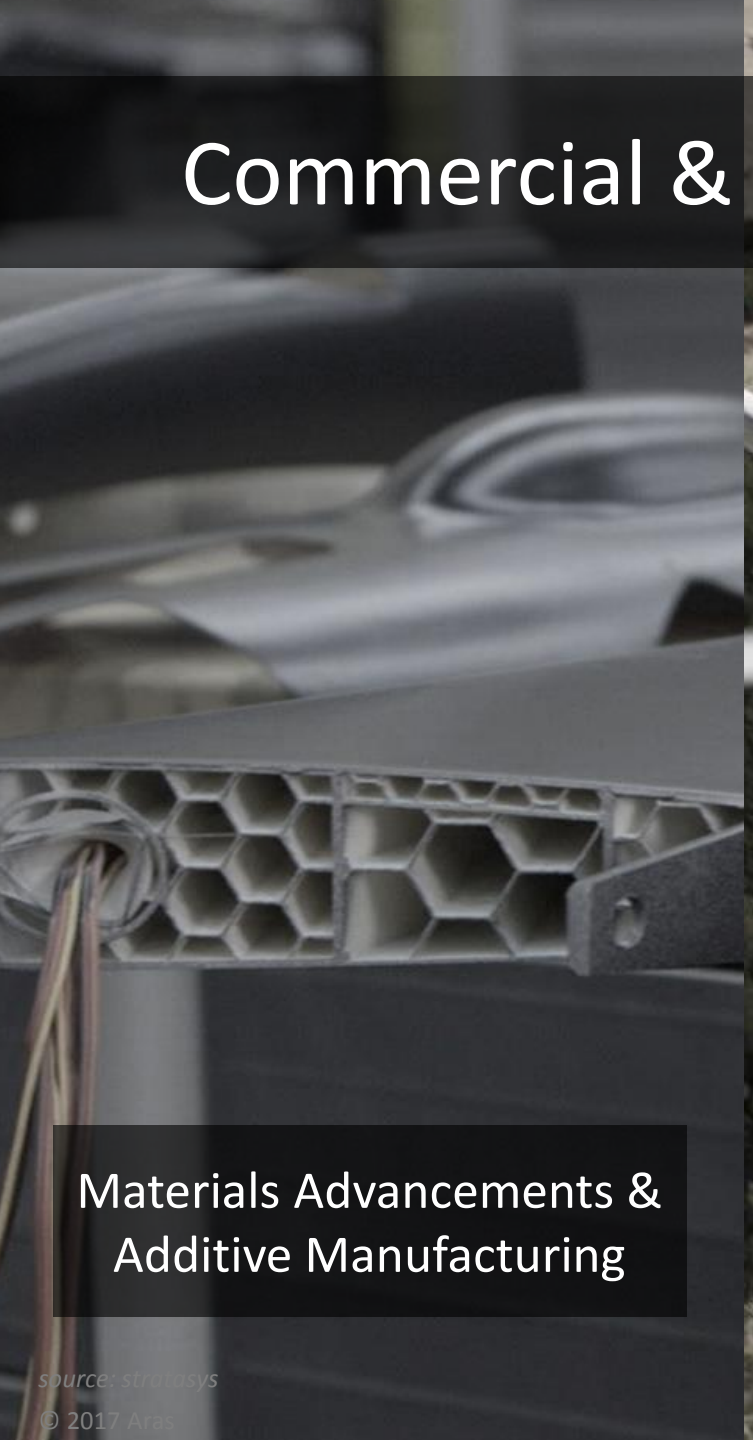
Necessity of the Digital Twin & Digital Thread

Marc Lind | Aras

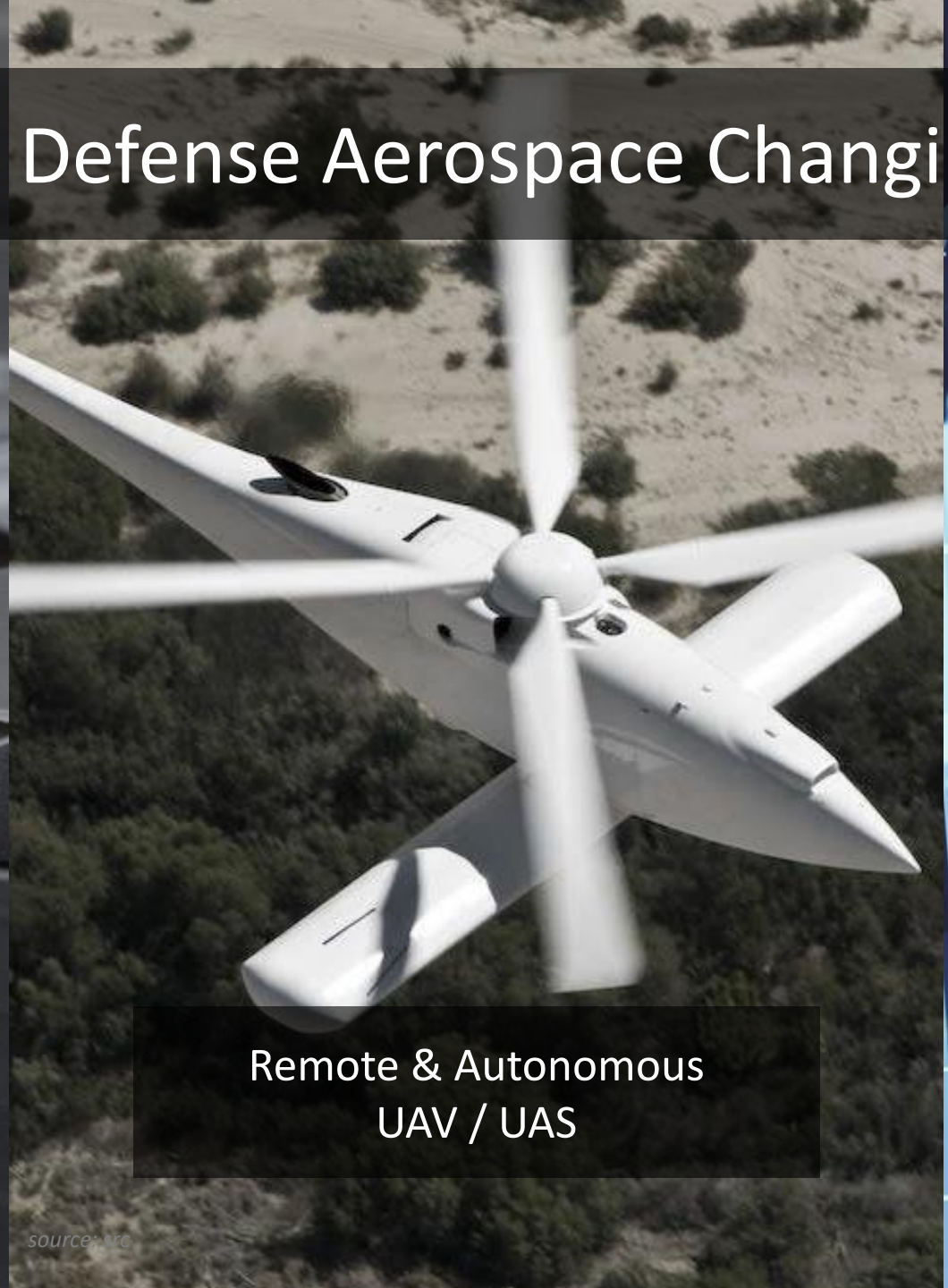
aras.com

Commercial & Defense Aerospace Changing



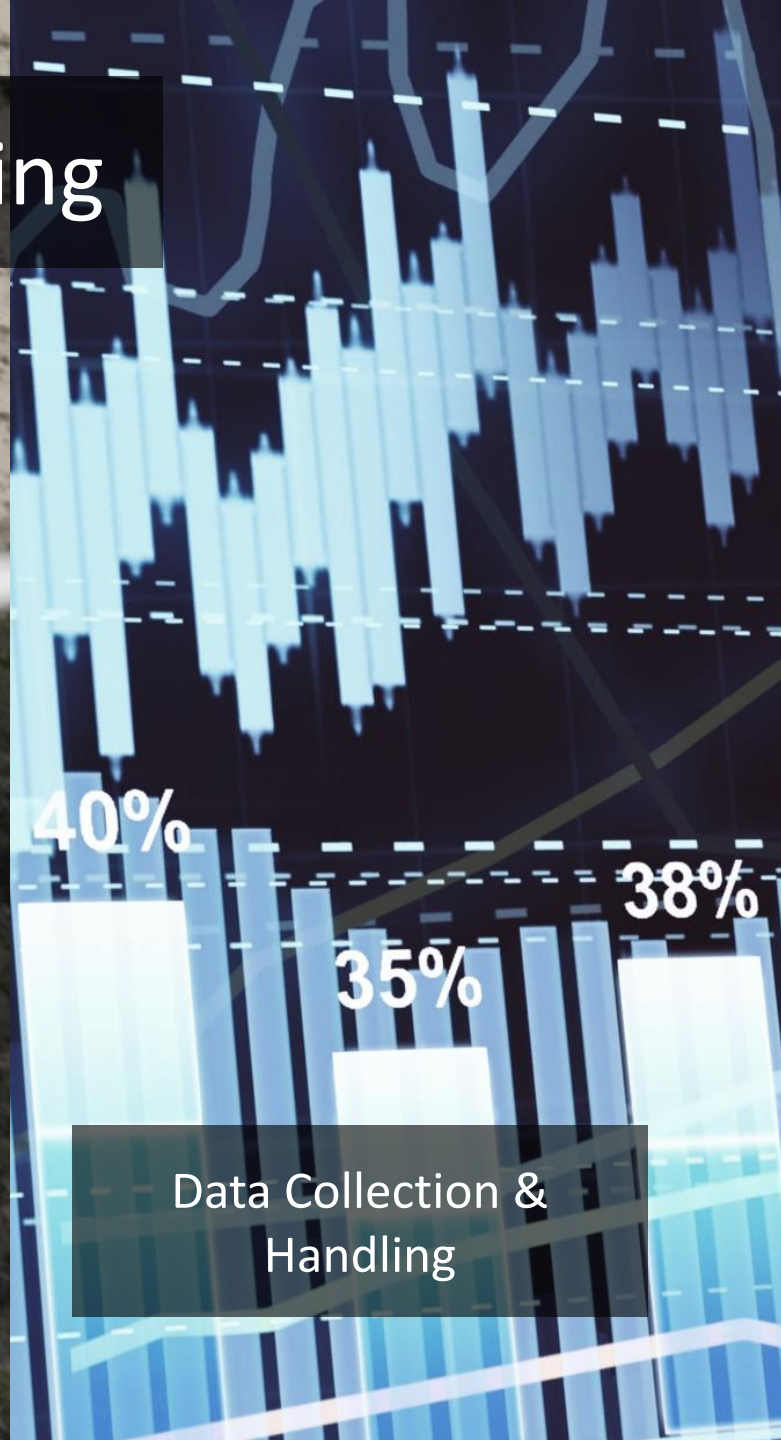
Materials Advancements & Additive Manufacturing

source: stratasys



Remote & Autonomous UAV / UAS

source: src



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

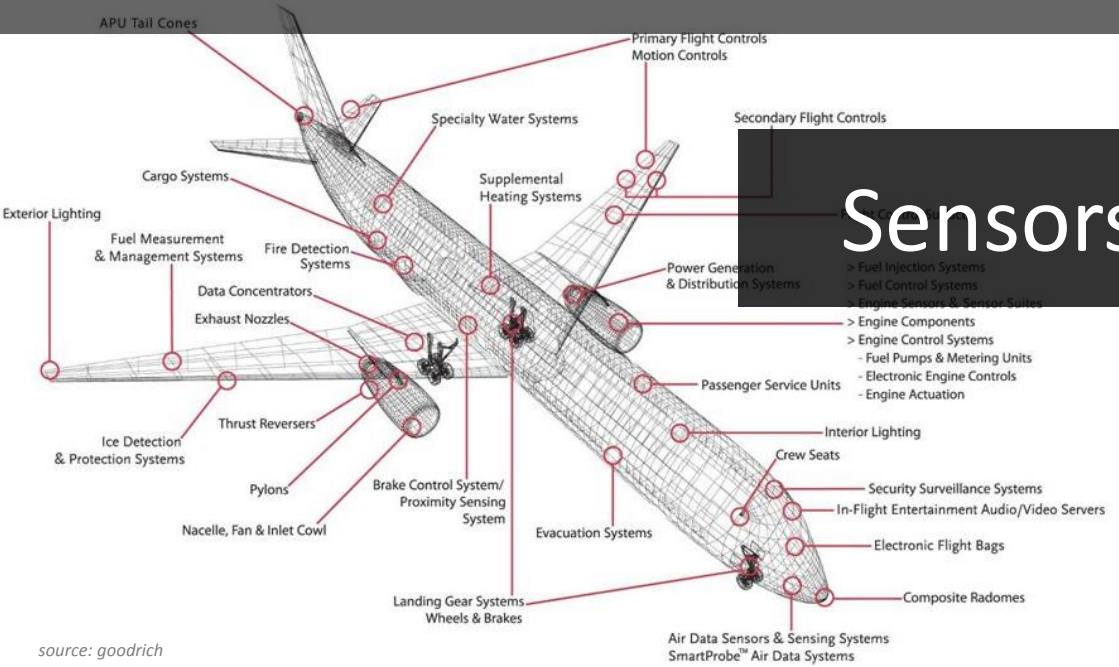
source: airbus

Data Streaming from Factory & Field

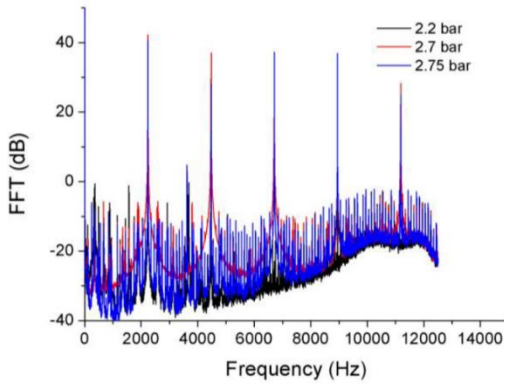
source: airbus

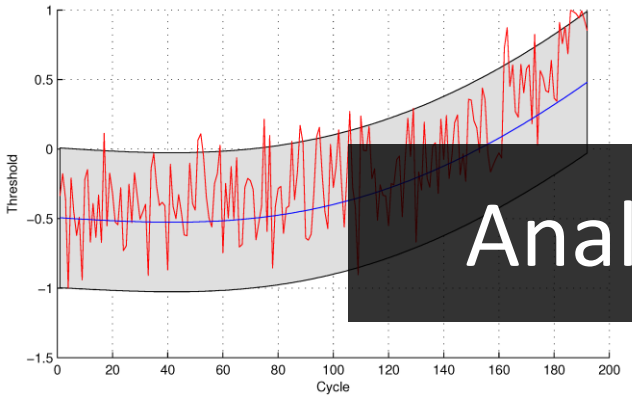

Efficiency Improvements
Performance Optimization
Predictive Maintenance

Many Initiatives Focused on Infrastructure



source: goodrich

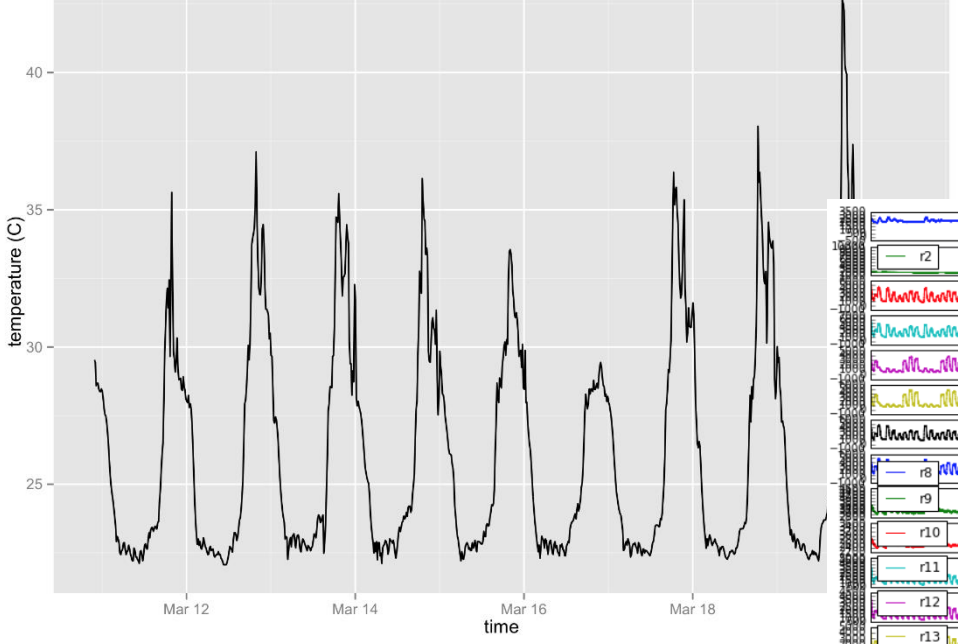


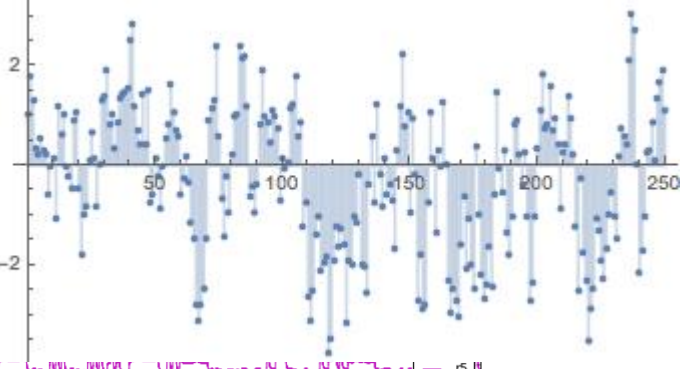


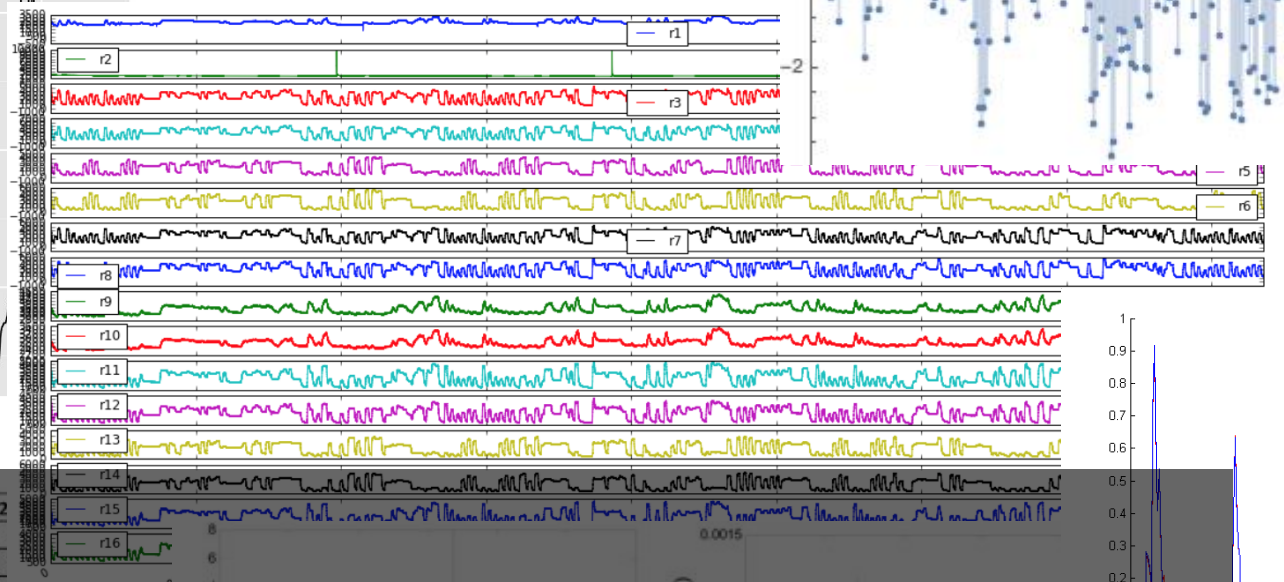
Sensors

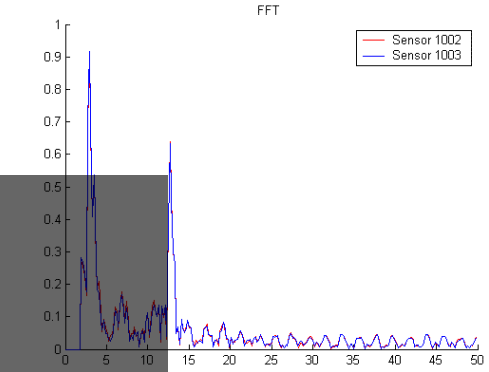
Datacenter & Cloud

Analytics





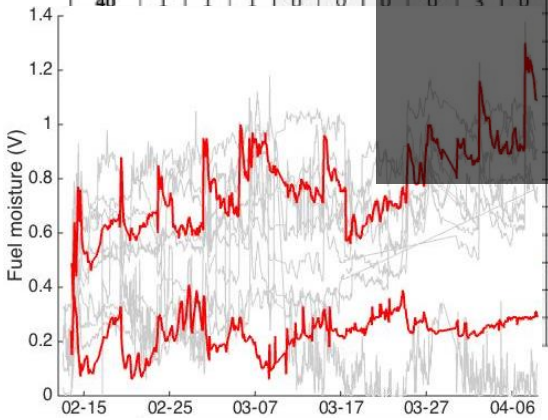




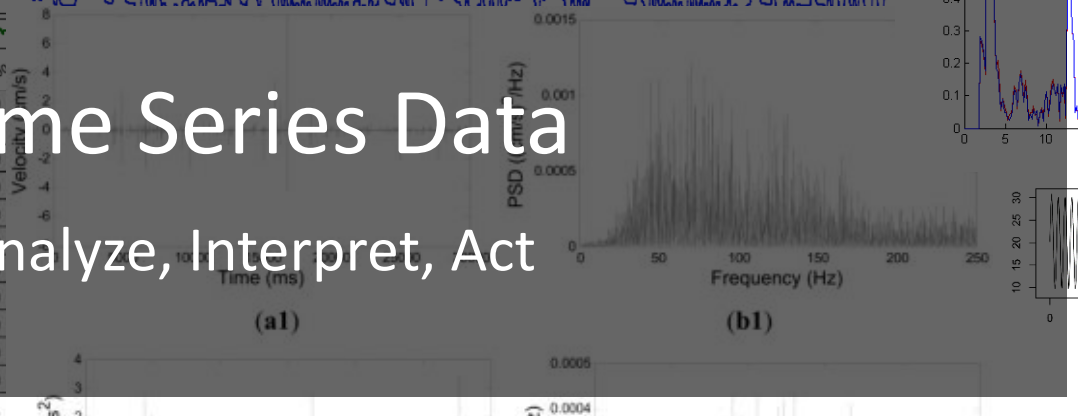
Time Series Data

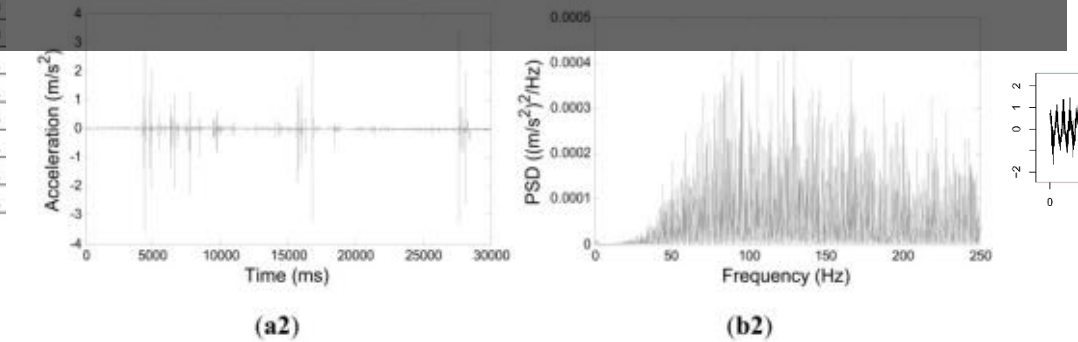
Analyze, Interpret, Act

FROM	31	32	33	20	51	52	100	40	81	82	83	211	212
31	1	1	1	1	1	1	1	1	1	1	1	1	1
32	1	3	0	0	0	0	0	1	0	0	0	0	0
33	1	0	3	0	0	0	1	1	0	0	1	0	0
20	1	0	0	3	0	0	0	0	0	0	1	0	0
51	1	0	1	0	3	0	1	0	0	0	0	0	0
52	1	0	1	0	1	3	1	0	0	0	0	0	0
100	1	0	1	0	0	1	3	0	0	0	1	0	0
40	1	1	1	0	0	0	0	3	0	0	0	0	0



1	1	0	0	0	0	0	0	
3	1	0	0	0	0	0	0	
2	3	0	0	0	0	0	0	
0	0	3	2	1	0	0	0	
0	0	2	3	2	0	0	0	
0	0	0	2	3	0	0	0	
0	0	0	0	0	3	2	1	
0	0	0	0	0	2	3	1	
0	0	0	0	0	0	2	3	
0	0	0	1	1	0	1	1	
0	0	0	1	1	0	0	1	
0	0	0	0	1	0	0	1	





Increasing Context Problem

(Some) Time Series Data

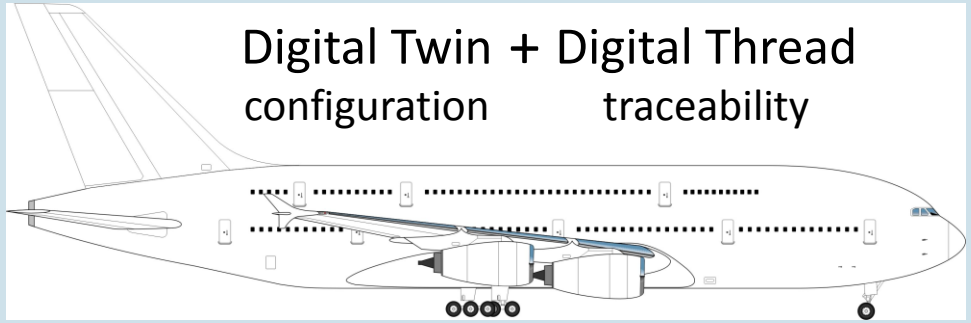
Airspeed	Hydraulic Pressure; brakes, flaps, spoilers, rudder, aileron, landing gear pumps
Altitude	Weight sensors - landing gear
Barometric Pressure (electronic/aneroid)	Turbines; RPM (N1/N2), Inlet- turbine pressure, Temperature, fuel burn
Outside Air Temperature (C/F)	Voltmeter; cockpit, main bus, 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)

Analysis

Context

Digital Twin + Digital Thread

configuration traceability

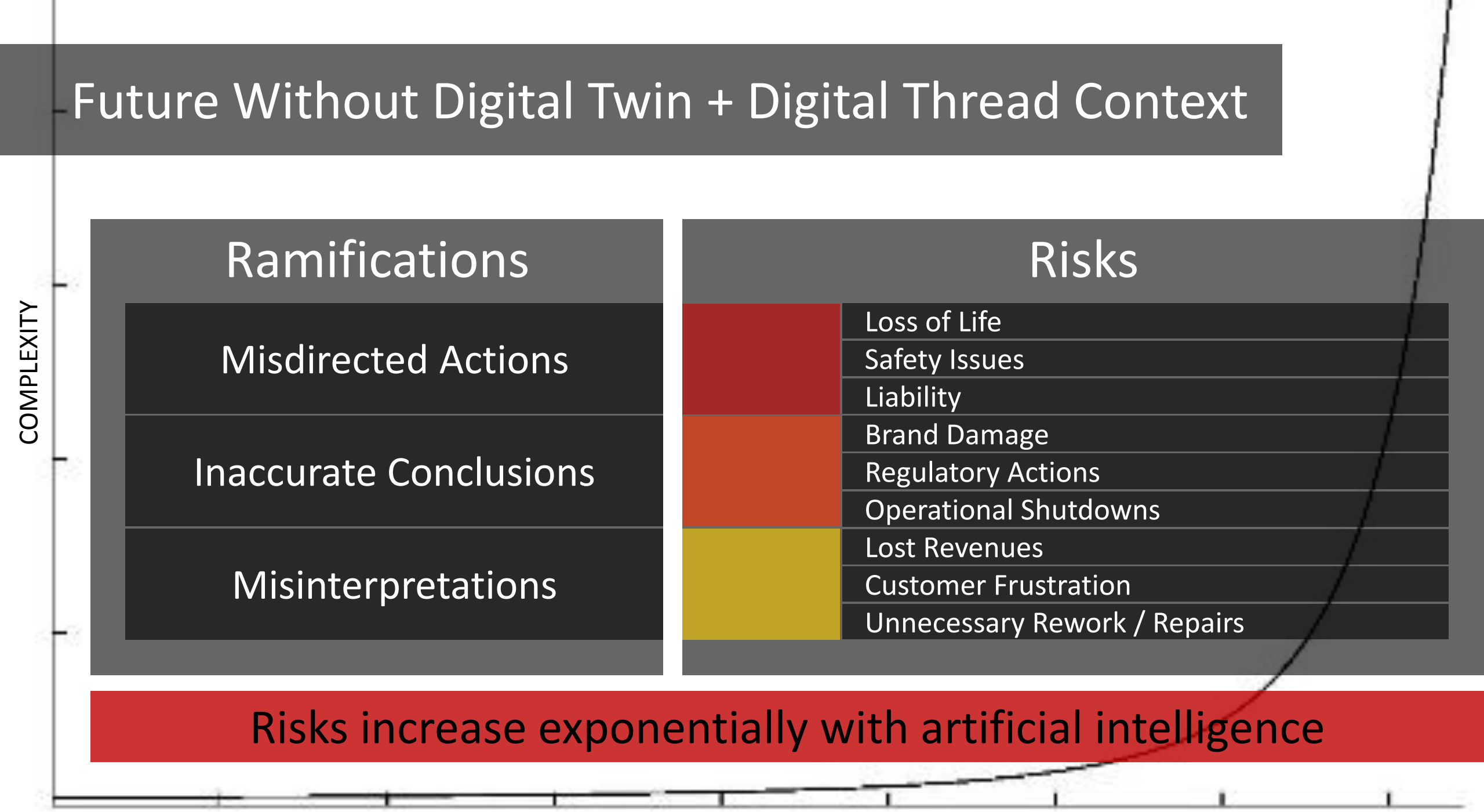


Knowledge = Information in Context

Stefane Gardmann

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

Future 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

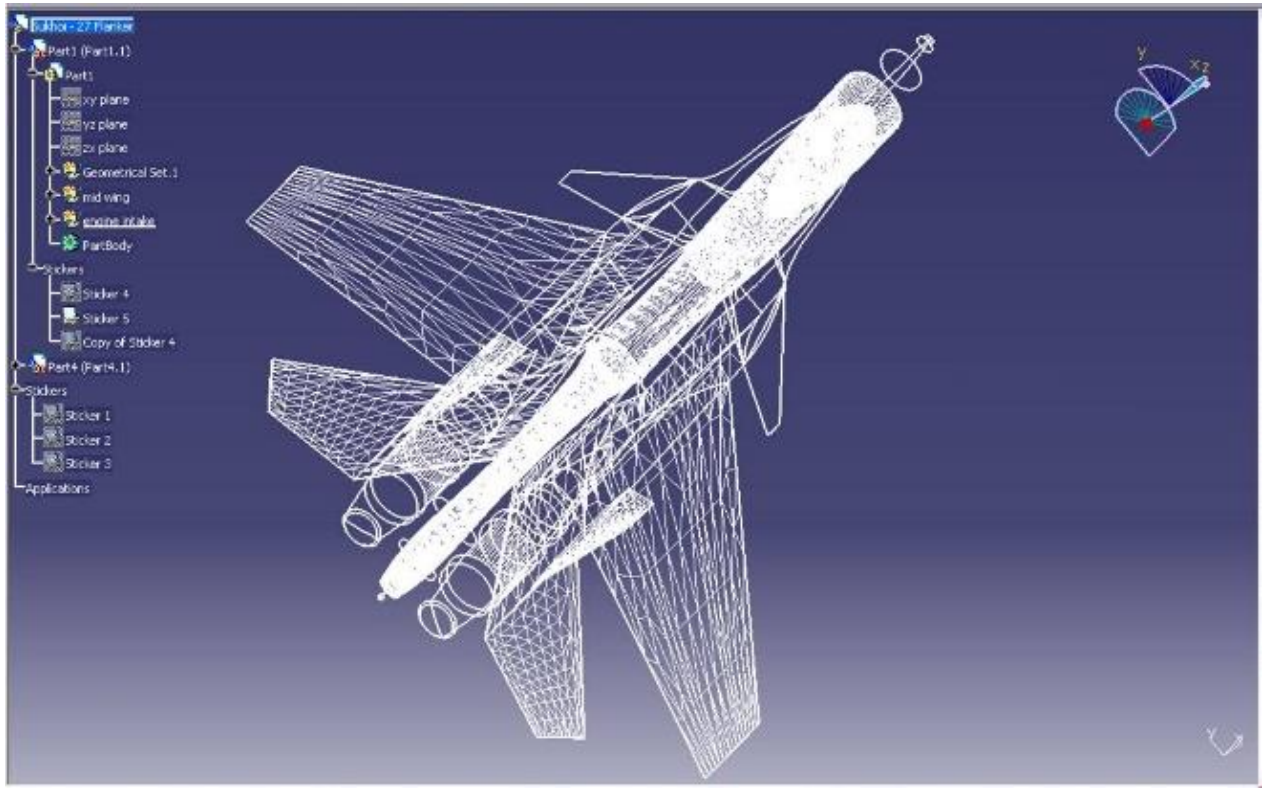
Risks increase exponentially with artificial intelligence

What is the Digital Twin Configuration?

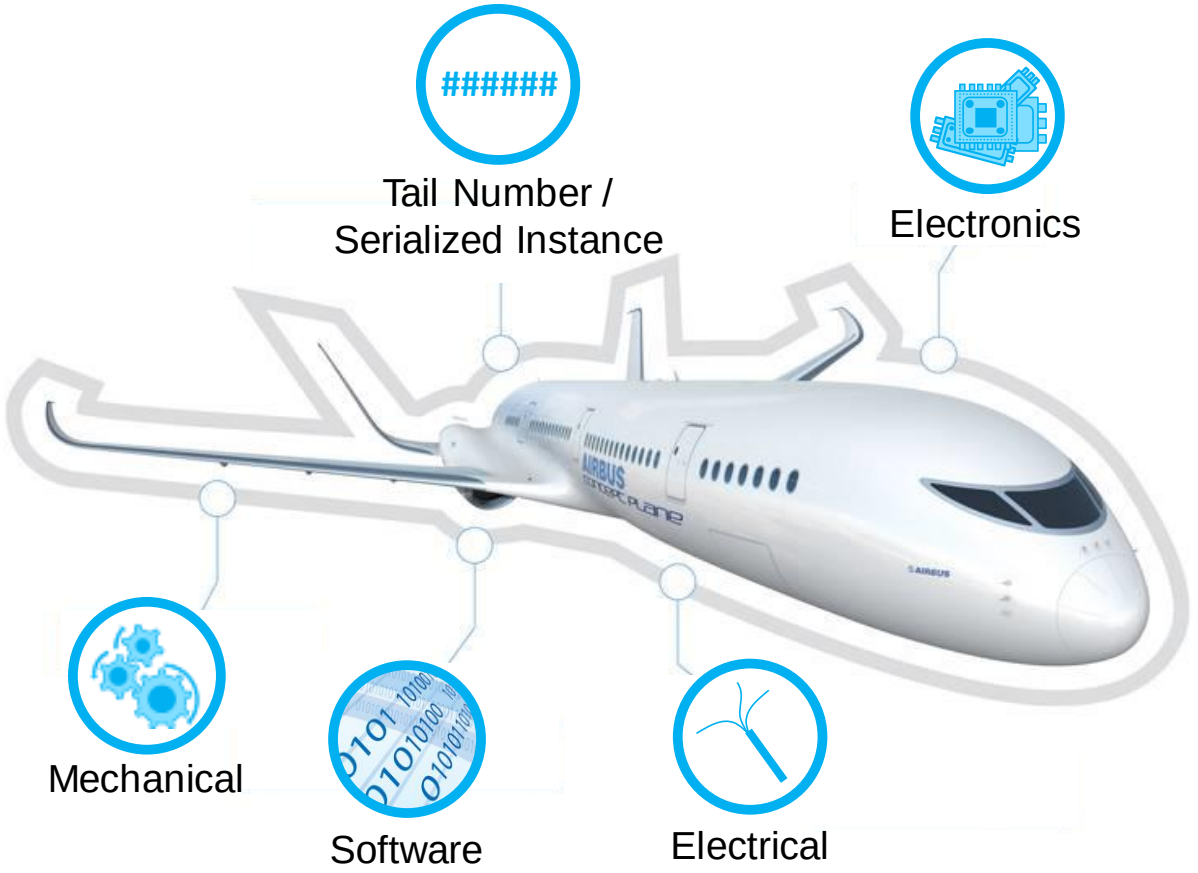
General representation of a family of aircraft or defense systems?

Just Mechanical?

As-Designed?

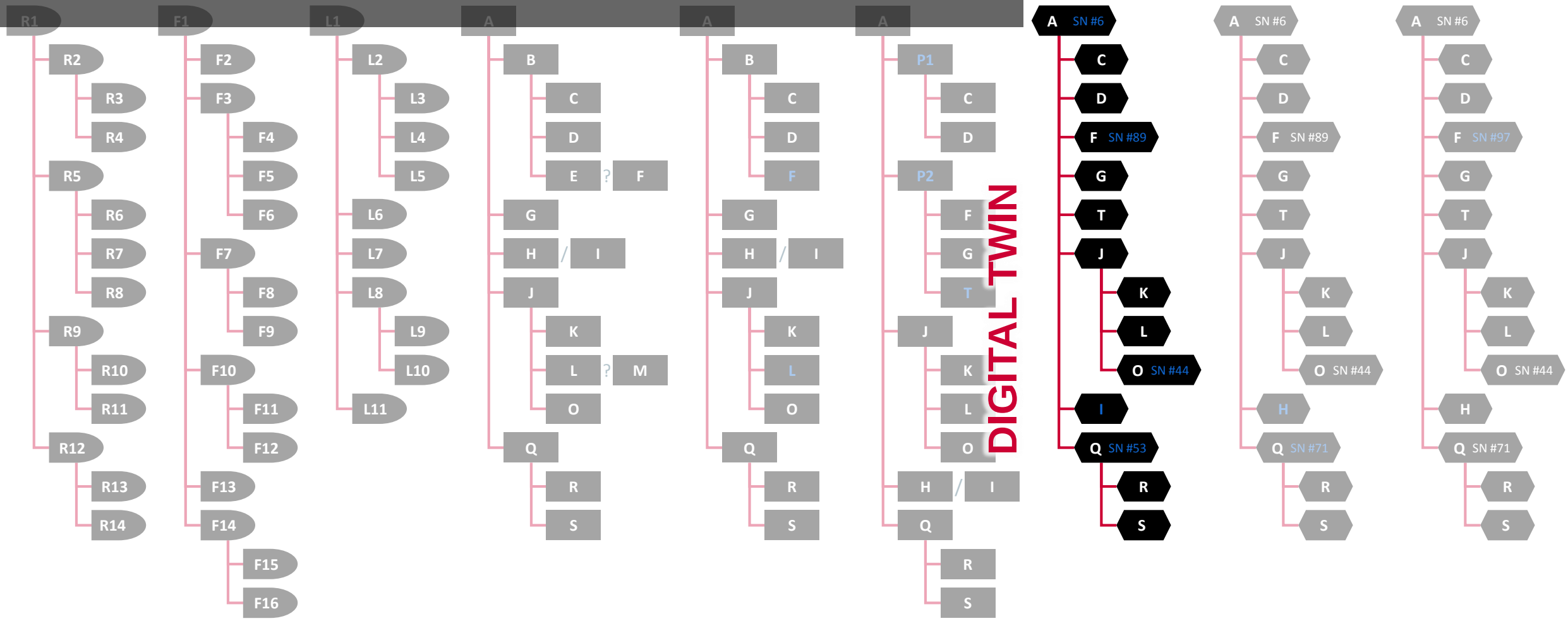


Digital Twin Configuration



exact digital representation of the physical thing right now

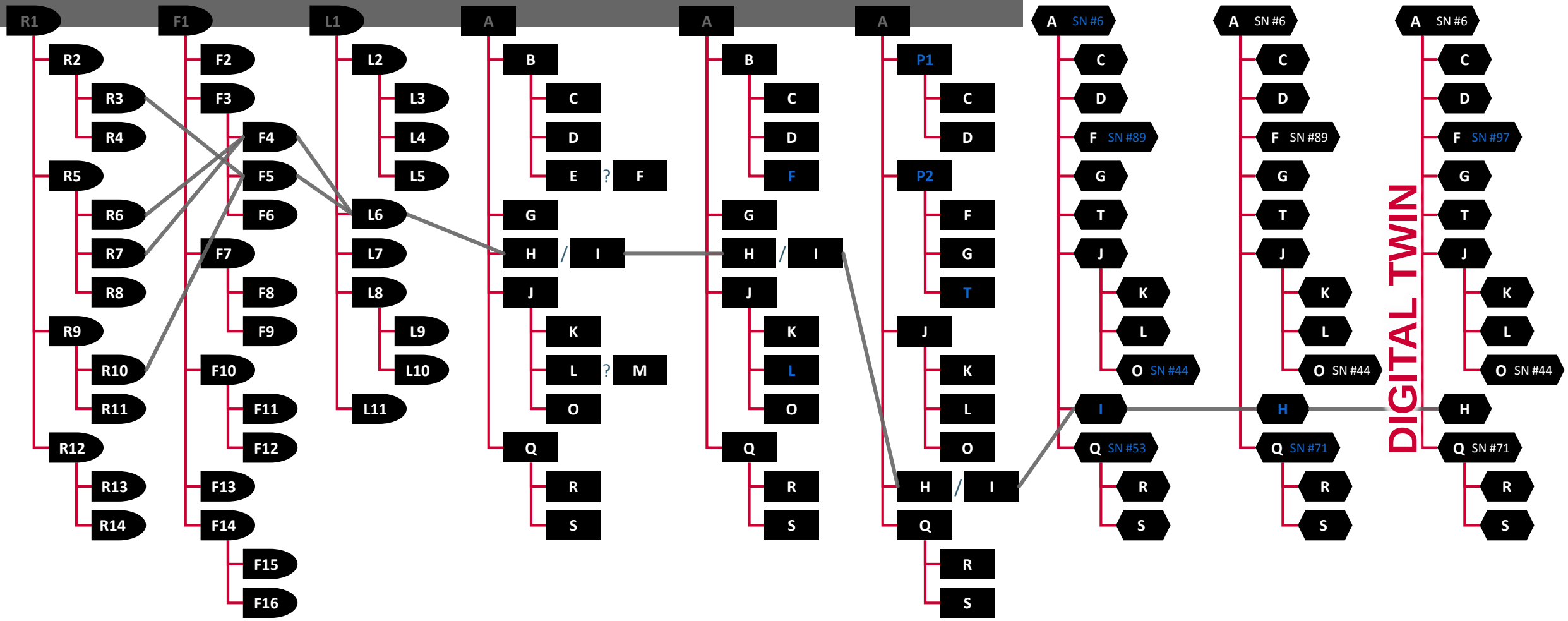
Digital Twin Over Lifecycle



REQUIRED FUNCTIONAL LOGICAL AS DESIGNED AS ORDERED AS PLANNED **AS BUILT** AS DELIVERED AS SERVICED

Concept **Design** **Development** **Launch** **Manufacture** **Service**

Digital Thread Lifecycle Traceability



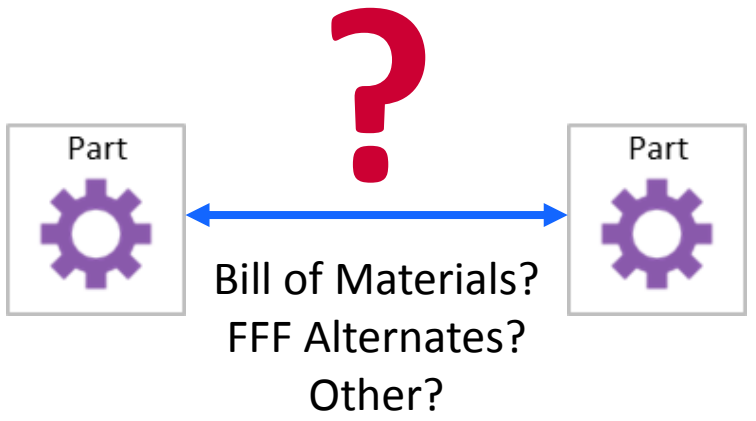
What is the Digital Thread?

Relationship Connections

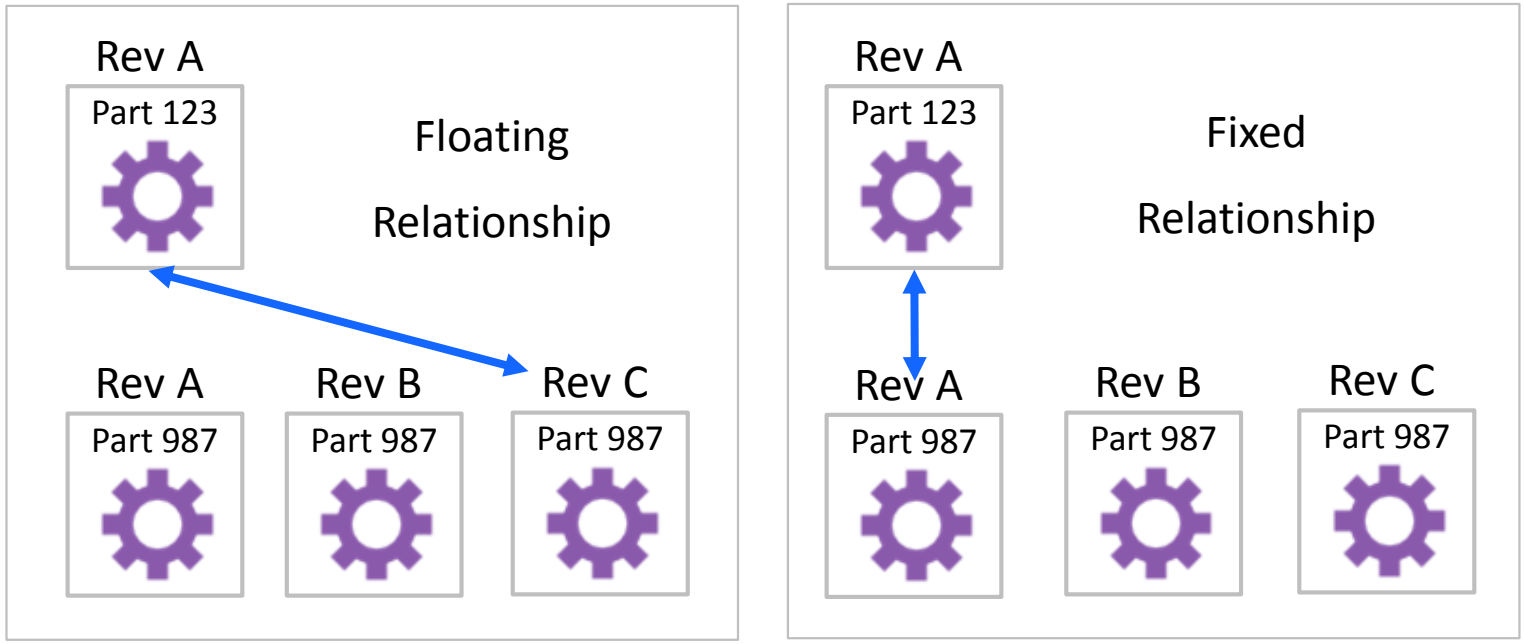
Meaningful relationship connections between all of a product's digital assets – and their revisions over the lifecycle – including (but not limited to) versions of BOMs, parts, software, electronics, CAD models, documents, requirements, process plans, service manuals, etc

Digital Thread = Meaningful Relationships

Context



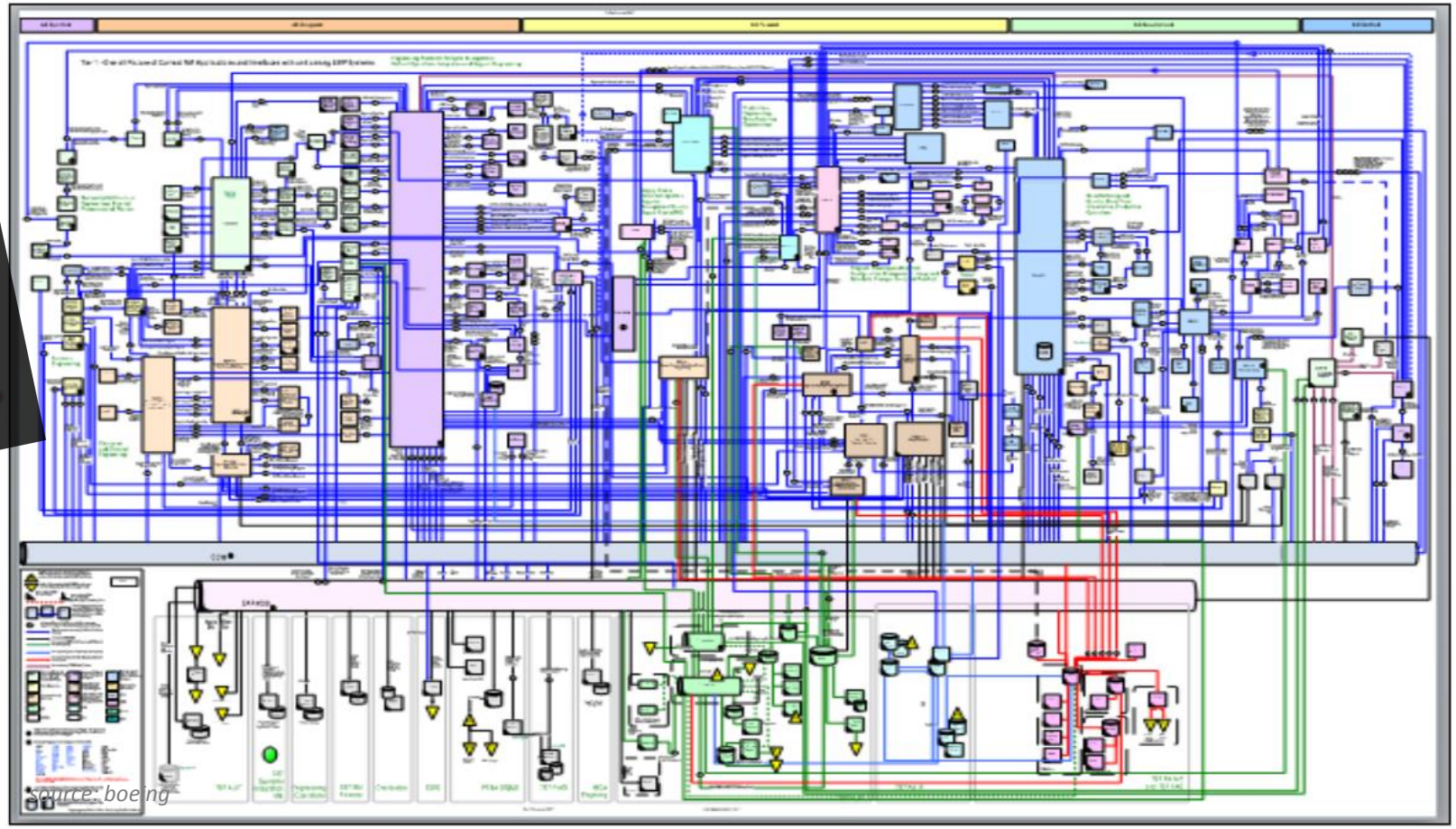
Dependency



Are Digital Twin & Thread Achievable?

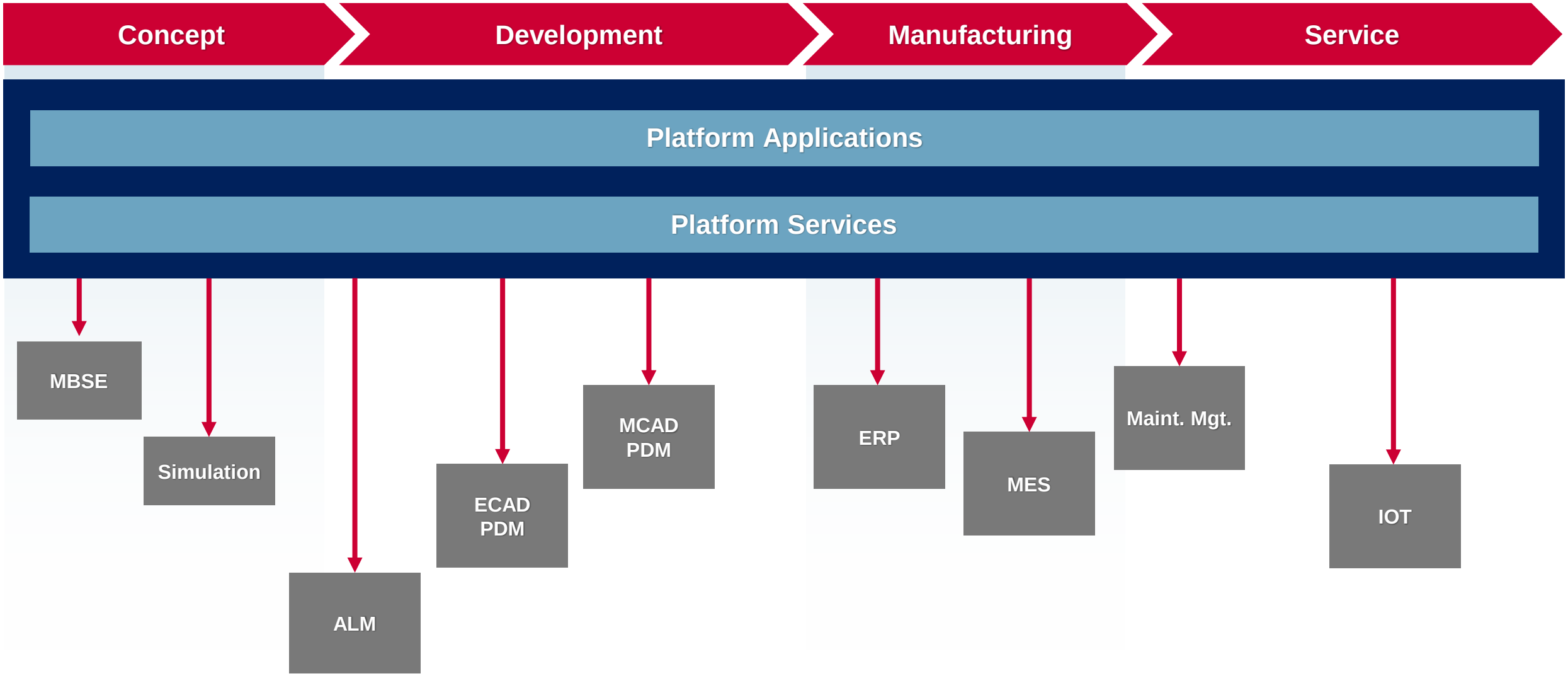
Thousands of Existing Systems & Petabytes of Data
Users around the World

RIP & REPLACE
NOT REALISTIC



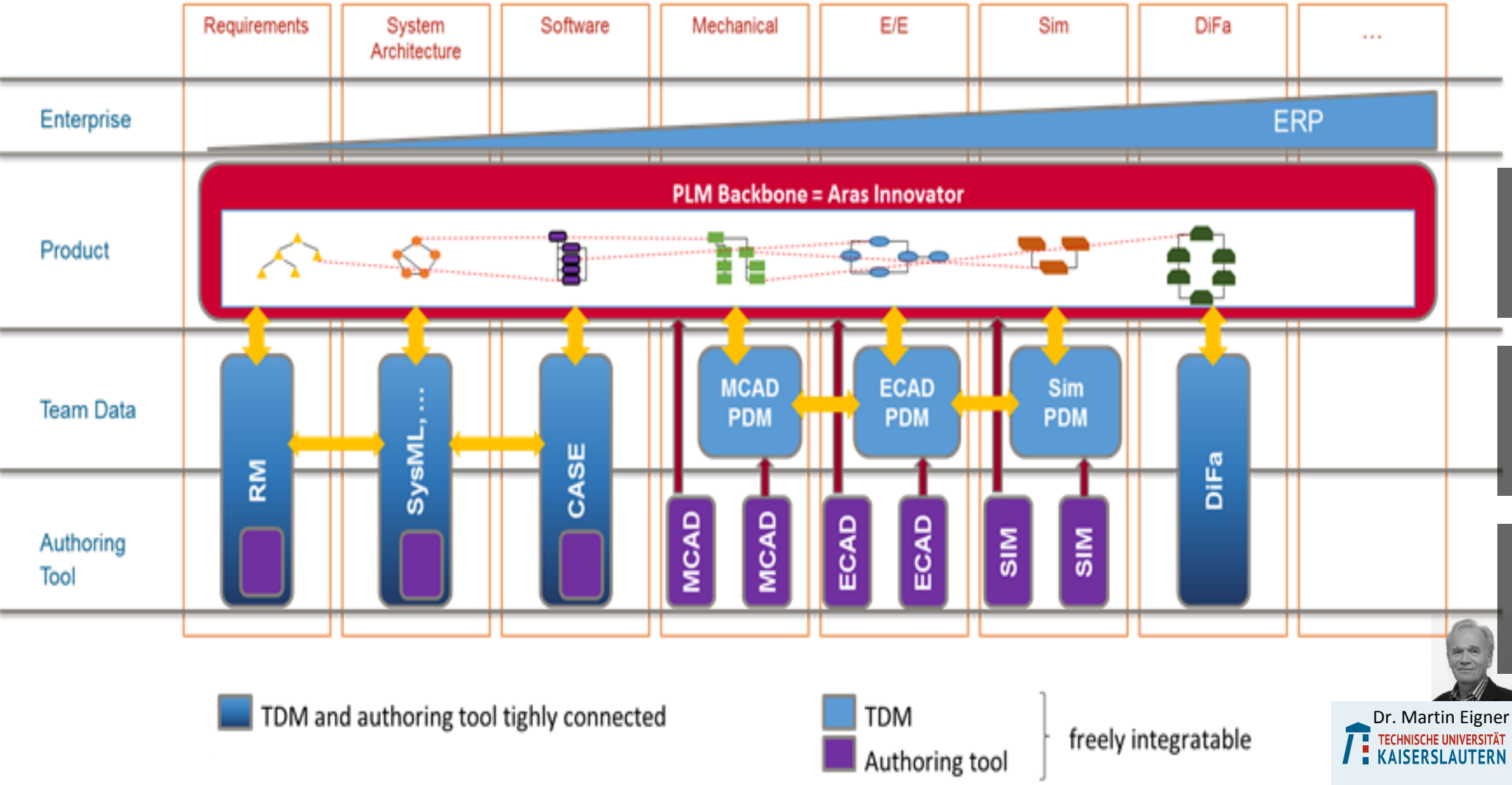
Source: boeing

Platform Overlay Approach



System-of-Systems Architecture

also called Platform for the PLM Backbone



TDM and authoring tool tighly connected

TDM
Authoring tool
freely integratable

Not just Links, but Relationships

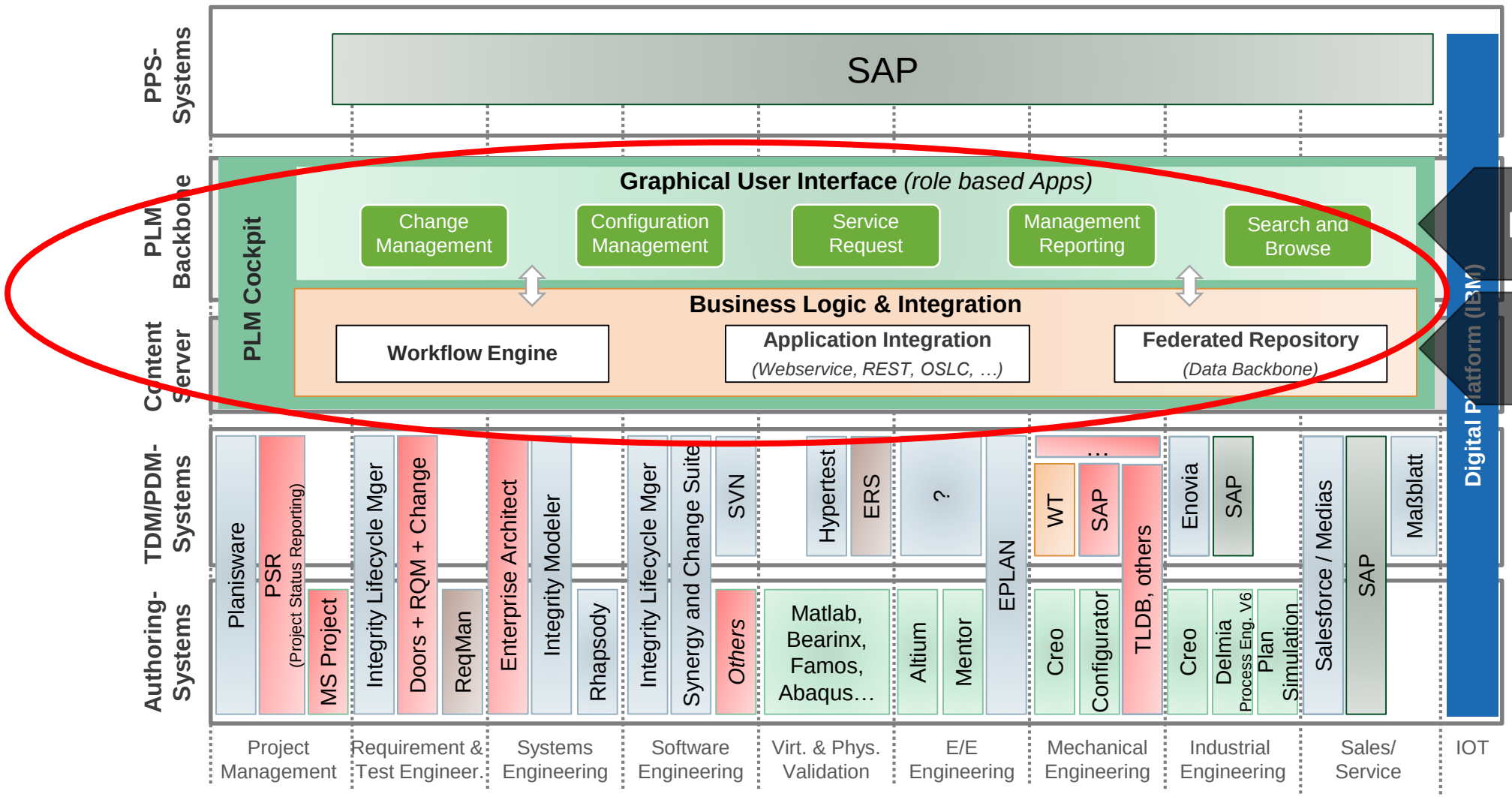
Avoids Risk & Disruption

Move Agile, Fast, Bi-modal IT

Dr. Martin Eigner
TECHNISCHE UNIVERSITÄT KAISERSLAUTERN

Example Architecture

Aras Platform at Schaeffler for 20,000 Users



Platform Requirements for Digital Twin & Thread

Ability to **ingest data**
through
API and Services

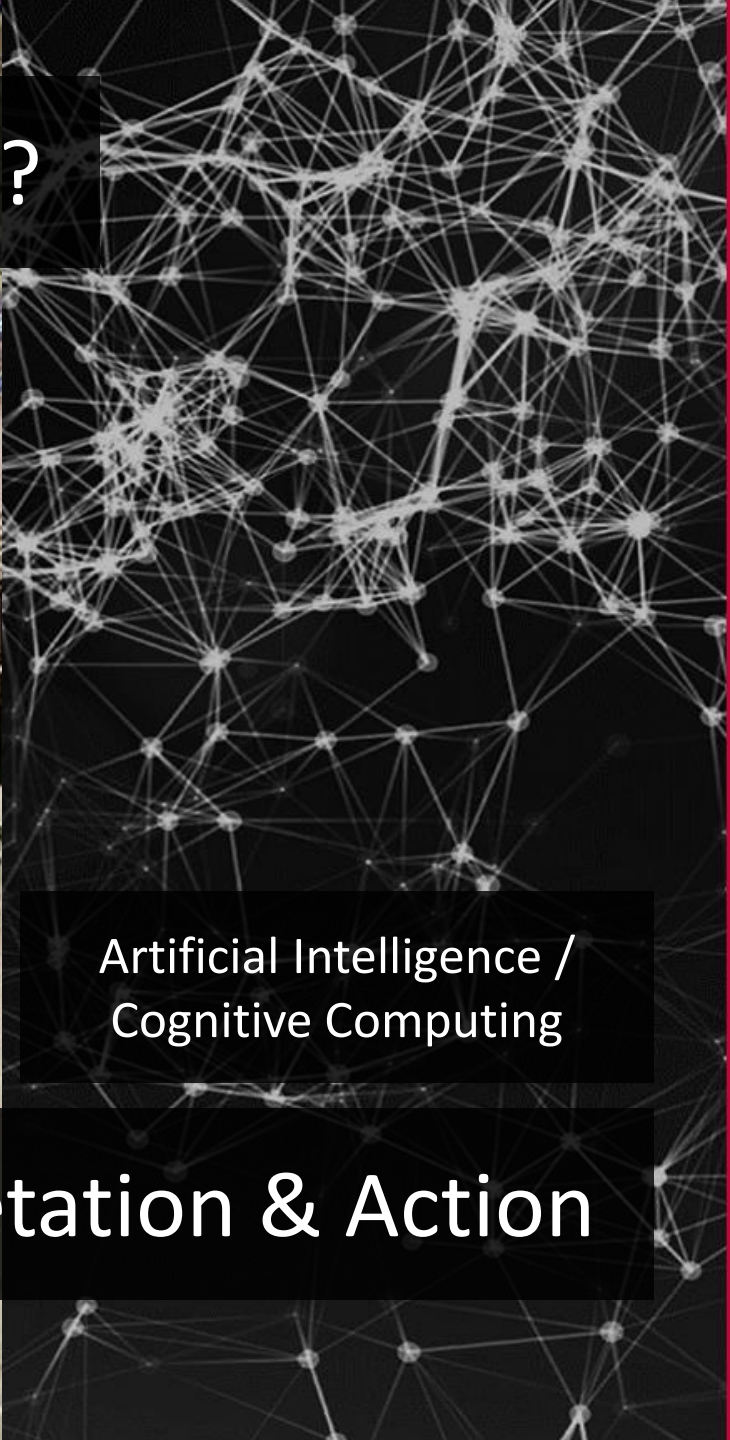
Integration
ability to manipulate processes and data through exposed API / Services

Extensibility
ability to build / extend functionality leveraging COTS framework

Ability to **exfiltrate data**
out of API / Services

MUST HAVE	CANNOT HAVE
Transparent & Interrogatable APIs	Proprietary APIs
FULL API Capabilities Exposed	Incomplete or Hidden API Function Calls
Open Data Model	Proprietary Data Models
Dynamic Data Model	Static / Hard Coded Data Model
Open Data Access	Obfuscated Data

Why are Digital Twin & Thread Necessary?



Smart Connected Technology

Industrial Internet & Industry 4.0

Artificial Intelligence / Cognitive Computing

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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