From Digital Twin
to Metaverse

Accelerator Forum *2024*

14:15

JACQUES BACRY
Executive Vice-President
Digital Country Group
Offer Leader

THOMAS ZYNDA
Digital Continuity
Director

FROM DIGITAL TWIN TO METAVERSE

Physical, *meet* digital

Meet your speakers

Jacques BACRY
Executive Vice President
Capgemini Group Lead for Digital Continuity

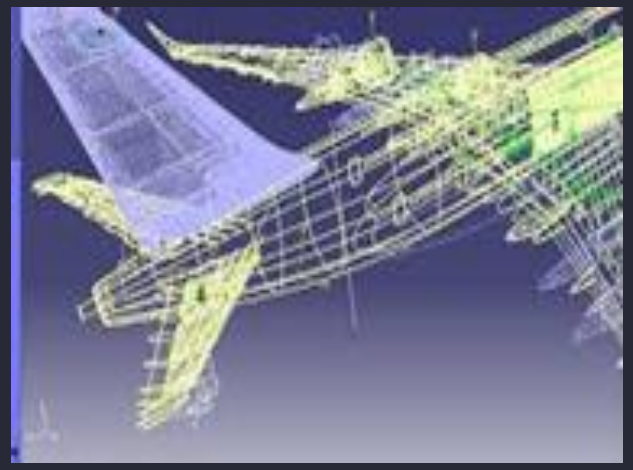
Thomas ZYNDA
Director
Capgemini Digital Continuity Director for Switzerland

AGENDA

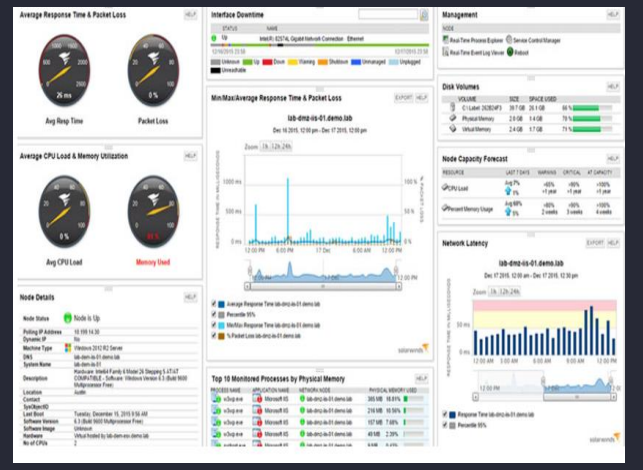
- Digital twin overview
- The journey
- Road to the metaverse
- Manufacturing use case

Where is the Digital twin ?

Apollo 13 story



3D Mockup

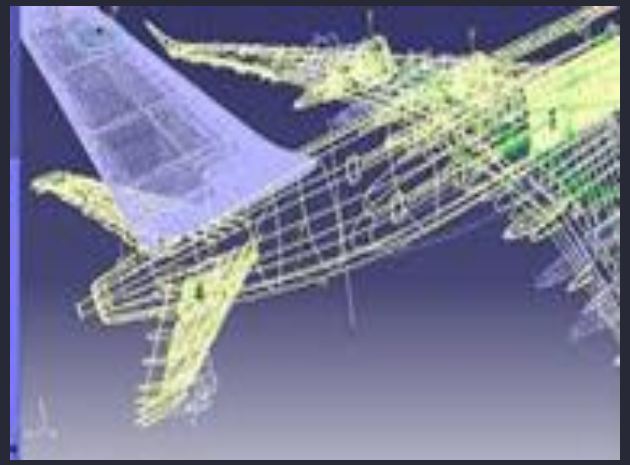


Supervision

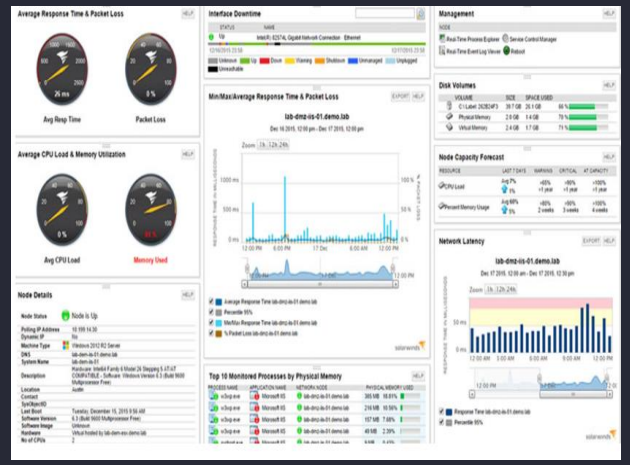
None of them are digital twin

Physical twin

No simulation with data in service



No digital loopback



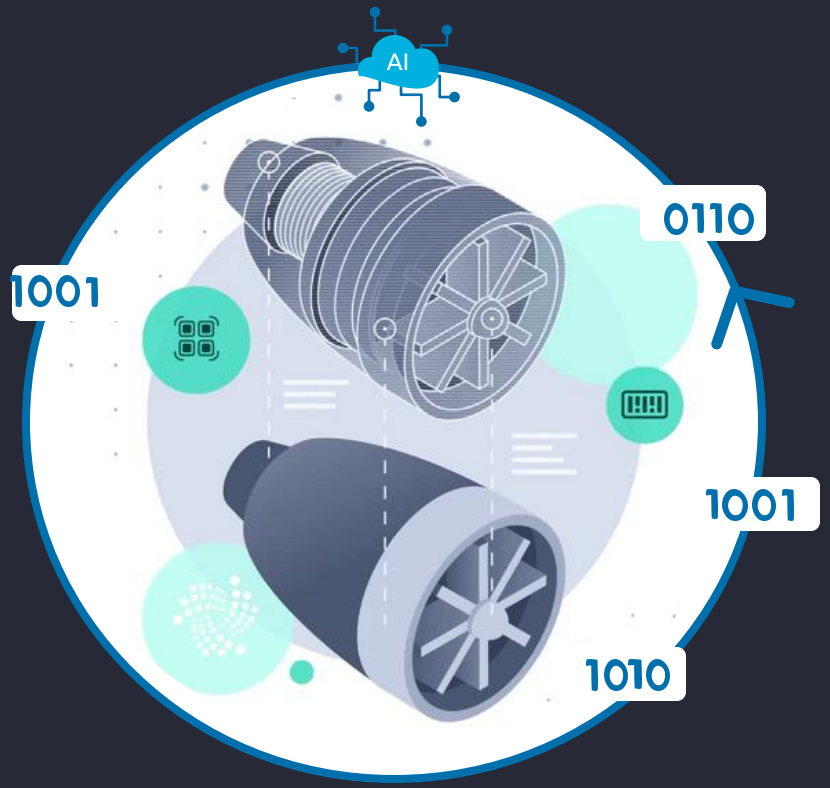
But a digital twin needs often all these capabilities

Engineering Knowledge + **3D Virtual representation** + **Predictability**


Combining Engineering with Tech, Data, Strategy, Design, Science and Business Transformation disciplines enables us to become more strategic and relevant to our Industry
This is what makes our Group, the market leader in Intelligent Industry

WHAT IS DIGITAL TWIN

A *Digital Twin* is a virtual representation of real-world entities and processes, synchronized at a specified frequency and fidelity. ©



- Experiment with different scenarios to answer questions including “WHY?”, “WHAT IS BEST?”, “WHAT IF?” and “WHAT NEXT?” .
- Evaluate impacts of decisions without real-world risk.
- Enable effective decision-making and help determine data-driven strategy to maximize profitability and reliability.

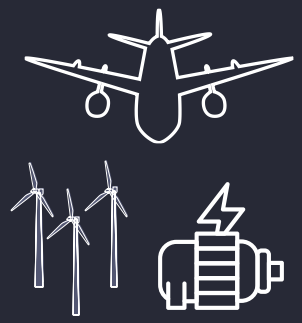
Digital Twins are profitability enablers, leveraging data, AI, and automation to maximize value.

THERE ARE MULTIPLE TYPES OF DIGITAL TWINS

across different industries…

… and for different systems

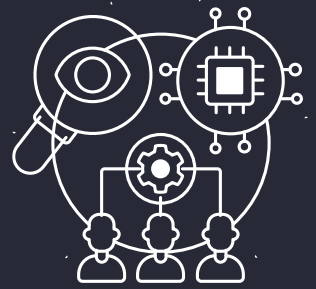
PRODUCT



ASSET or FLEET

FACTORY

NETWORK or SUPPLY CHAIN



BUSINESS PROCESS

Digital twins serve many purposes; there is no single digital twin.

Different stakeholders interact with digital twins from different perspectives and derive different types of value.

What is Digital Twin – Digital Twin as profitability enabler

Experiment with different scenarios by answering questions "WHAT IS BEST?", "WHAT IF?" and "WHAT NEXT?" , throughout the lifecycle

Enable effective decision-making and help determine data-driven strategy to maximize profitability and reliability.

Evaluate impacts of decisions without any real-world risk.

Three major types of Digital Twin

Digital Twin AS DESIGNED	Digital Twin AS BUILT	Digital Twin AS USED & maintained
Concept & Design	*Produce*	*Operate/Support*

Want to *know more* about Digital Twin types?

THE “REINDUSTRIALISATION” ACCELERATES THE DIGITAL-PHYSICAL CONVERGENCES STANDARDIZATION

The final objective of digital twin is to have a specific object containing the model's synthesis (requirements, systems , …) integrated by design to be able to manage a complete lifecycle virtual representation

The process variability management is a key success factor to optimize : **Margin, Cost & Time**

(Reuse, Standard, New Requirements Introduction,…)

=> Define Strongly the Product / Process / Resource **invariants**

Digital Twin to build & operate factories in different ways

Time to FAB

Digital Twin enables to synchronise the product and manufacturing line development process, and to create first in the digital world.

Ramp-up Acceleration

The digital avatar of the factory, can be used to trained operators and simulate production scenarios

Optimum Production

Closing the feedback loop of the simulation models with ‘real world data’ enables to fine tune them and identify faster the most efficient production scenarios

WHERE ARE YOU ON YOUR JOURNEY ?

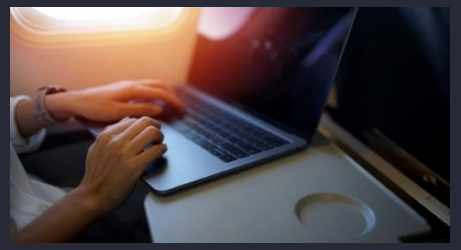
OBSERVE & UNDERSTAND

Measure data to visualize, monitor, and report on observed phenomenon such as pressure, temperature, or energy consumption.

MODEL

Create and validate models of the system of interest.

Compare in-service data to theoretical data modelling for design validation.



ANALYZE & IMPROVE

Leverage real-time and historical performance data in context across different scenarios to drive improvements.

AUTOMATE

Link data to executable models accessible by everyone, use AI to predict, drive smart insights across the value chain, and shift employee focus to higher level tasks.

MONETIZE

Platform-as-a-service

Next generation digital twins focus on use-oriented and results-oriented models delivered via an as-a-service model.

EARLY → **ADVANCED**

The successful transformation path to Digital Continuity and Convergence

Business convergence & Digital twin enabled services
Extend simulation of full data in services to synchronize virtual representation to the real object of system of interest

Digital Continuity
Run and simulate the main collaborative business processes on top of connected models

Interconnected
Digitalization of business resources and processes allows for repeatable and continuous tasks using automation, yet remain fragmented and executed in isolation

Digitized
Identify the relevant cross-disciplines data to be digitized

It's key to address 3 areas along this journey

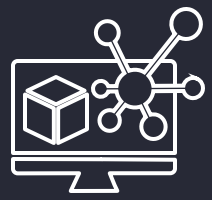
- People / Organization
- Process / Methods & Tools
- Product / Technologies

Example of Journey through different levels of maturity

Starting point → Digitized → Interconnected → Digital Continuity → Business convergence & Digital Twin enabled services

Digital/Functional Mock-up

- Model Based Engineering
- Multi-CAD data integration - Product, Equipment, Shopfloor Layout
- 3D View & Navigate
- Business capabilities
- Process management
- Document management



Configured Mock-up

- Products & systems variability
- Standardization
- Supplier access

Digital Continuity

- Product-, Equipment- and Process-data link
- Virtual commissioning with simulation applications

Convergence & Digital Twin

- PLM/ERP/ MES integrated in production
- Modelling and simulation of life cycles
- Production and services data loopback to engineering

People / Organization

Process / Methods & Tools

Product / Technologies

IMMEDIATE STEPS TO CONTINUE THE DIGITAL TWIN JOURNEY

Our step-by-step roadmap is based on continuous value monitoring

Digital Twin Days

100 days Digital Twin Journey

Platform Solutions

Phase 1 Value assessment

Phase 2 MVPs & Roadmap

E2E support of platform delivery

Confirm Interest | **Go/ No Go** | **Decision Dossier**

Activities

- Ideation workshop
- Specific workshops and data analysis.
- GO/NO GO steering
- MVP development
- Development decision dossier preparation
- Development, deployment and scale-up

Deliverables

- Digital technologies and related disruption
- Techno watch on solution per underlying process/business area
- Pain points / Use cases formalised
- Initial view on benefit case and roadmap
- Use cases list prioritised
- Data mapping
- Future solution blueprint
- Impacted processes scan
- Change analysis
- POC dedicated to one use case
- ROI analysis to support GO / NO GO decision
- E2E MVP Digital Twin on limited number of use cases
- Future Solution Architecture Blueprint
- Impact assessment (processes / skills)
- Roadmap of development
- Risk Assessment
- Strategy and Transformation
- Solution Definition
- Development and Deployment
- Run Services
- Domain Expertise

DIGITAL TWIN HIGH-LEVEL ARCHITECTURE AND USE CASES

DIGITAL TWIN

COLLABORATIVE PLATFORM

QUICK WINS ENTRY POINTS
MBSE APPROACH

Models & Simulations layer

DATA CONTINUITY

Semantic & Data Management layer

DATA CONTINUITY

Data Sources, Devices, and Software layer

USE CASE EXAMPLES

- Multi-disciplinary teams can explore scenarios with colleagues & stakeholders in virtual environments to replay historic events, perform root cause analysis, or agree on future approaches
- Build a centralized knowledge base for a shared, tangible view of day-to-day business operations

- Systems level simulations aggregating multiple disparate data sources
- Enriched 3D environment for co-design & co-develop
- Forecasting or replays using historical or synthetic data to optimize production

DIGITAL COLLABORATION AND CONTINUITY

- Provide data access and ontology-driven interoperability (semantic platform as a service)
- Enable configuration of different simulations
- OT Virtualization and integration with Data & AI Enterprise platform

PHYSICAL- DIGITAL INTEGRATION

- Shopfloor visibility and Condition Monitoring
- Alerting in real time
- Automatic updating of execution parameters, autonomous control of real-world counterpart

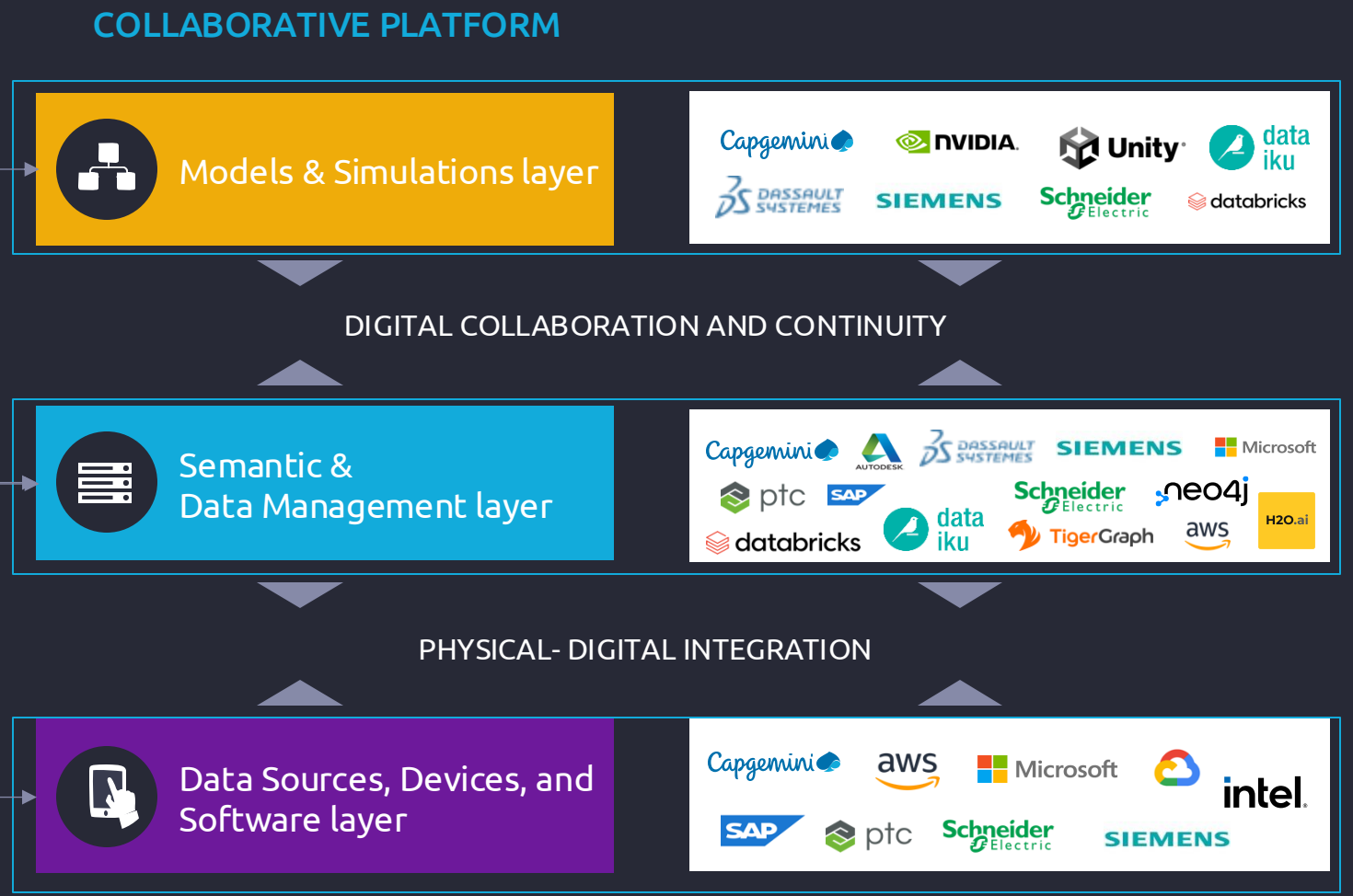
KEY PARTNERSHIPS

STRATEGIC PARTNERSHIPS

Capgemini maintains strategic partnerships with industry leaders across the ecosystem, including:

- Metaverse & 3D technologies
- Digital Engineering Lifecycle Management
- Cloud hyperscalers
- Graph technology and AI
- IoT and connected business solutions
- National and acadmeic research consortiums

PARTNERSHIPS ACROSS THE STACK



The generative AI enablers for Digital Continuity

"It is predicted that **20%** of all test data for consumer -facing use cases will be **synthetically** generated by 2025". – Gartner

Generation

- Automated generation on demand from information to structures to synthetic data
- Generate product structure invariants to enable the change process
- Generate many products and productions scenarios and evaluate consequences such as NRC, RC, Lead time …

Information access and use

- Improved capitalization and reuse of company IP/ config. Mgt rules
- Empowerment & effectiveness . information access

Information understanding & insights

- Assisted patterns and relationships discovery for powerful insights and efficiency gains
- Automatic information context discovery across disparate systems

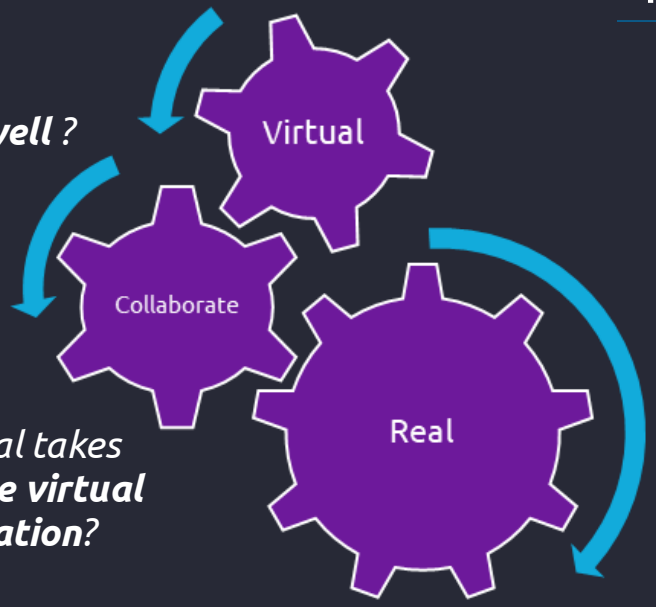
Road to the metaverse

The new paradigm

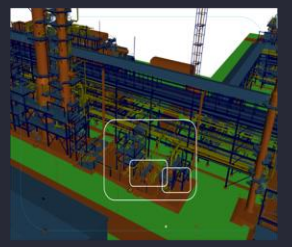
*Does-it **simulate well** ?*

*How virtual **collaborate** with the real?*

*How the real takes benefit of **the virtual augmentation**?*



Horizon 1



SINGLE DTWIN

Horizon 2

Connected TWINS

Horizon 3

AUGMENTED LIFE

How to get there

*"**Internet of Twins** – Defines all the various elements of the Virtual Metaverse. This is where the B2B metaverse is currently trying to find a way to connect all these technologies. The communication between digital twins, combining their simulations within a network, will in the future make it possible to model ever-more complex situations"*

Digital twin use cases in aerospace sector
WE OBSERVE tangible results

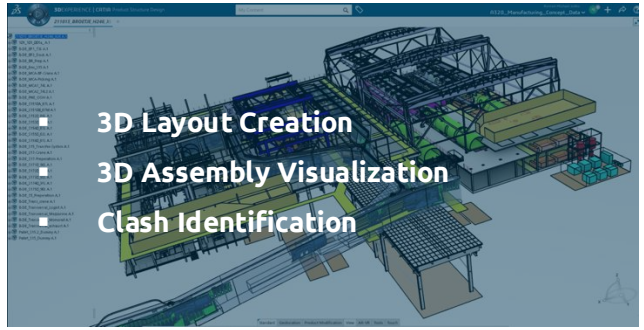
Main Pain Points

High manual effort to **design & validate factory layout** before start of production

No possibility to **validate planned production & logistic processes** in detail

No visibility on **ergonomic and safety conditions** in future factory

Implemented Use Cases



Cumulated Benefits Potential

~5%

Direct RC Reduction

~12%

Future RC Avoidance

~3%

Direct NRC Reduction

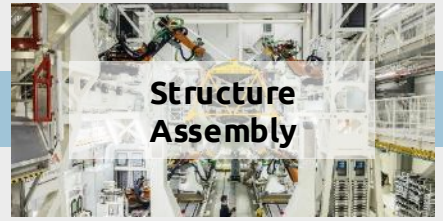
~40%

Lead Time Reduction

We supported the client in the design phase of its system bringing quantifiable value

WE DEVELOP AND DEPLOY DIGITAL TWIN TECHNOLOGIES ON E2E ASSEMBLY LINES

Industrial Digital Twin (Digital Twin) at all stages of production process



2020 **2 countries** **6 Hangars** **+4 new lines** **2023** **+X future lines**

DEPLOYED CAPABILITIES OF DIGITAL TWIN

IMSE: Industrial Model & Space Exploration

Multi Parametric Modelling of the industrial system architecture as baseline for simulations

IDMU: Industrial Digital Mock-Up

Virtual simulation of production resources, product parts and manuf processes

RSCM: Rate Simulation & Capacity Mngmt

Virtual simulations of production flows assessing the system capacity and simulating behaviours under disturbance

VC: Virtual Commissioning

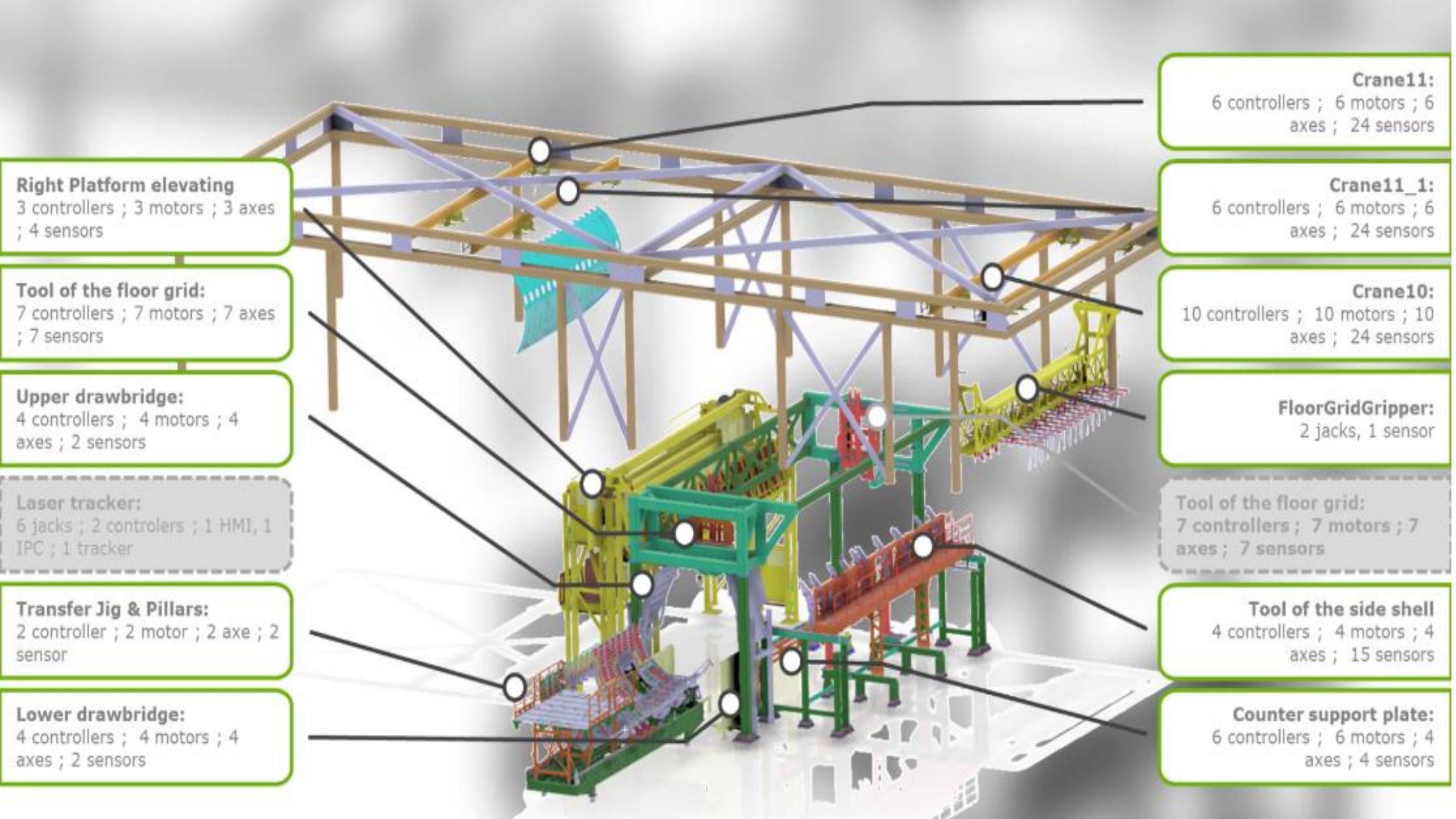
Upfront virtual testing of automation technology ensuring process feasibility and enabling adjustments

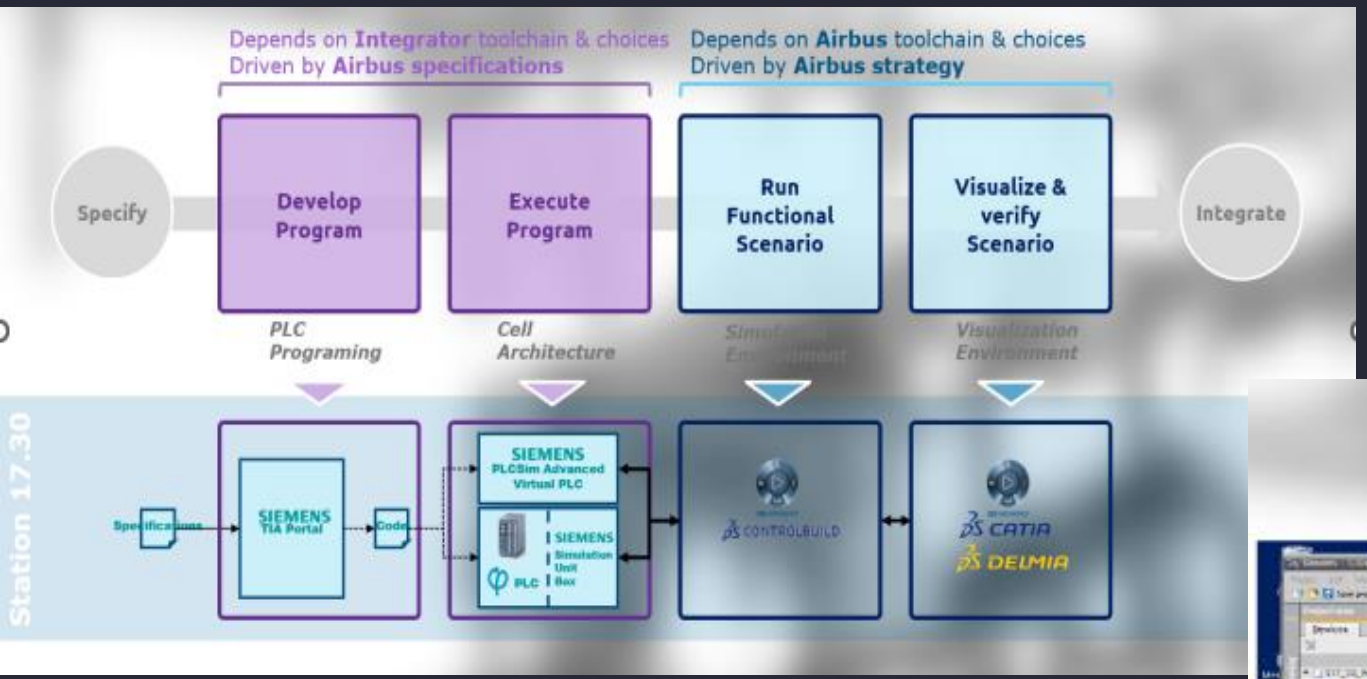
SFC: Shopfloor Connectivity

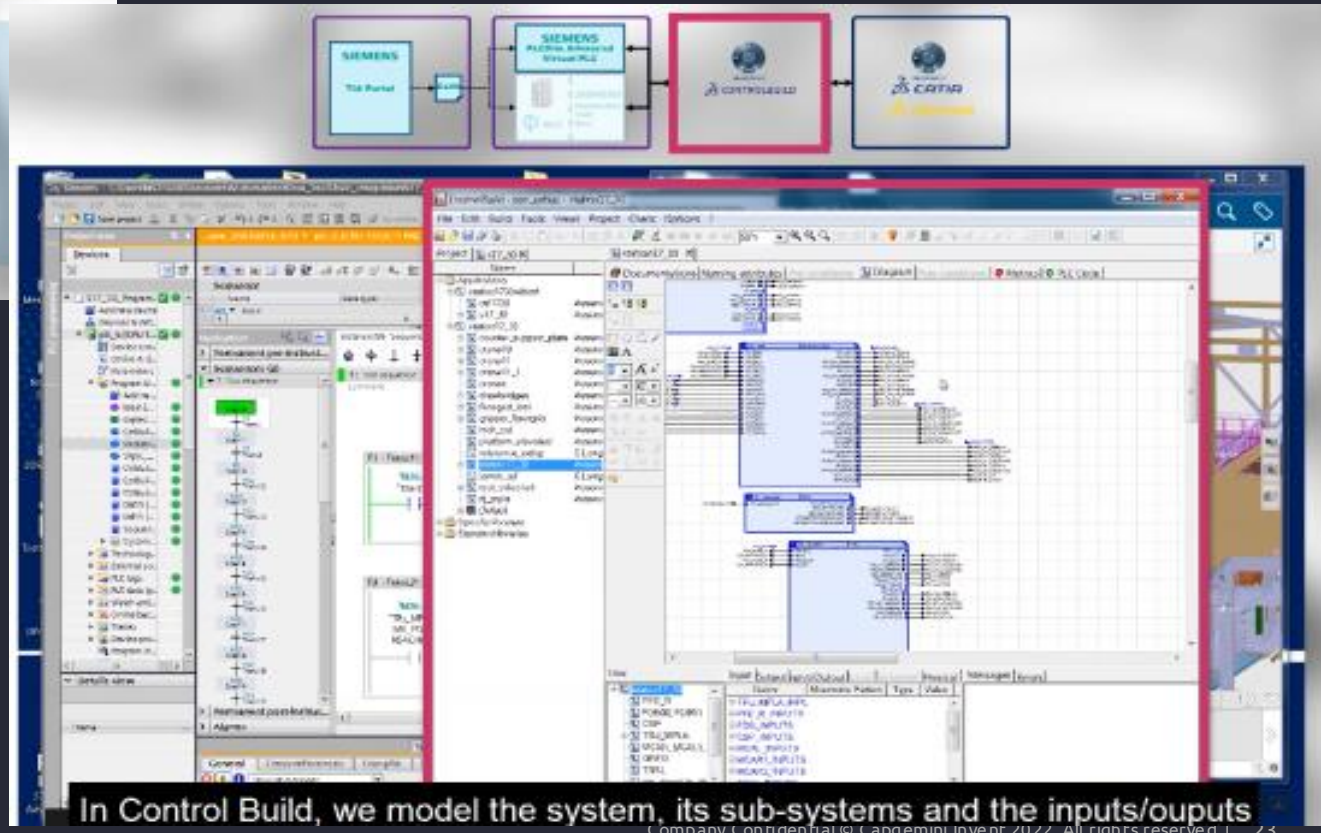
Connecting shopfloor assets to create data transparency and build simulations as well as predictions based on real time data

SCDT: Supply Chain Digital Twin

E2E simulation for procurement and suppliers based on a sustainable and cross functional data model


Right Platform elevating
3 controllers ; 3 motors ; 3 axes ; 4 sensors
Tool of the floor grid:
7 controllers ; 7 motors ; 7 axes ; 7 sensors
Upper drawbridge:
4 controllers ; 4 motors ; 4 axes ; 2 sensors
Laser tracker:
6 jacks ; 2 controlers ; 1 HMI, 1 IPC ; 1 tracker
Transfer Jig & Pillars:
2 controller ; 2 motor ; 2 axe ; 2 sensor
Lower drawbridge:
4 controllers ; 4 motors ; 4 axes ; 2 sensors
Crane11:
6 controllers ; 6 motors ; 6 axes ; 24 sensors
Crane11_1:
6 controllers ; 6 motors ; 6 axes ; 24 sensors
Crane10:
10 controllers ; 10 motors ; 10 axes ; 24 sensors
FloorGridGripper:
2 jacks, 1 sensor
Tool of the floor grid:
7 controllers ; 7 motors ; 7 axes ; 7 sensors
Tool of the side shell
4 controllers ; 4 motors ; 4 axes ; 15 sensors
Counter support plate:
6 controllers ; 6 motors ; 4 axes ; 4 sensors





Capgemini invent

GET THE FUTURE YOU WANT

capgemini.com