Necessity of the Digital Twin & Digital Thread

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Commercial & Defense Aerospace Changing

Materials Advancements & Additive Manufacturing

Remote & Autonomous UAV / UAS

Data Collection & Handling
Smart Connected Future = Even More Changes

New Defense Technologies + Next Gen Aircraft
More Systems-of-Systems & Craft-to-Craft
Introduction of Artificial Intelligence / Machine Learning
Data Streaming from Factory & Field
Efficiency Improvements
Performance Optimization
Predictive Maintenance
Many Initiatives Focused on Infrastructure

Sensors

Datacenter & Cloud

Analytics
Time Series Data
Analyze, Interpret, Act
(Some) TIME SERIES DATA

- Airspeed
- Altitude
- Barometric Pressure (electronic/aneroid)
- Outside Air Temperature (C/F)
- Fuel pressure (x number of engines)
- Fuel flow (x number of engines)
- Cabin air pressure (psi/hg)
- Cargo air pressure; doors, bulkheads
- Cabin temperature; doors, bulkhead
- Cargo temperature
- Fuel temperature; fuel tanks, fuel pumps
- Radar air traffic – TCAS

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Hydraulic Pressure; brakes, flaps, spoilers, rudder, aileron, landing gear pumps
Weight sensors - landing gear
Turbines; RPM (N1/N2), Inlet- turbine pressure, Temperature, fuel burn
Voltmeter; cockpit, main bus, cabin, auxiliary power, cargo, engines, APU
Generator meters (engines, APU)
Electricity Load (amp/hr); flight deck, cabin, cargo
Fire sensors; cabin, cargo, engines, fuel, brakes, electronics bay
Carbon Dioxide; cabin, cargo
Magnetic Compass
GPS (satellite / terrestrial)
Radio Compass (NDB)
Doppler radar; weather, lightning, downdraft (microburst)

Increasing Context Problem

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Knowledge = Information in Context
Future Without Digital Twin + Digital Thread Context

Ramifications

- Misdirected Actions
- Inaccurate Conclusions
- Misinterpretations

Risks

- Loss of Life
- Safety Issues
- Liability
- Brand Damage
- Regulatory Actions
- Operational Shutdowns
- Lost Revenues
- Customer Frustration
- Unnecessary Rework / Repairs

Risks increase exponentially with artificial intelligence
What is the Digital Twin Configuration?

General representation of a family of aircraft or defense systems?

Just Mechanical?

As-Designed?
exact digital representation of the physical thing right now
What is the Digital Thread?

Relationship Connections

Meaningful relationship connections between all of a product’s digital assets – and their revisions over the lifecycle – including (but not limited to) versions of BOMs, parts, software, electronics, CAD models, documents, requirements, process plans, service manuals, etc.
Digital Thread = Meaningful Relationships

Context

Dependency

Bill of Materials?
FFF Alternates?
Other?

Rev A
Part 123
Rev A
Part 987
Rev B
Part 987
Rev C
Part 987

Floating Relationship

Rev A
Part 123
Rev A
Part 987
Rev B
Part 987
Rev C
Part 987

Fixed Relationship
Are Digital Twin & Thread Achievable?

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

RIP & REPLACE
NOT REALISTIC
Platform Overlay Approach

Concept → Development → Manufacturing → Service

Platform Applications

Platform Services

MBSE
Simulation
ALM
ECAD PDM
MCAD PDM
ERP
MES
Maint. Mgt.
IOT

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System-of-Systems Architecture
also called Platform for the PLM Backbone

PLM Backbone = Aras Innovator

- Not just Links, but Relationships
- Avoids Risk & Disruption
- Move Agile, Fast, Bi-modal IT
Example Architecture
Aras Platform at Schaeffler for 20,000 Users
Platform Requirements for Digital Twin & Thread

**MUST HAVE**
- Ability to **ingest data** through API and Services
- Integration: ability to manipulate processes and data through exposed API / Services
- Extensibility: ability to build / extend functionality leveraging COTS framework
- Ability to **exfiltrate data** out of API / Services
- Transparent & Interrogatable APIs
- FULL API Capabilities Exposed
- Open Data Model
- Dynamic Data Model
- Open Data Access

**CANNOT HAVE**
- Proprietary APIs
- Incomplete or Hidden API Function Calls
- Proprietary Data Models
- Static / Hard Coded Data Model
- Obfuscated Data
Why are Digital Twin & Thread Necessary?

Context is Critical for Interpretation & Action
CALL TO ACTION

Aras is actively engaging in proof of concept initiatives for open reference architecture development

Please share your use cases & best practices

Digital Twin and Digital Thread

To collaborate & contribute, please contact:

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