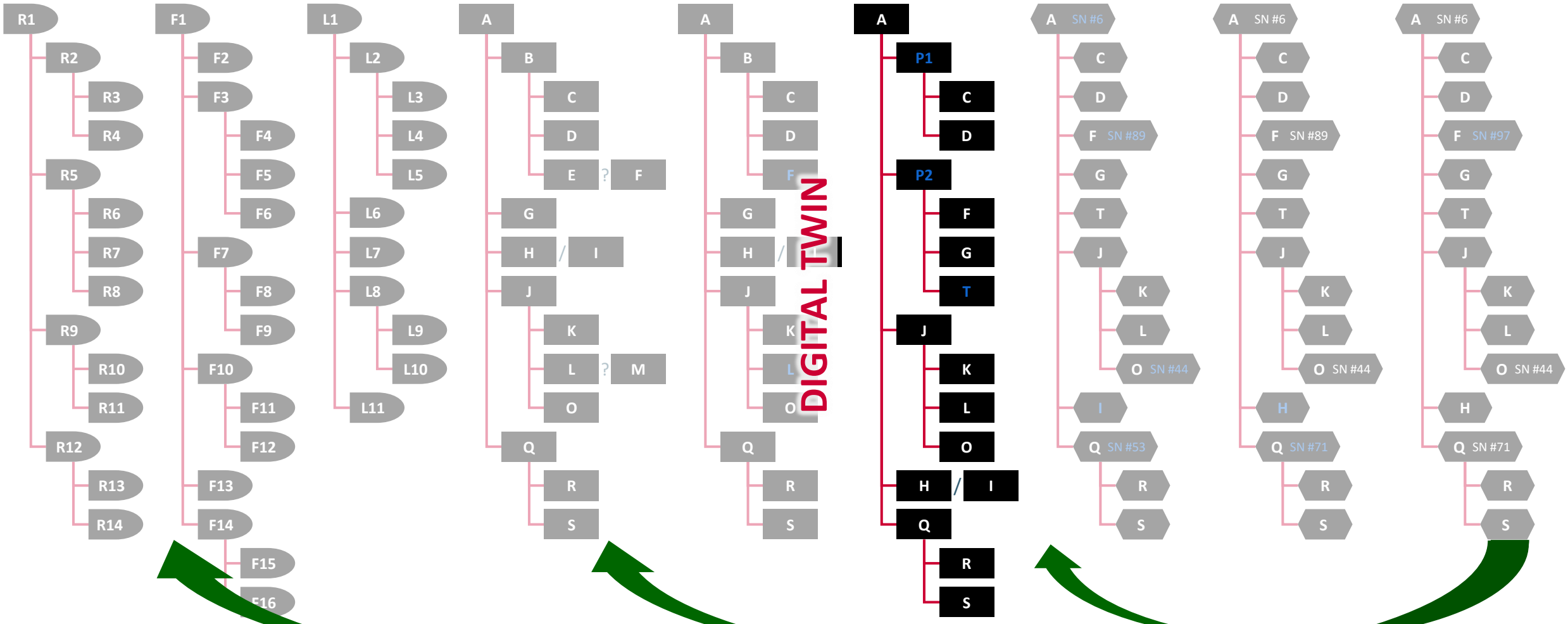


Digital Twin Configuration

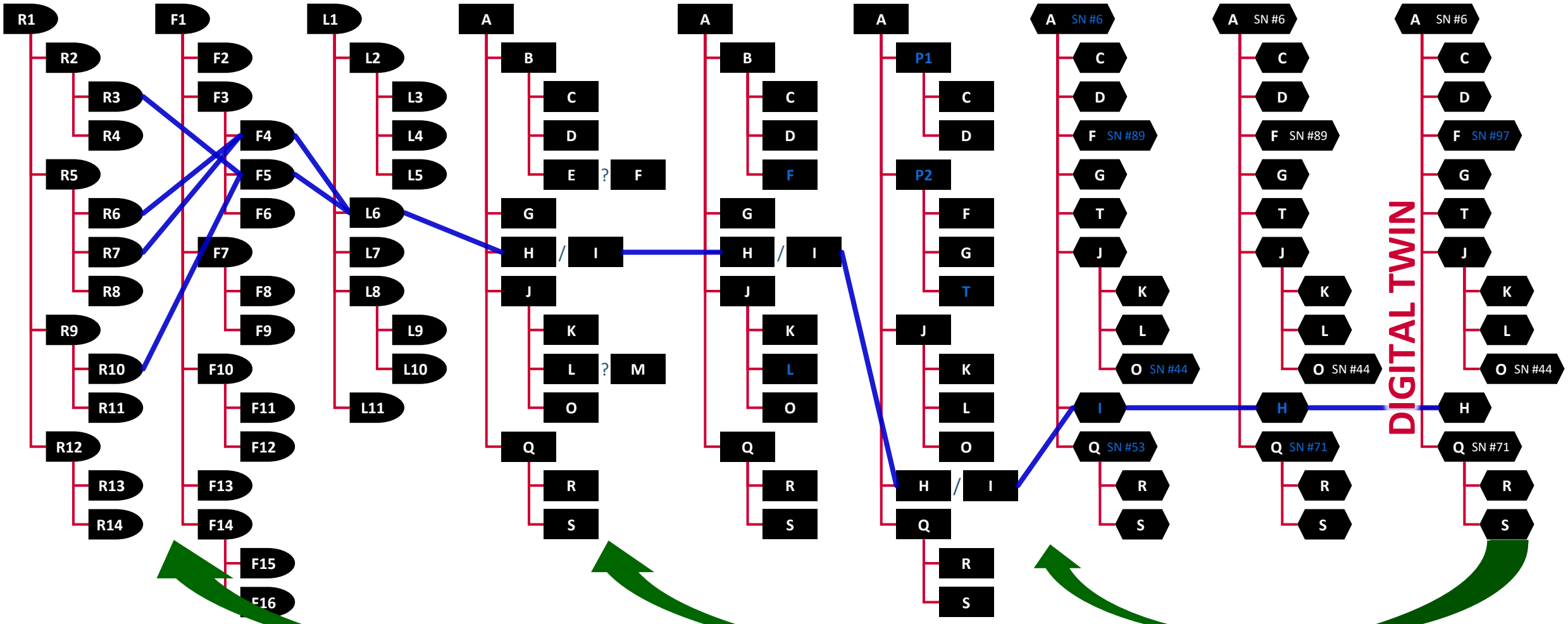


exact digital representation of the physical asset right now

Digital Twin Configuration Over Lifecycle



Digital Thread Traceability Across Lifecycle



What is the Digital Thread?

Meaningful Relationship Connections

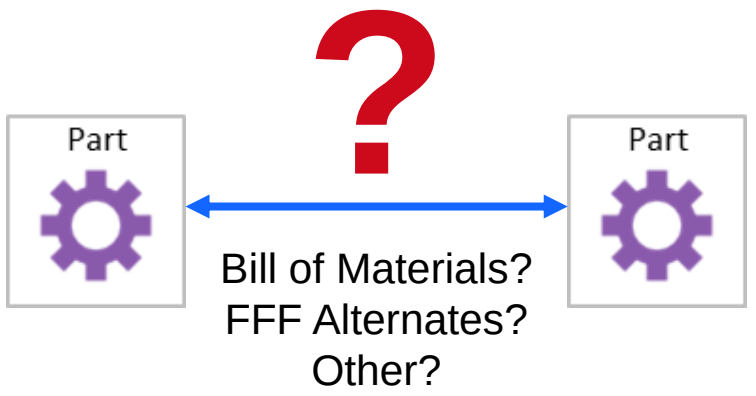
Meaningful relationship connections between all of a product's digital assets – and their revisions over the lifecycle – across the multiple domains in the lifecycle within and throughout an enterprise including the supply chain.

Digital thread connect data elements of products, bills of material, parts, software, electronics, CAD models, documents, requirements, simulation & analysis data, verification & validation data, supplier specifications, technical data pack (TDP) contents, manufacturing process plans, inspection & test plans, quality records, service manuals, maintenance records, and many other digital assets.

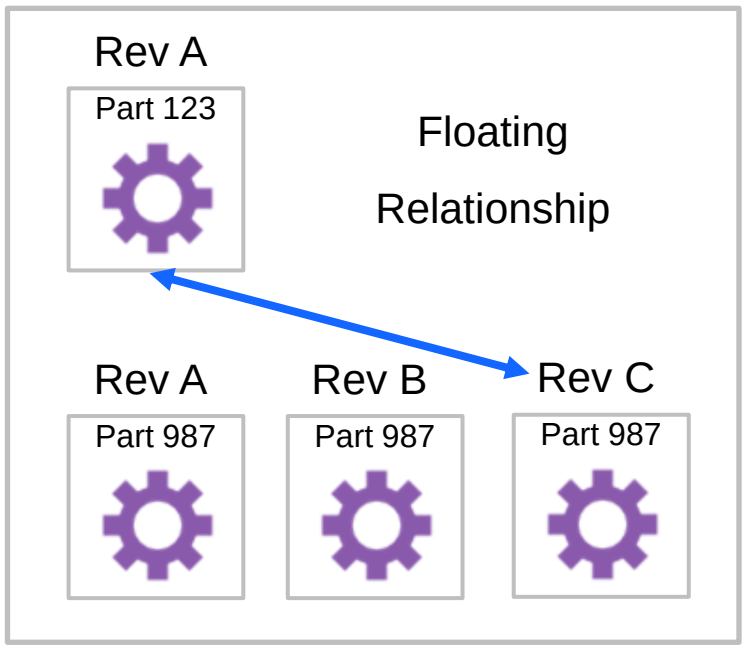
Digital thread is an attribute of an enterprise's information architecture as opposed to a software system that is purchased, and exists both within and between data elements in different tools and systems from a wide range of vendor providers.

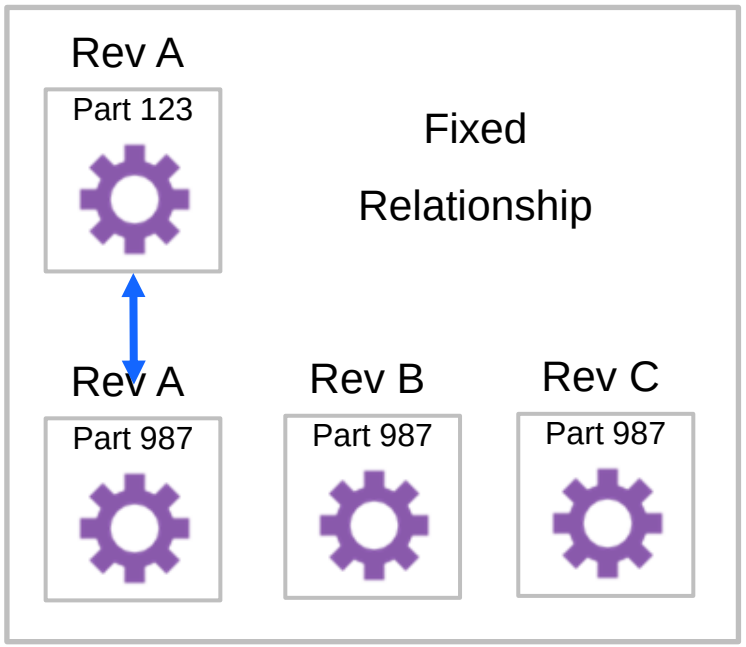
Digital Thread = Meaningful Relationships

Context



Dependency



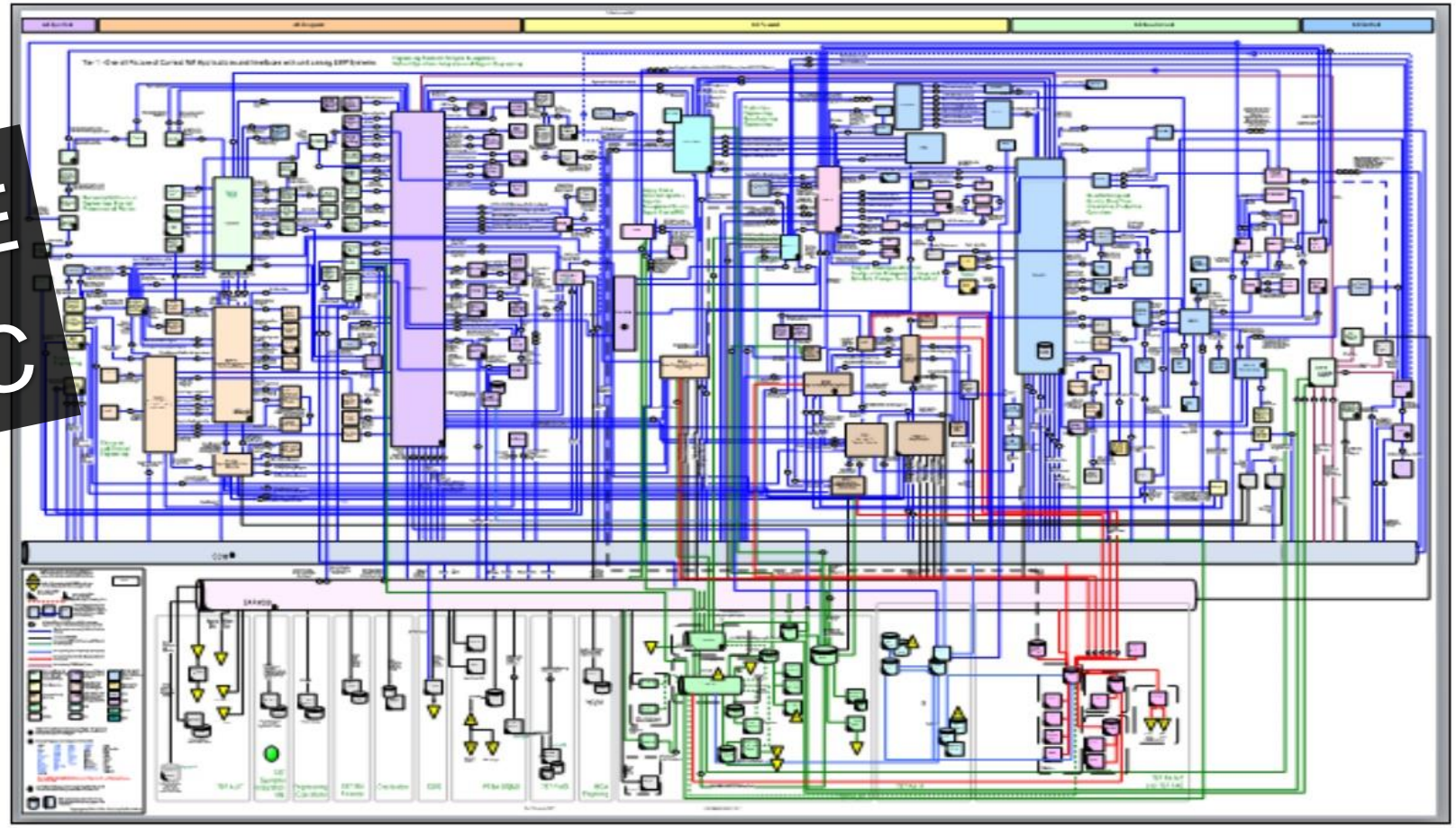


Security

Are Digital Twin & Digital Thread Achievable?

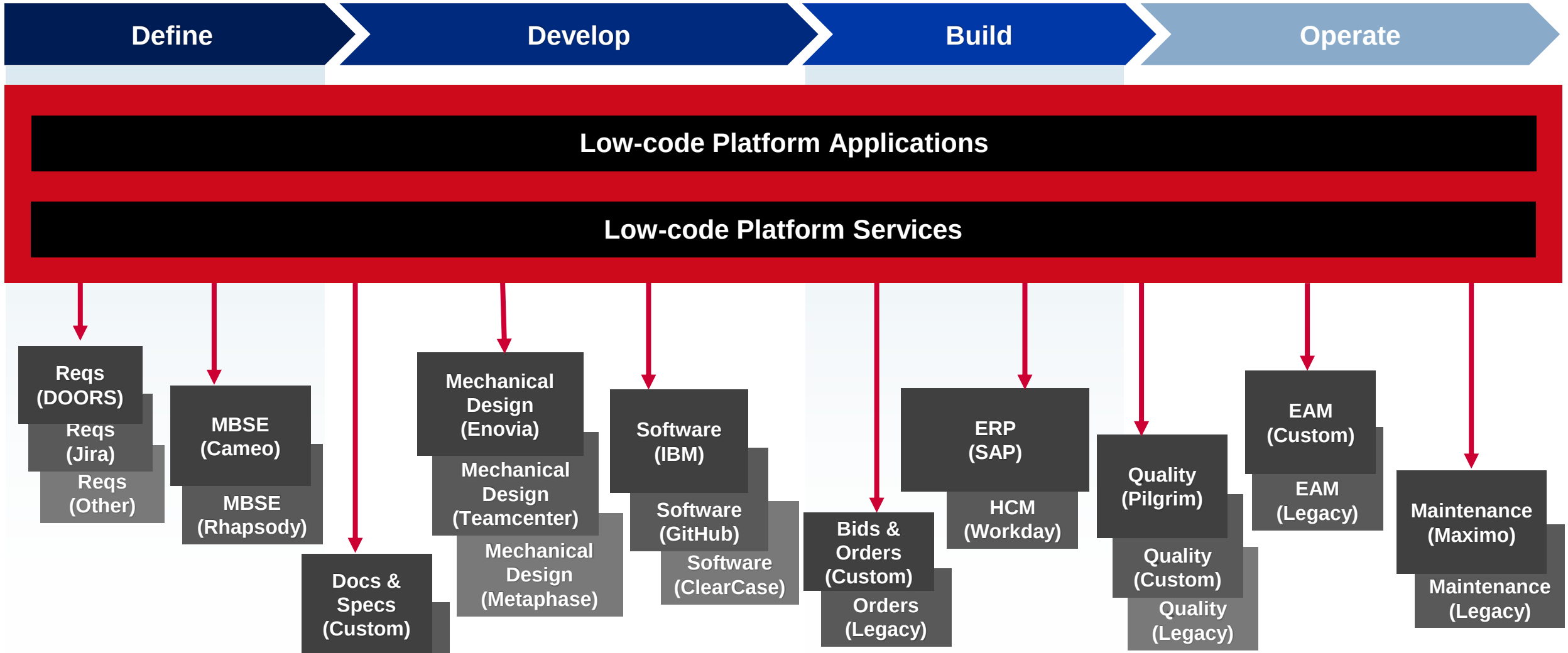
Thousands of Existing Systems & Petabytes of Data
Users around the World

RIP & REPLACE NOT REALISTIC

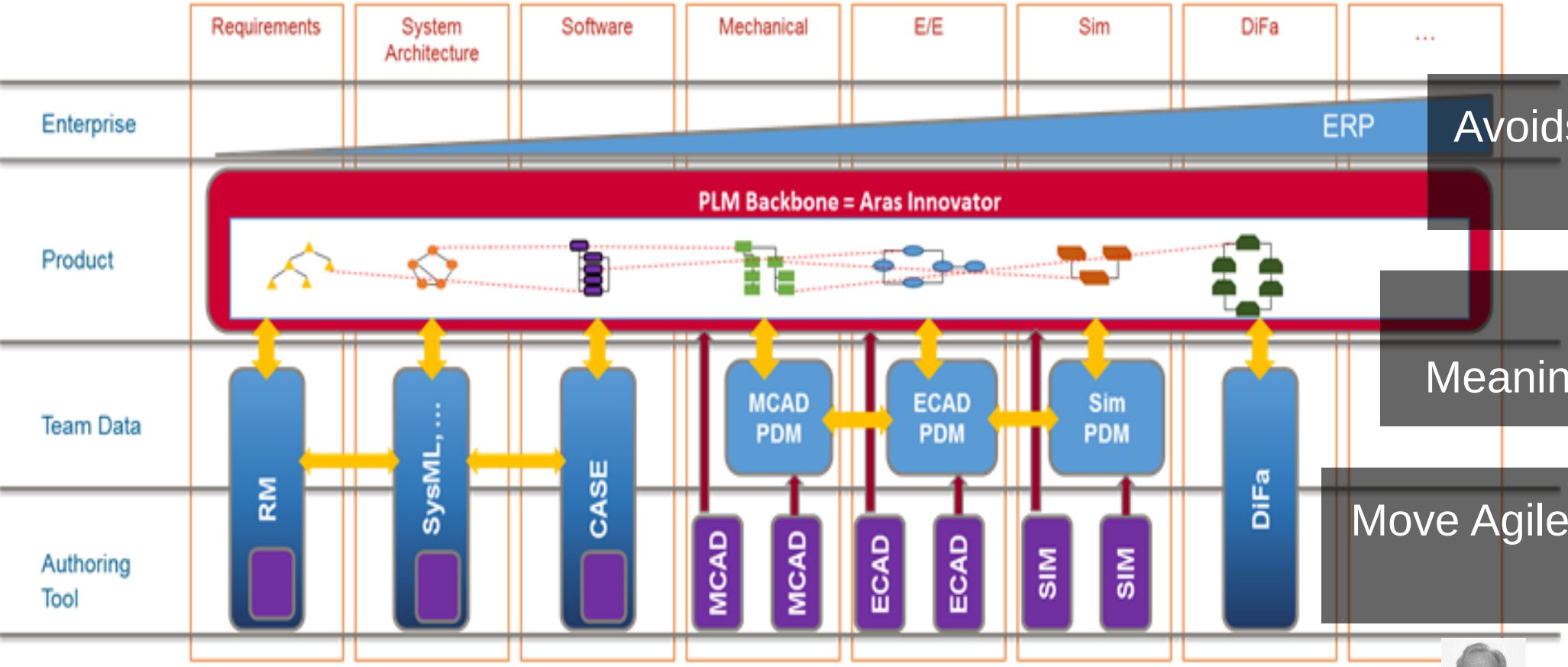


source: gpdis 2015

Platform Overlay Approach



System-of-Systems Architecture



Avoids Risk / Disruption of Rip & Replace

Not just Links, Meaningful Relationships

Move Agile, Digitalize Faster, Bi-modal IT

TDM and authoring tool tighly connected

TDM
Authoring tool
freely integratable

Dr. Martin Eigner
TECHNISCHE UNIVERSITÄT KAISERSLAUTERN

GLOBAL INTEROPERABILITY SUMMIT 2022

Platform Requirements for Tool-Agnostic Digital Thread

PLATFORM REQUIREMENTS	CANNOT HAVE	MUST HAVE
Ability to **ingest data** through API and Services	Proprietary Closed APIs	FULL + Open APIs
Integration ability to manipulate processes and data through exposed API / Services	Proprietary Data Models	Open Data Model
Ability to **exfiltrate data** out of API / Services	Obfuscated Data	Open Data Access
Extensibility ability to build / extend functionality leveraging COTS framework	Static / Hard Coded Data Model	Dynamic Data Model

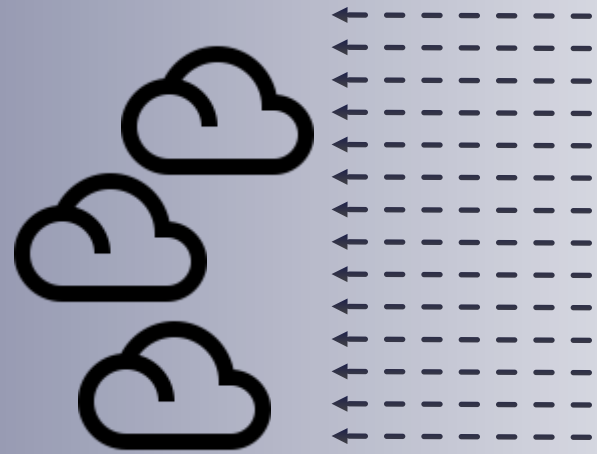
source: https://www.cimdata.com/en/aerospace-and-defense/publications/obsolescence-management a&d plm action group platform requirements

must be able to openly connect to numerous tools & systems

Attributes of Digital Twin Configuration

Digital Twin Configuration

Digital Twin Performance

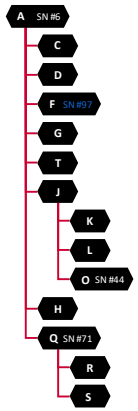


Data Lakes

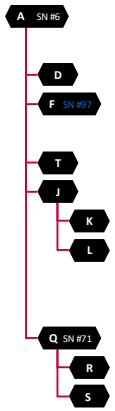
IoT Sensor Data

Data Model Requirements for Digital Twin Configuration

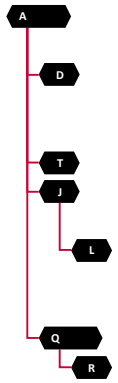
Customer Demands



Customer 1



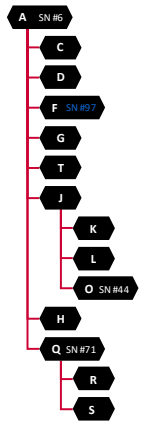
Customer 2



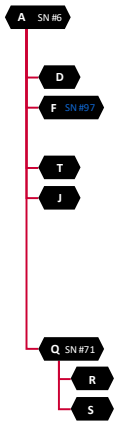
Customer 3

Customer 4

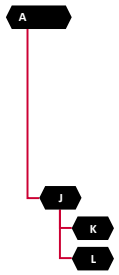
Supply Chain Perspective



OEM

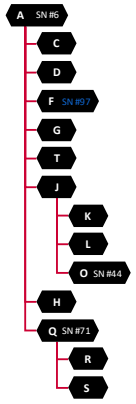


Owner Operator

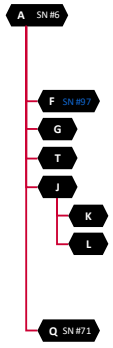


Tier Supplier

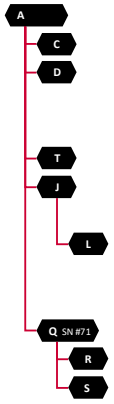
Business Model



In-Product
Capability Purchase



Power
by the Hour



PaaS
(Product as a Service)

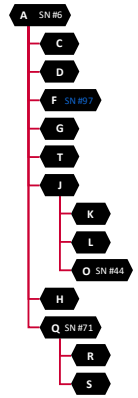
Usage-based
Billing

Digital Twin Configuration

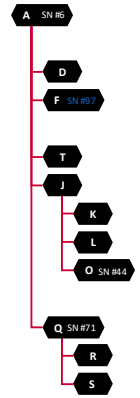
Asset Model

(Persistent & Derived)

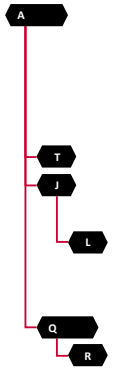
Target Scenario



Predictive
Maintenance



Performance
Optimization

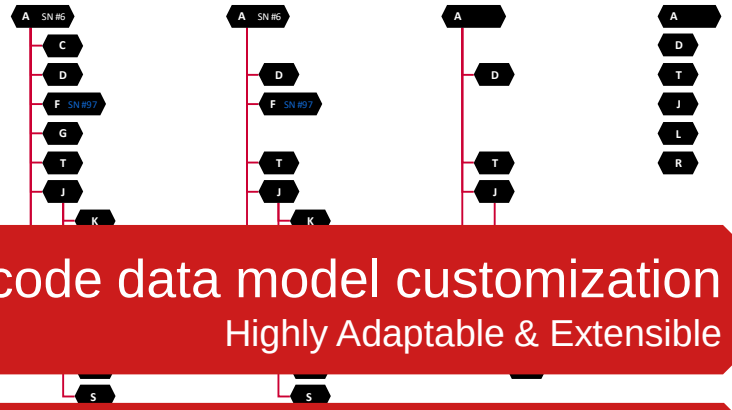


Over-the-Air
Software Updates

Remote
Operation

Data Model Requirements for Digital Twin Configuration

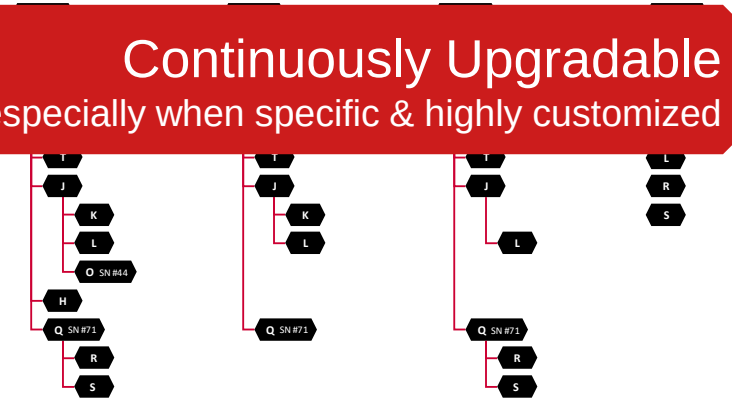
Customer Demands



Low-code data model customization
Highly Adaptable & Extensible

Open connectivity & interoperability
Link / Federate with Legacy

Continuously Upgradable
especially when specific & highly customized



In-Product Capability Purchase

Power by the Hour

PaaS (Product as a Service)

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Digital Twin Configuration

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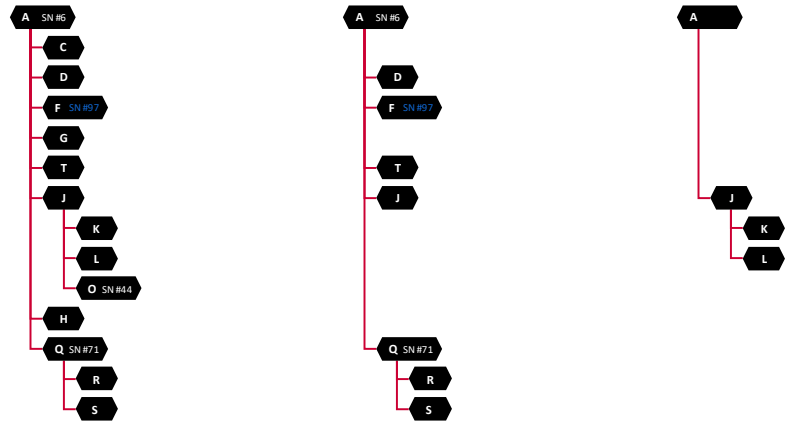
Supply Chain Perspective



OEM

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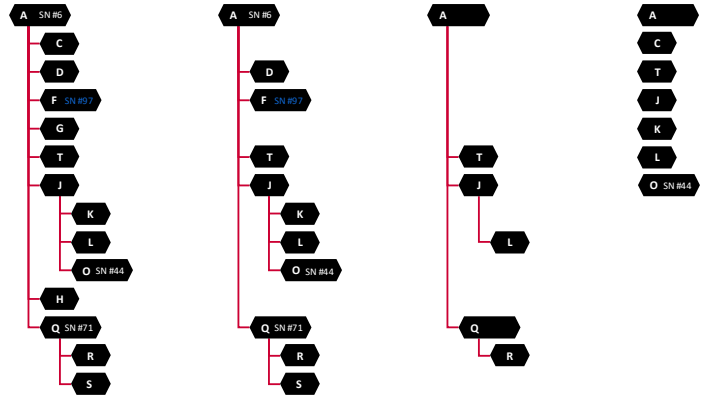
Tier Supplier

Target Scenario



Predictive Maintenance

Performance Optimization

Over-the-Air Software Updates

Remote Operation

Aras Digital Twin Core for Configuration Management

PDM

ERP

EAM

Other Enterprise Systems

Federated Connections

Data can be derived and persisted

Digital Twin Configuration

Exact digital representation of a physical asset

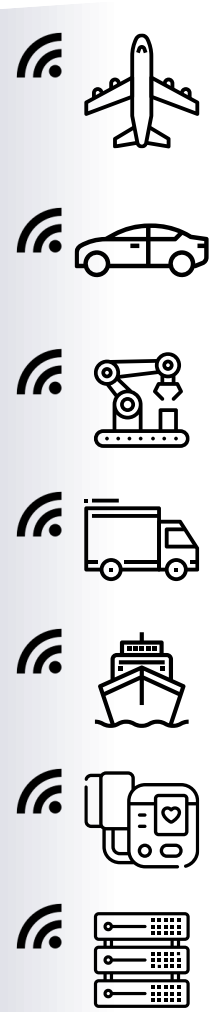
As-built / As-maintained asset model

Necessary context for analytics, visualization, and simulation

Digital Twin Performance

Time series data from sensors

- IoT Sensor Data
- Data Lakes
- Analytics
- AI / ML



aras INNOVATOR

DTC

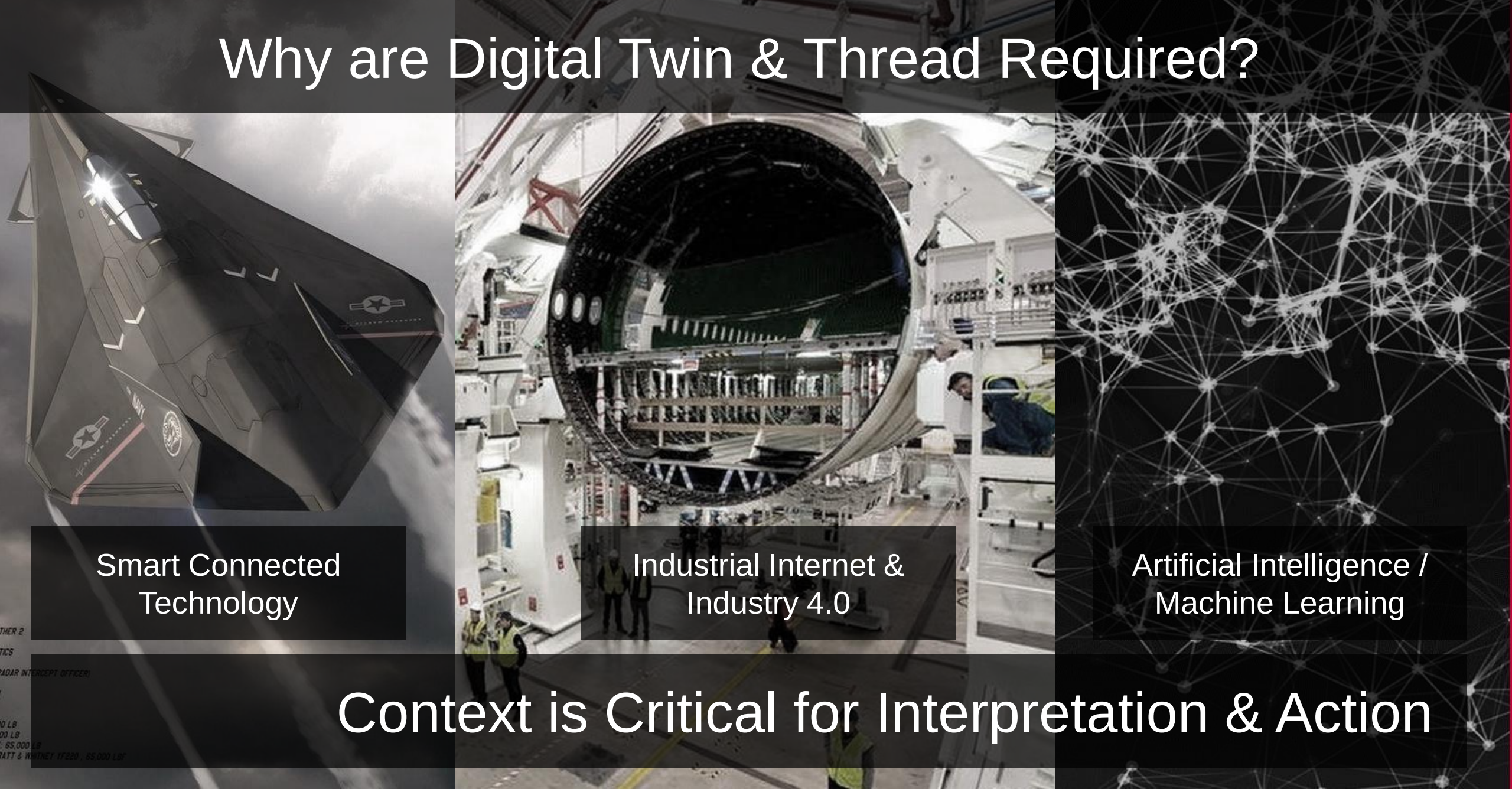
Aras Partners

Microsoft Azure IBM aws Google Cloud Platform

GLOBAL PRODUCT DATA INTEROPERABILITY SUMMIT 2022


Product designs
Manufacturing processes
Quality tests
Maintenance effectiveness
Digital Thread Video: https://bit.ly/3eKx3YQ
aras

Why are Digital Twin & Thread Required?



Smart Connected Technology

Industrial Internet & Industry 4.0

Artificial Intelligence / Machine Learning

Context is Critical for Interpretation & Action

Kawasaki

Aerospace Systems Company

source: khi

AIRBUS

source: Airbus

smart manufacturing

How innovative thinking in IT can revolutionize a long-established business

The Airbus A350 and other models in the company's line benefit from the use of the "Greenhouse" IT concept.

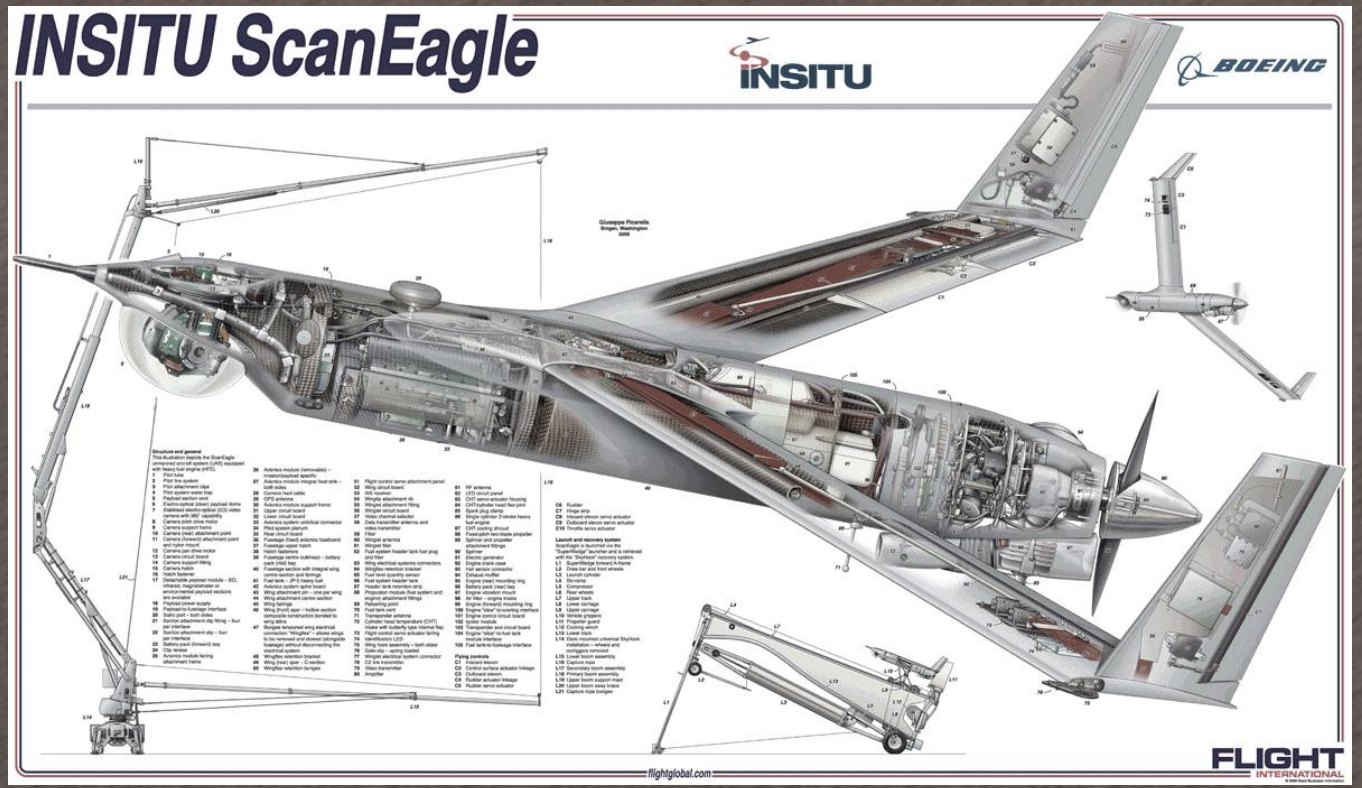
Airbus Creates a 'Greenhouse' for Digital Transformation

To say that business is booming at Airbus would be an understatement. The global aircraft maker, which supplies half the world's commercial aircraft, currently has bookings for new jet airplanes in its commercial division that total more than one trillion Euro, pushing out new orders to a 10-year waiting period. As a result, Airbus is focusing considerable effort to devise innovative, new ways to streamline engineering, test, manufacturing and quality to build planes faster and more effectively.

From an IT perspective, making the business faster means undertaking a digital transformation so that teams across the enterprise can access and share product data more quickly and easily than ever before. It's the only way to clear out the order backlog quickly while ensuring superior product quality. What's fascinating about the digital transformation story at Airbus is not so much what they are doing, but how they are doing it. The story highlights how innovative thinking in IT can revolutionize a business, even one as established and global as Airbus.

Airbus relies on more than 1,000 point systems to keep engineering, test, manufacturing and quality running smoothly. It's these applications that Airbus IT recognized needed to be modernized, upgraded, and integrated to streamline the business. "The question was how can IT enable modernization of so many systems without writing code from scratch and taking years to do it," said Henrik Weimer

INSITU
A Boeing Company



source: insitu

Insitu
Fast Facts

Employees:
1000+ worldwide

Founded:
1994

Headquarters:
Bingen, Washington, USA

25 YEARS OPERATIONAL EXPERIENCE

1.3 MILLION OPERATIONAL FLIGHT HOURS

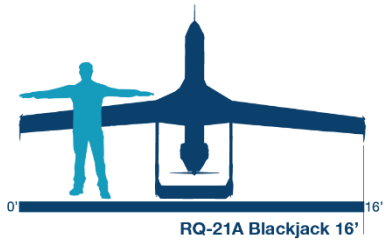
2 PROGRAMS OF RECORD WITH THE DEPARTMENT OF DEFENSE

Unmanned Air Vehicles

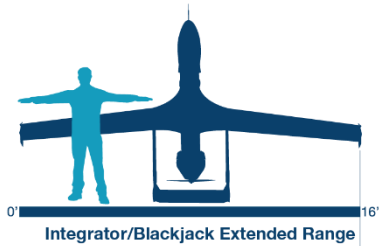
ScanEagle Wingspan 10'

ScanEagle3 Wingspan 13'

Integrator/Blackjack Wingspan 16'



RQ-21A Blackjack 16'



Integrator/Blackjack Extended Range Wingspan 16'

Global Presence

Global customer base of more than **28** COUNTRIES

10,000+ HOURS OF ISR SERVICES ON AVERAGE per month GLOBALLY

Global UAS operators trained: 9,500

Deployable field personnel world-wide: 250+

Global Sites of Operation: 47

Multiple aircraft platforms with  **field-swappable payloads**

Unparalleled 99% **mission reliability rate**

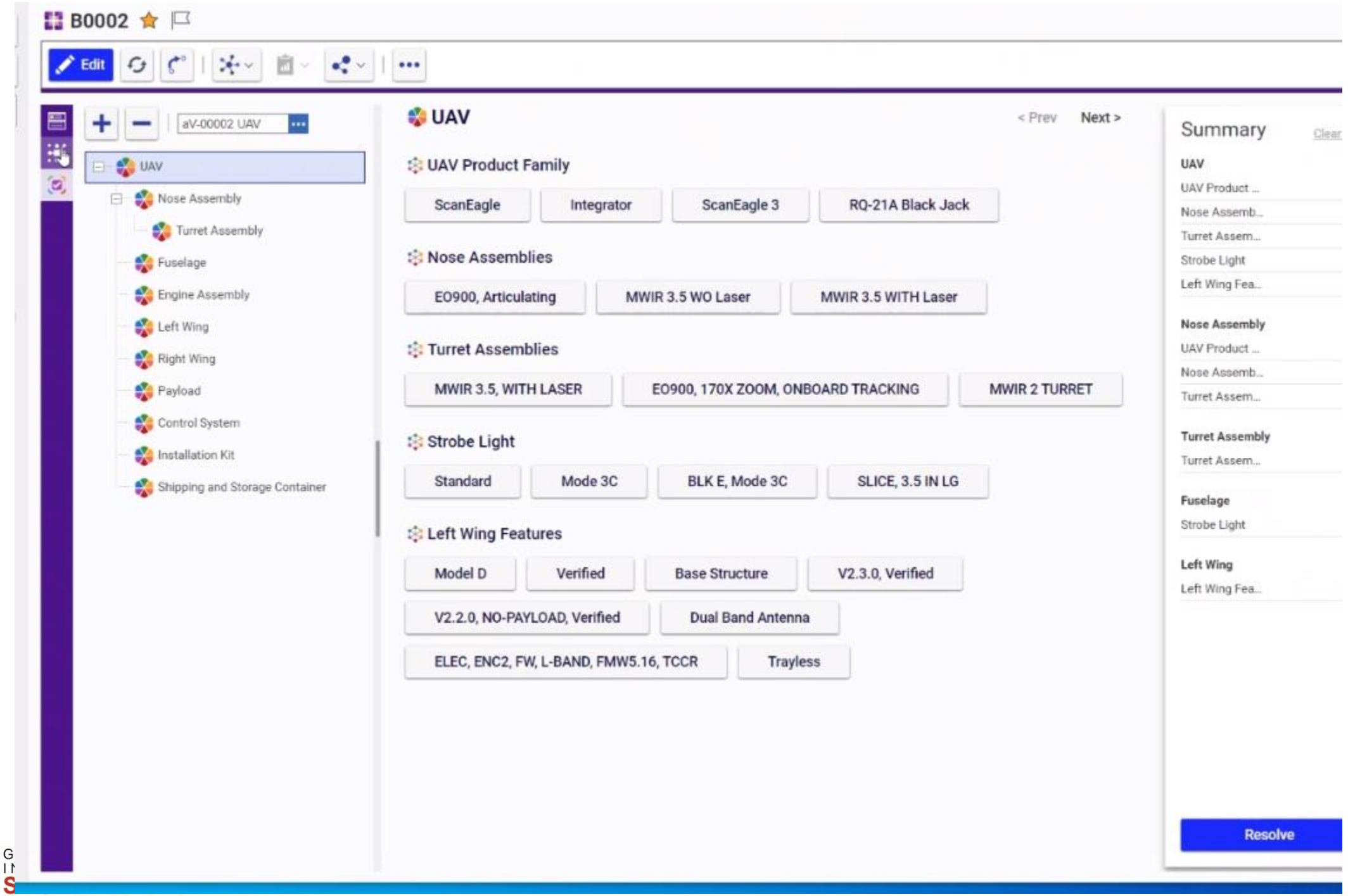
More than **3500 UAVs** built to date

Maritime Operations

Shipboard Flight Sorties: 8,000

Shipboard Flight Hours: 60,000

Operations from **27** different class ships


B0002
Edit
aV-00002 UAV
UAV
Nose Assembly
Turret Assembly
Fuselage
Engine Assembly
Left Wing
Right Wing
Payload
Control System
Installation Kit
Shipping and Storage Container
UAV
< Prev
Next >
UAV Product Family
ScanEagle
Integrator
ScanEagle 3
RQ-21A Black Jack
Nose Assemblies
EO900, Articulating
MWIR 3.5 WO Laser
MWIR 3.5 WITH Laser
Turret Assemblies
MWIR 3.5, WITH LASER
EO900, 170X ZOOM, ONBOARD TRACKING
MWIR 2 TURRET
Strobe Light
Standard
Mode 3C
BLK E, Mode 3C
SLICE, 3.5 IN LG
Left Wing Features
Model D
Verified
Base Structure
V2.3.0, Verified
V2.2.0, NO-PAYLOAD, Verified
Dual Band Antenna
ELEC, ENC2, FW, L-BAND, FMW5.16, TCCR
Trayless
Summary
Clear
UAV
UAV Product ...
Nose Assemb...
Turret Assem...
Strobe Light
Left Wing Fea...
Nose Assembly
UAV Product ...
Nose Assemb...
Turret Assem...
Turret Assembly
Turret Assem...
Fuselage
Strobe Light
Left Wing
Left Wing Fea...
Resolve

More Info

Digital Thread – Digital Thread with Aras | Connect Everything

eBook – Unlocking Productivity Gains: The Case for a Digital Thread

Case Study – Kawasaki Heavy Industries

Video – Lifecycle Traceability and the Digital Thread

Digital Twin – Digital Twin Core from Aras | Create, Manage, and Sustain Context

eBook – Managing Product as a Service with the Digital Twin

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