Digitalization @ Siemens

Forum Teratec, June 27th, 2017

From record store …

… to streaming


From manual machine configuration…
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Trafo
QZ1

… to virtual commissioning

From fixed maintenance intervals…

… to predictive maintenance




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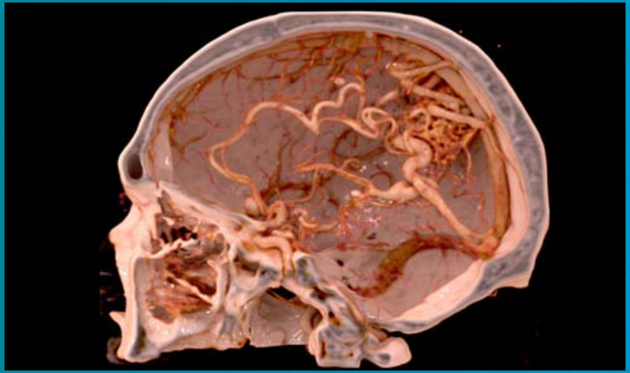
Ingenuity for life




Out technological core:
Electrification, automation, and digitalization

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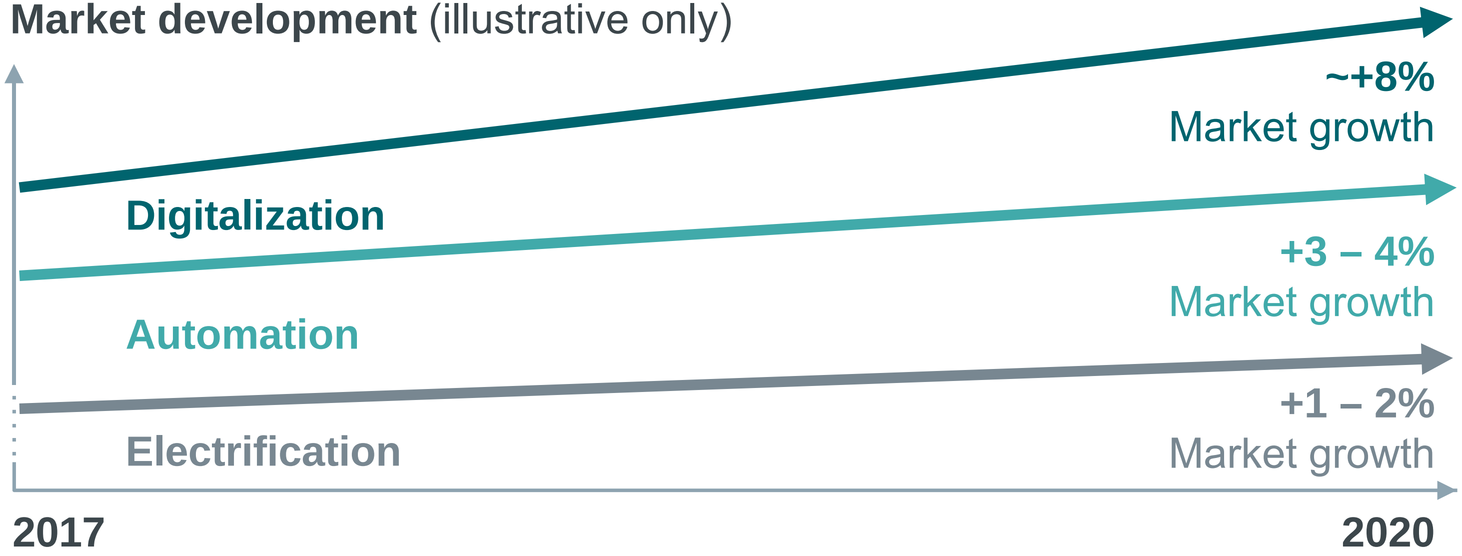
Global trends

- Digitalization
- Globalization
- Urbanization
- Demographic change
- Climate change

Market development (illustrative only)



Power generation	Power transmission, power distribution and smart grids	Efficient use of energy	Efficient healthcare delivery

Holistic approach to digitalization

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Design & Engineering → Automation & Operation → Maintenance & Utilization

Siemens Software

Siemens Digital Services

- Connectivity
- Open interfaces
- Data analytics
- Artificial intelligence
- Customer-specific apps by Siemens or third-party suppliers
- Cost transparency

MindSphere

The cloud-based, open IoT operating system

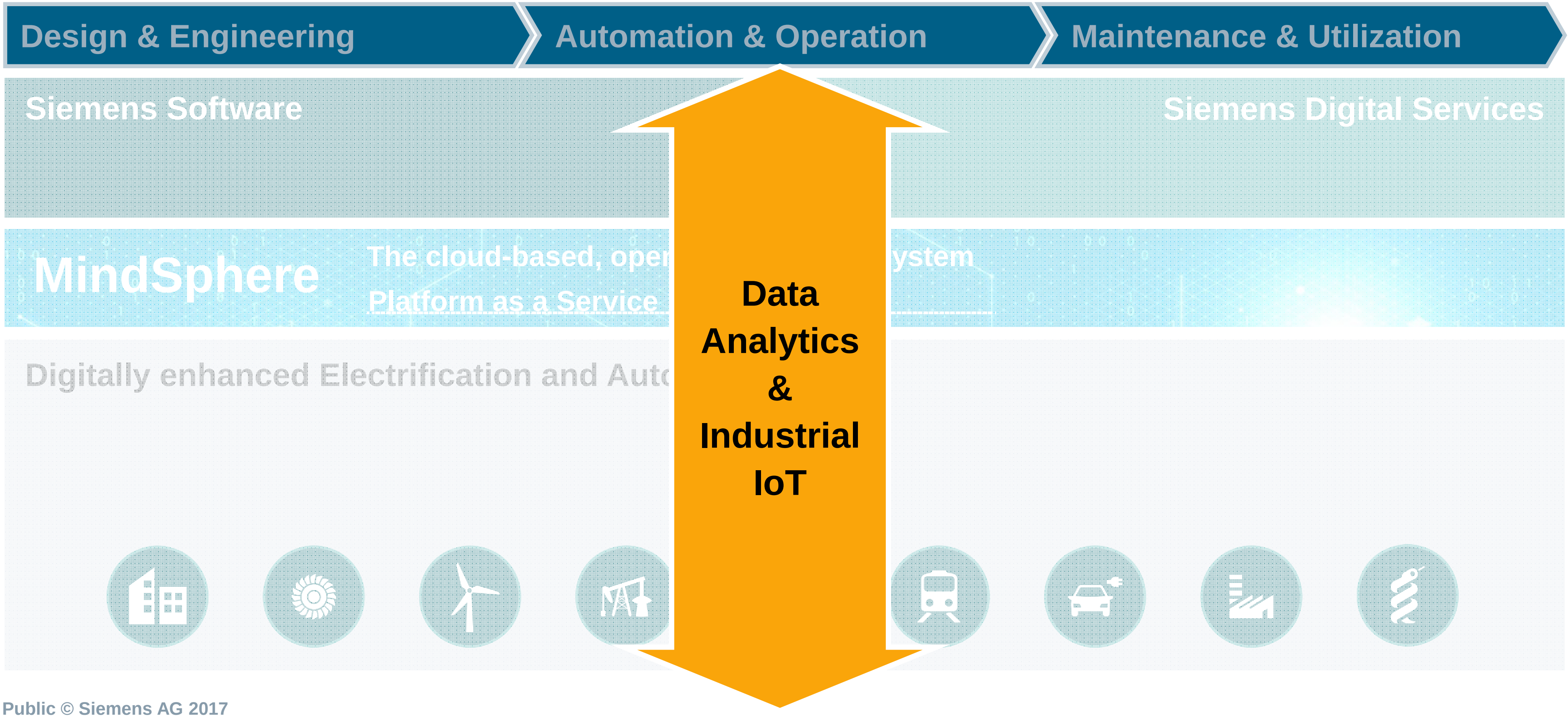
Platform as a Service

Enabler: Infrastructure as a Service (storage, processing power, provider agnostic)

Digitally enhanced Electrification and Automation

Holistic IT security concept

The “vertical” view: Data Analytics and the Industrial IoT



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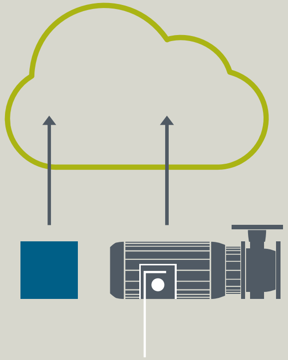
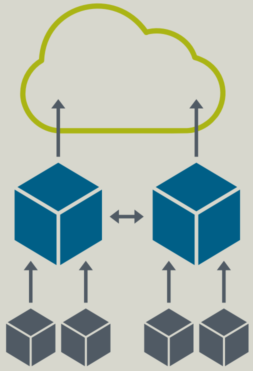
Industrial Internet of Things: From connected to interacting devices

Connected devices



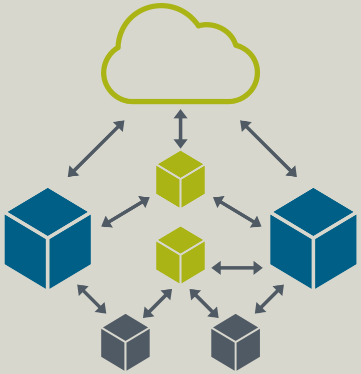
IP connected devices supply “**big data**” to cloud based **data analytics**

Smart devices / edge computing



Smart devices provide local **automation, analytics, optimization** and other **services**

Interacting devices



Distributed **interacting autonomous devices** negotiate and coordinate processes

App-empowered functional flexibility over system lifetime

- Connectivity (also for legacy devices)
- Asset analytics, predictive maintenance, process optimization
- Static and streaming data analysis in the cloud

- Local decision making at the point of influence for scalability and data ownership protection
- Division of labor between in-field and cloud functionalities

- Maximum structural flexibility and robustness in complex, large-scale distributed systems
- Automated system (re)configuration

Example: Availability guarantee for train service

Challenge

- 26 high-speed trains at Renfe Spanish Rail Company (Madrid-Barcelona-Malaga)
- Performance contract with availability guarantee
- Passengers are reimbursed for delays >15 min

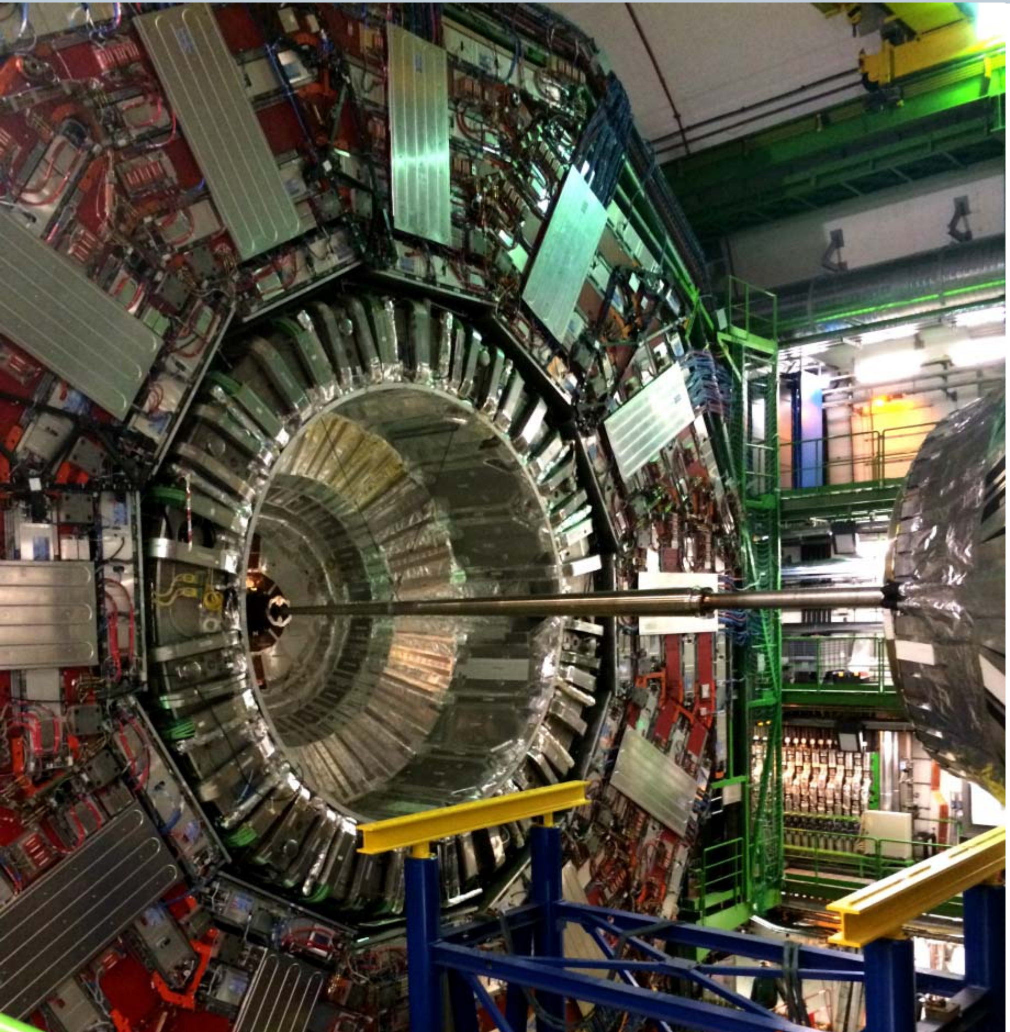
Solution

- Analytics on sensor data of critical components for predictive maintenance

Outcome

- On-time rate of 99.9%
- Due to high reliability 60% passengers switched from aircraft to train

Example: Data analytic for availability of CERN's Large Hadron Collider



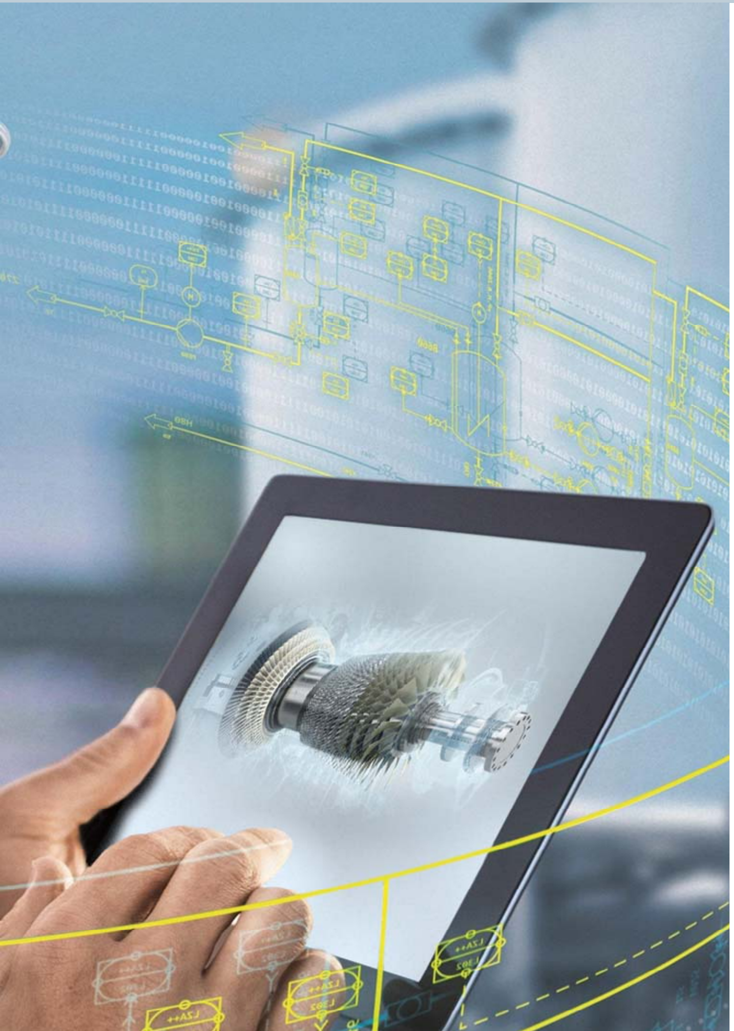
Challenge

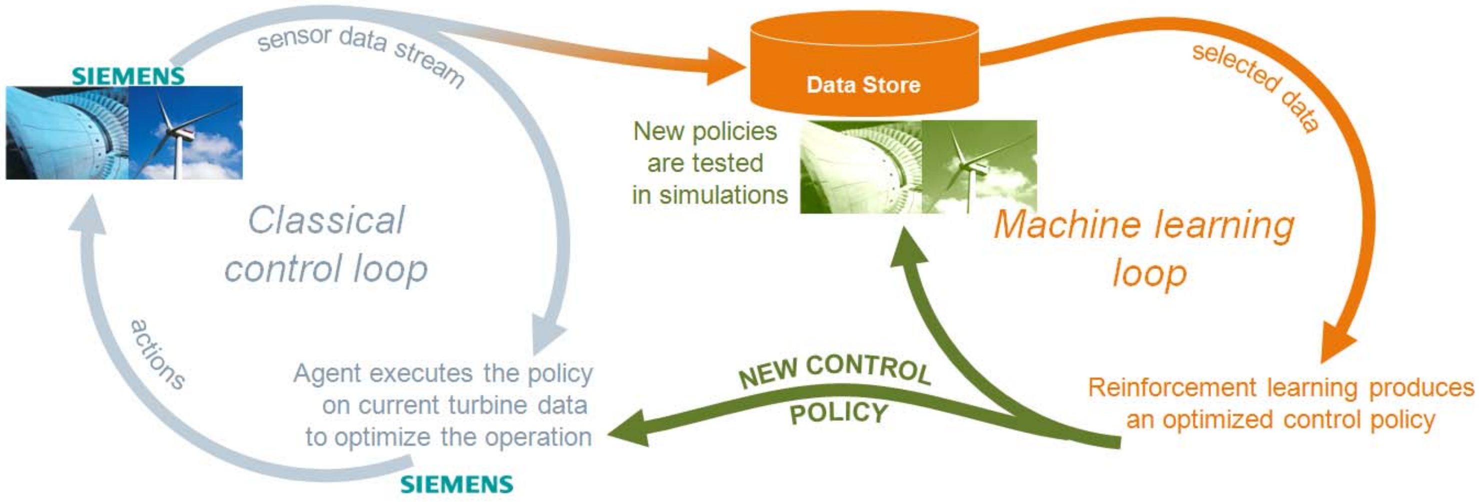
- Probably the largest and most complex machine in the world
- Huge effort and opportunity cost to identify and fix machine failures

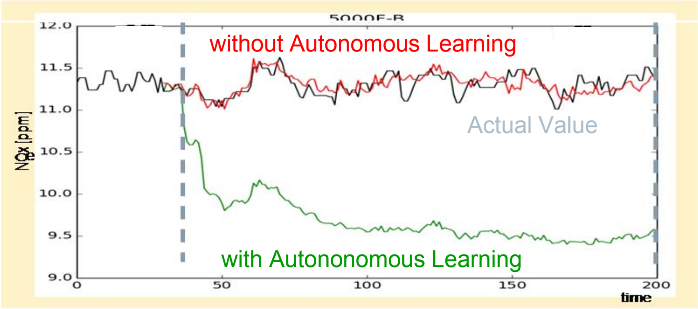
Solution

- Supervisory system with ~ 600 SIMATIC industrial control systems (for comparison: ~50-100 in an automotive plant)
- Diagnostic SW combing tailored algorithms with machine learning on historical data from failure situations
- Intuitive user interface to accelerate issue resolution

Example: Autonomous learning in gas turbines to reduce NO_x emissions







Simulated activation @base load

15-20% additional NO_x reduction

Example: Optimization of energy output from wind turbines

Challenge

- Huge pressure on wind power industry to bring down cost of cost of produced energy
- Wind and weather conditions as hugely complex control parameters
- Influence of wear & tear on turbine performance
- No obvious way to determine optimal control policy

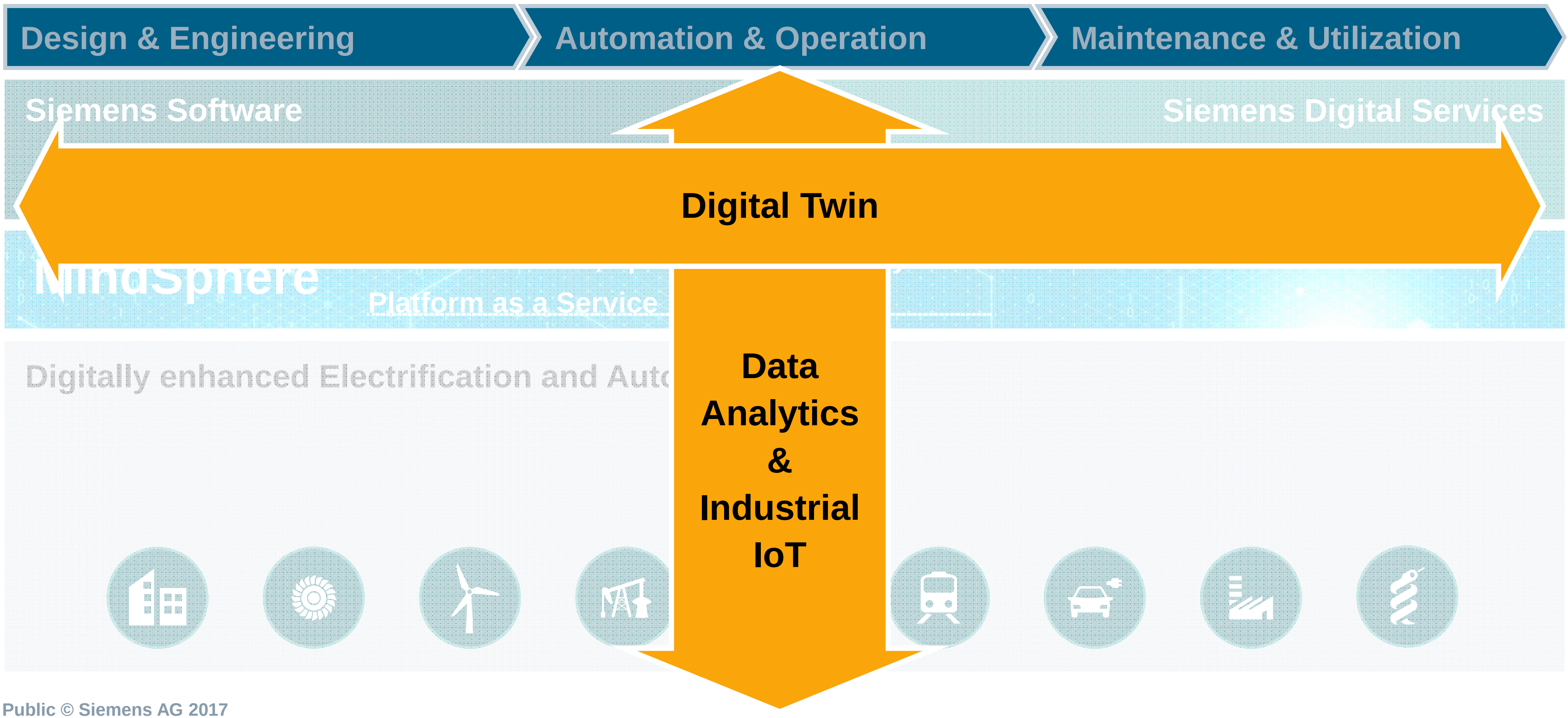
Solution

- Control policy determined with machine learning on historical weather and turbine performance data

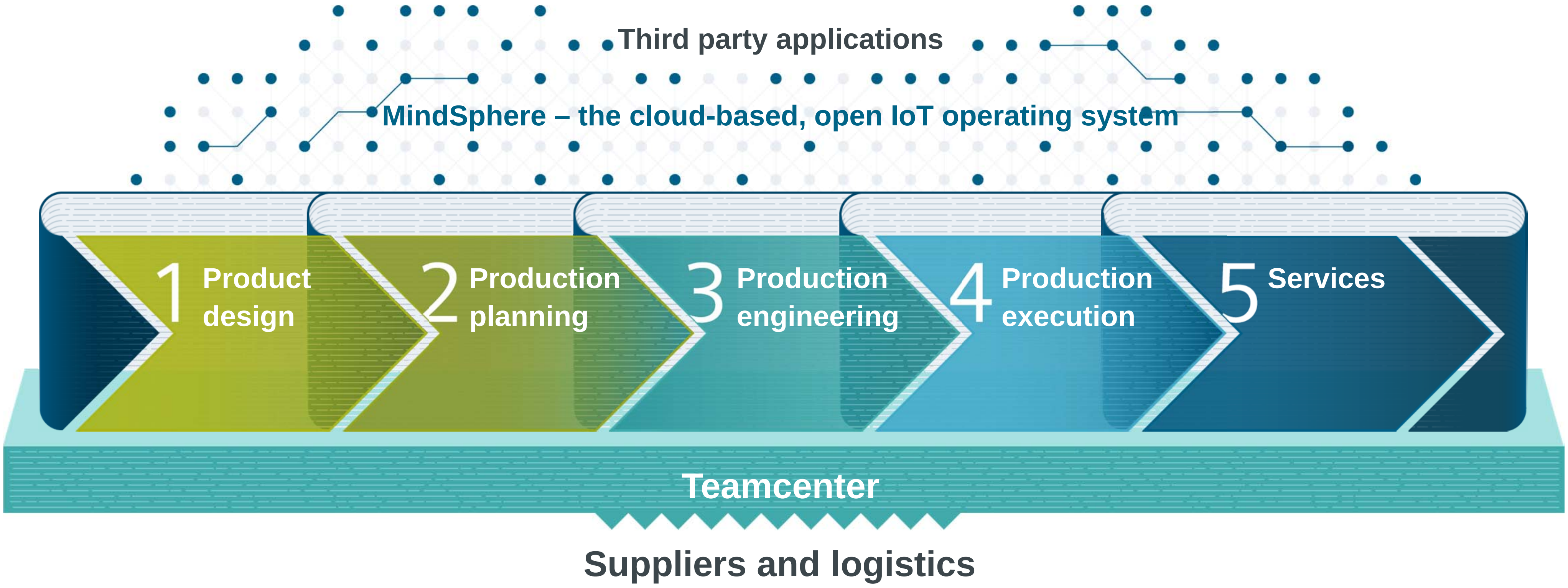
Output

- Up to 3% increase of annual energy production – without modification of the hardware

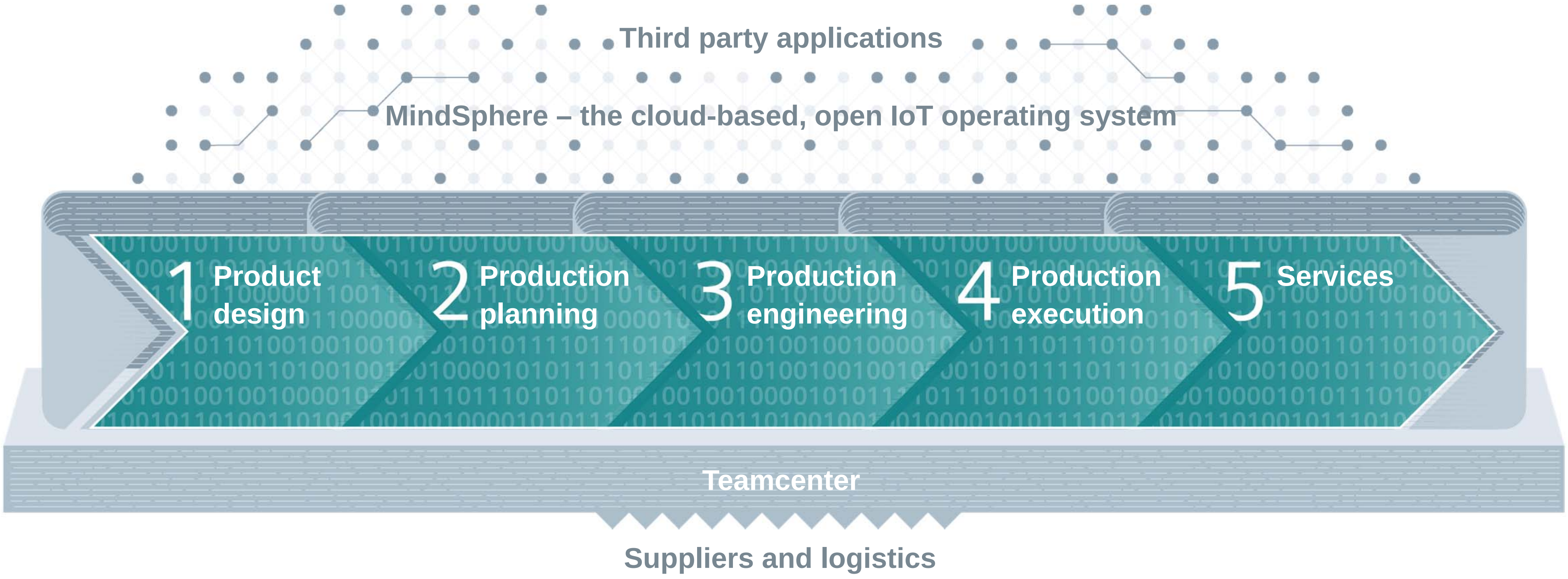
The “horizontal” view: The digital twin



Integrating and digitalizing the entire value chain …



… based on the concept of a digital twin



Integrating and digitalizing the entire value chain with a holistic approach

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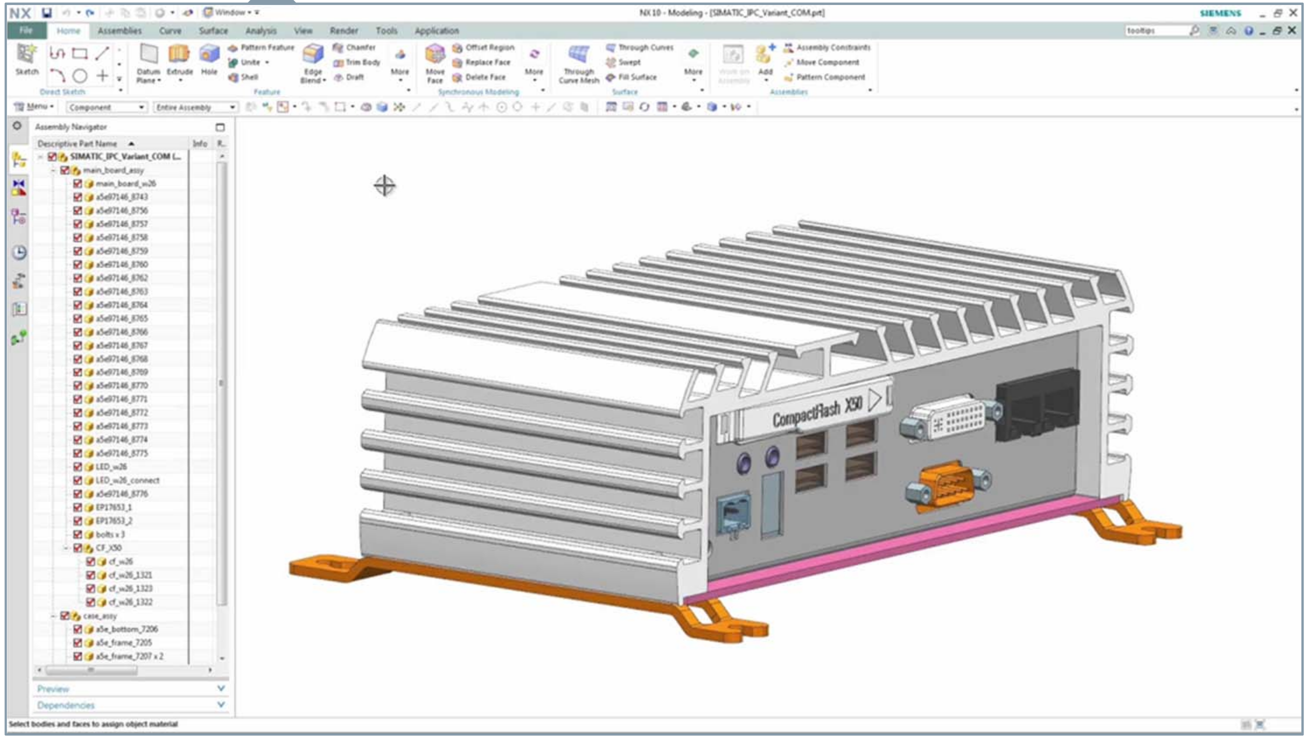
1 Product design | 2 | 3 | 4 | 5



Design a product by integrating CAD/CAE/CAM

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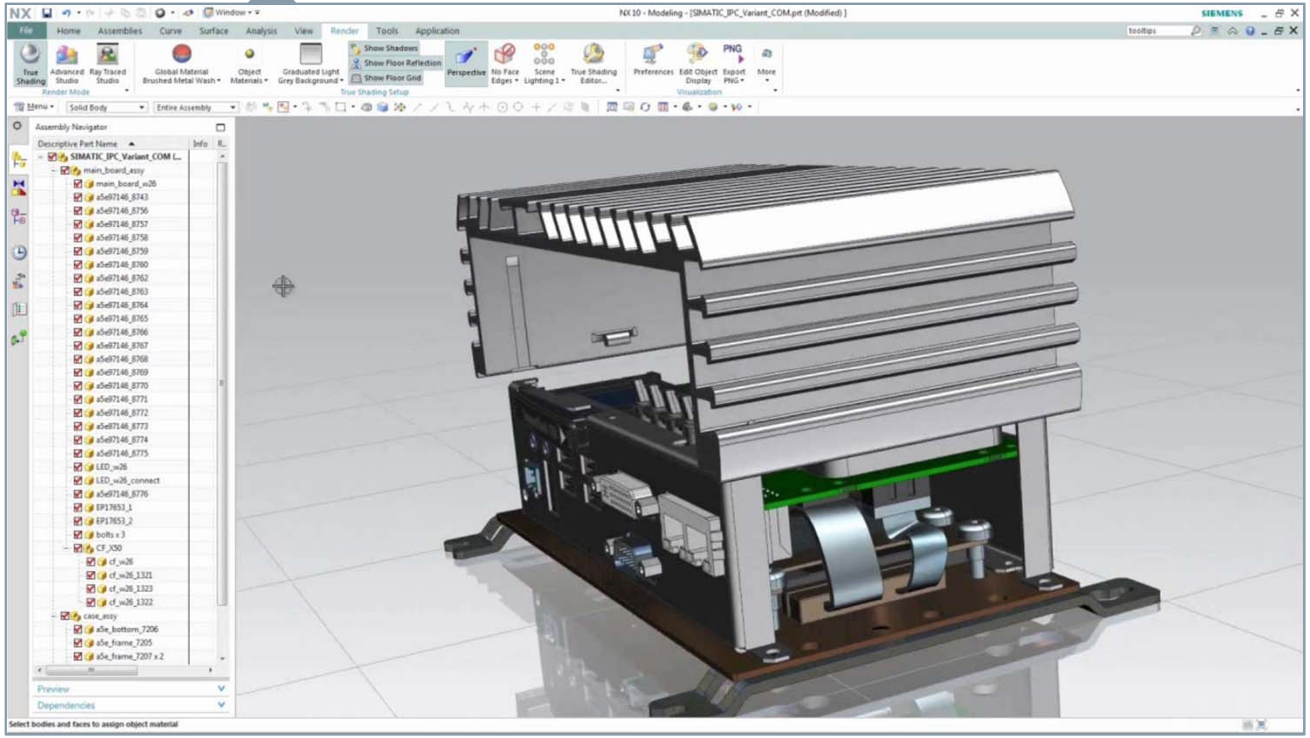
1 **Product design** | 2 | 3 | 4 | 5



Realize innovation with 3D simulation

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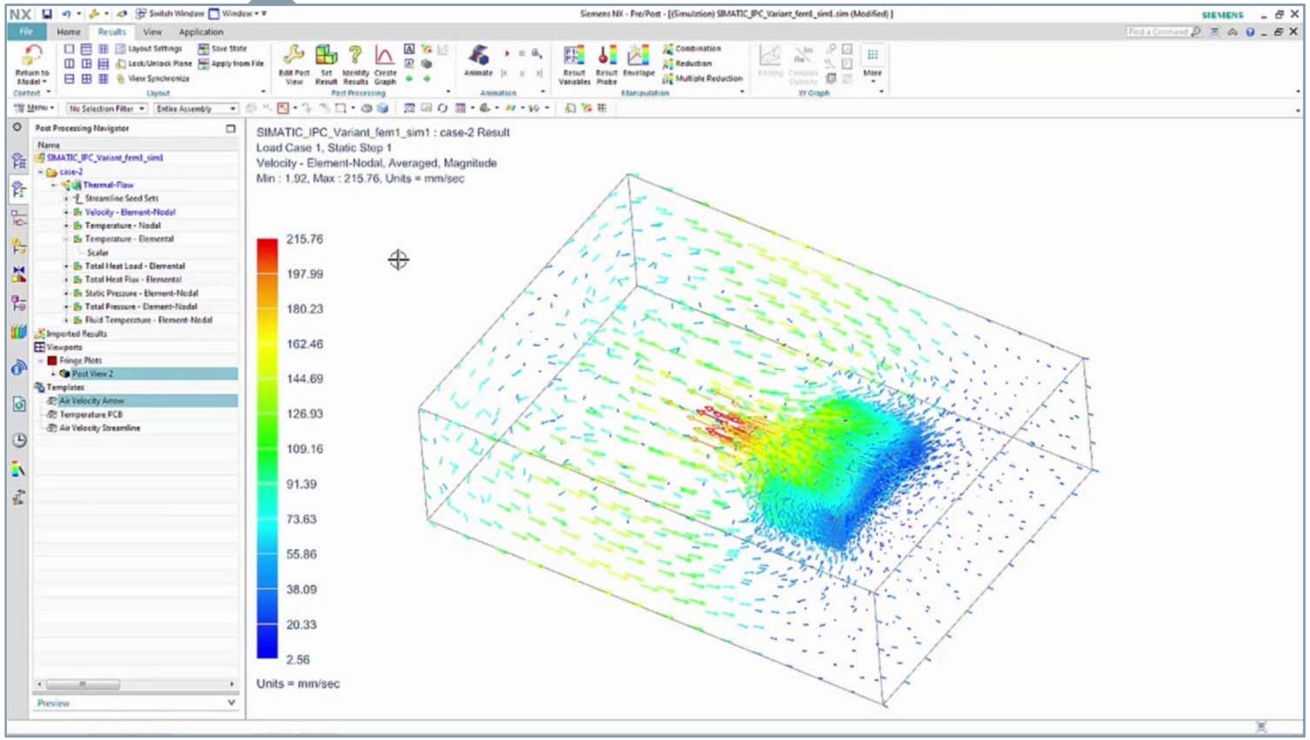
1 Product design 2 3 4 5



Simulate, analyze and optimize assembly processes and ergonomics

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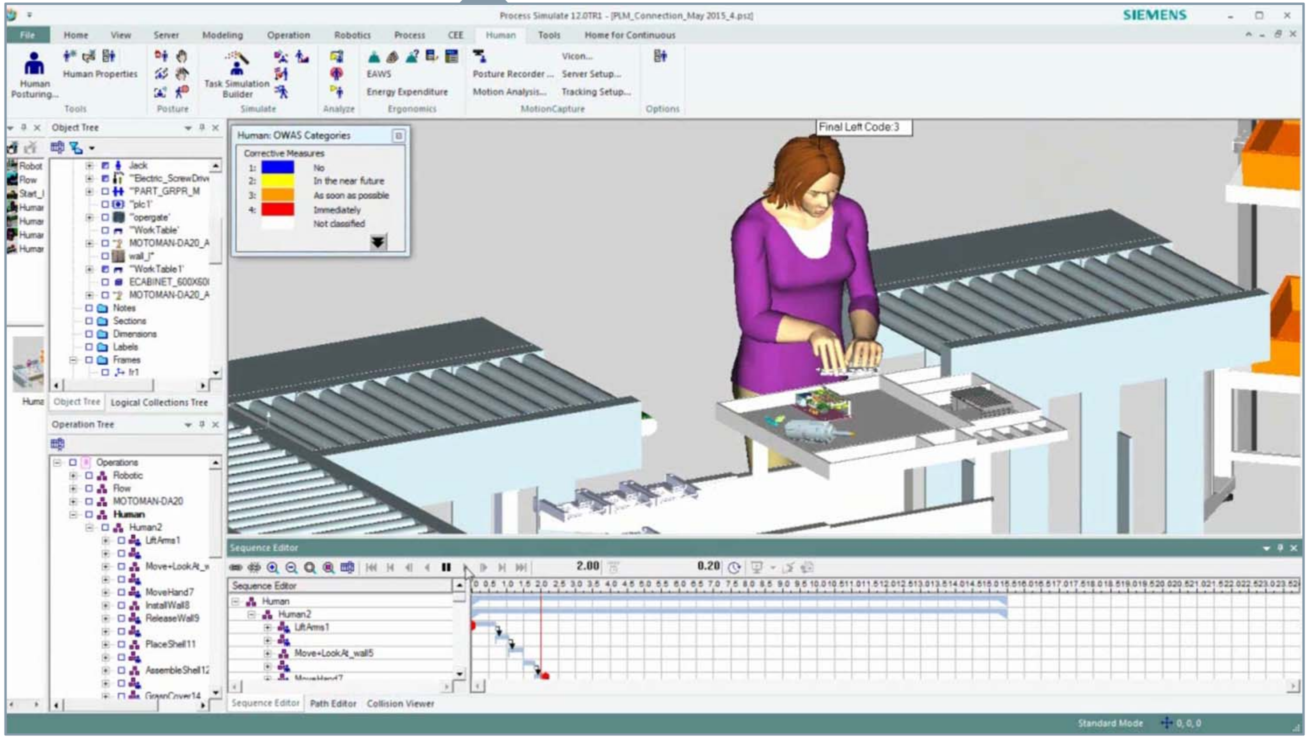
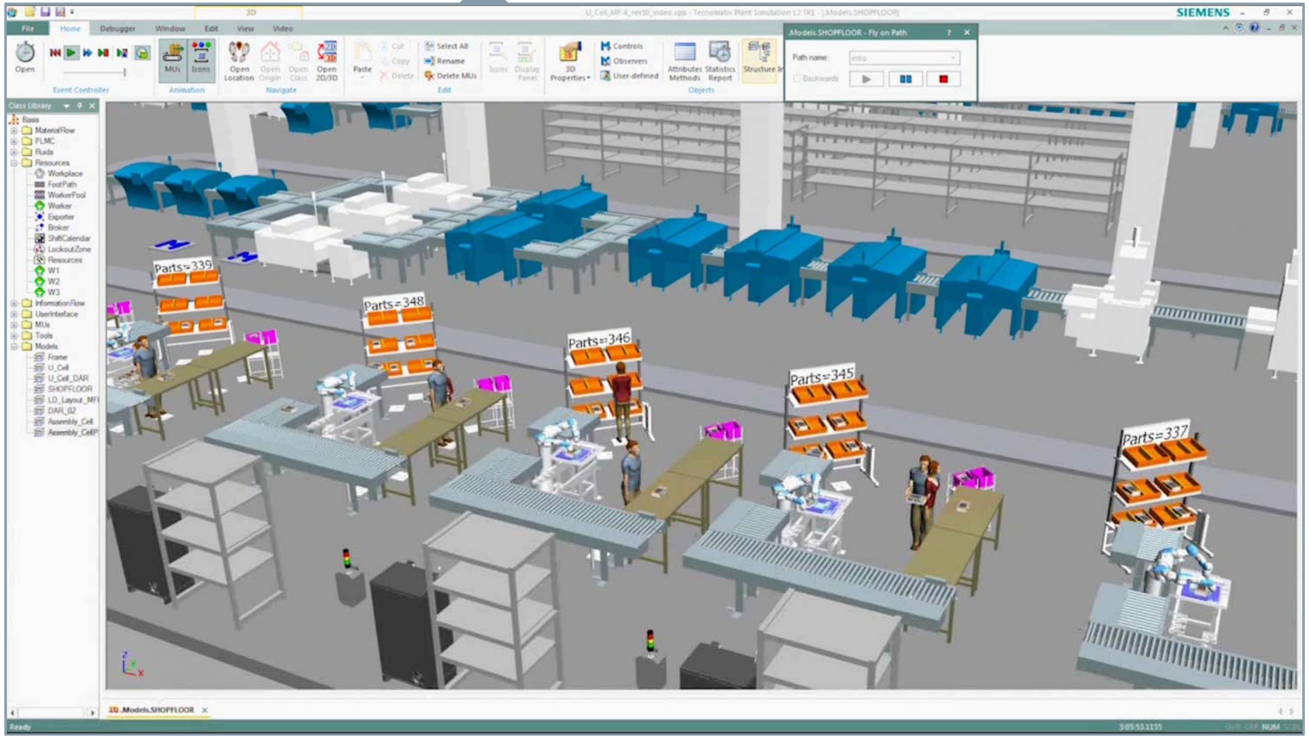
1 | 2 Production planning | 3 | 4 | 5



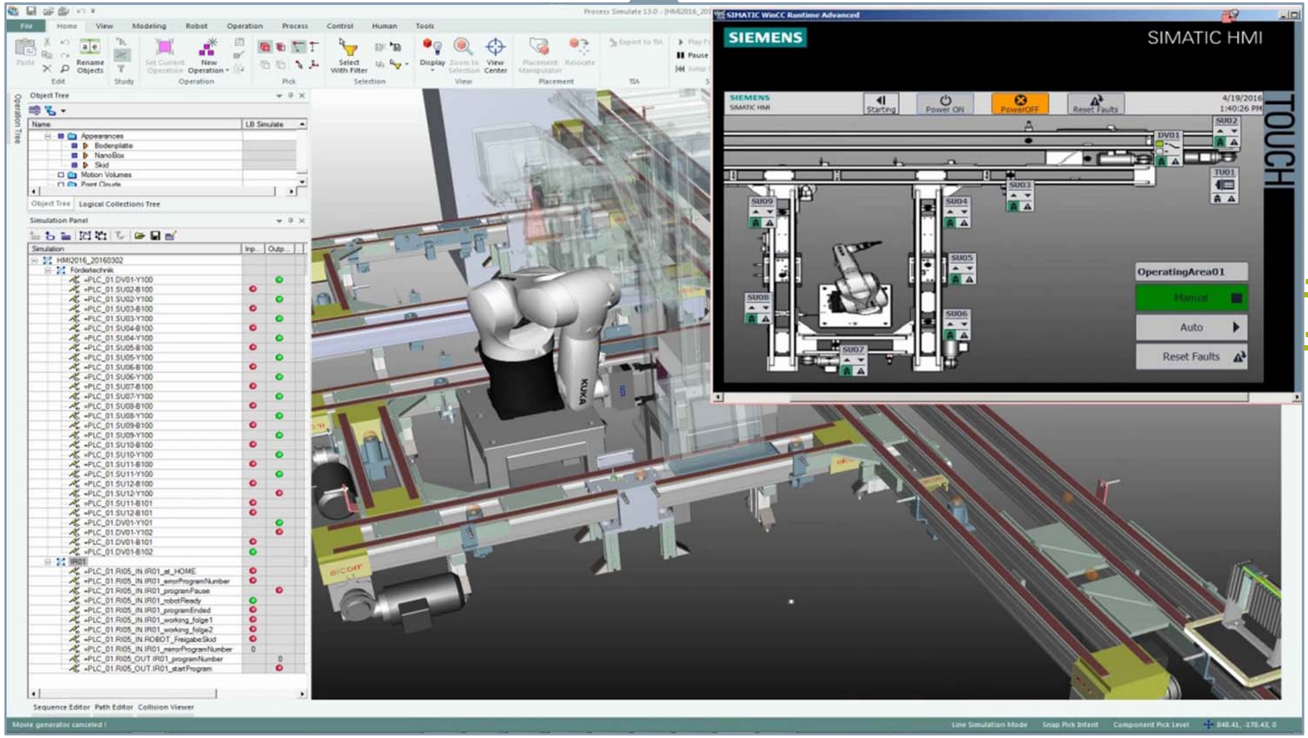
Simulate, analyze and optimize production systems and logistics processes

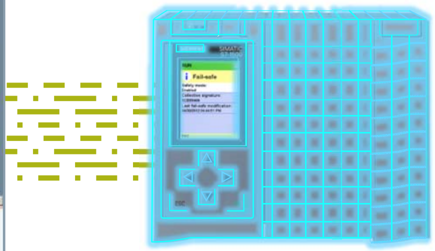
1 | **2 Production planning** | 3 | 4 | 5



Simulate and validate automation equipment virtually

1 2 3 Production engineerin 4 5

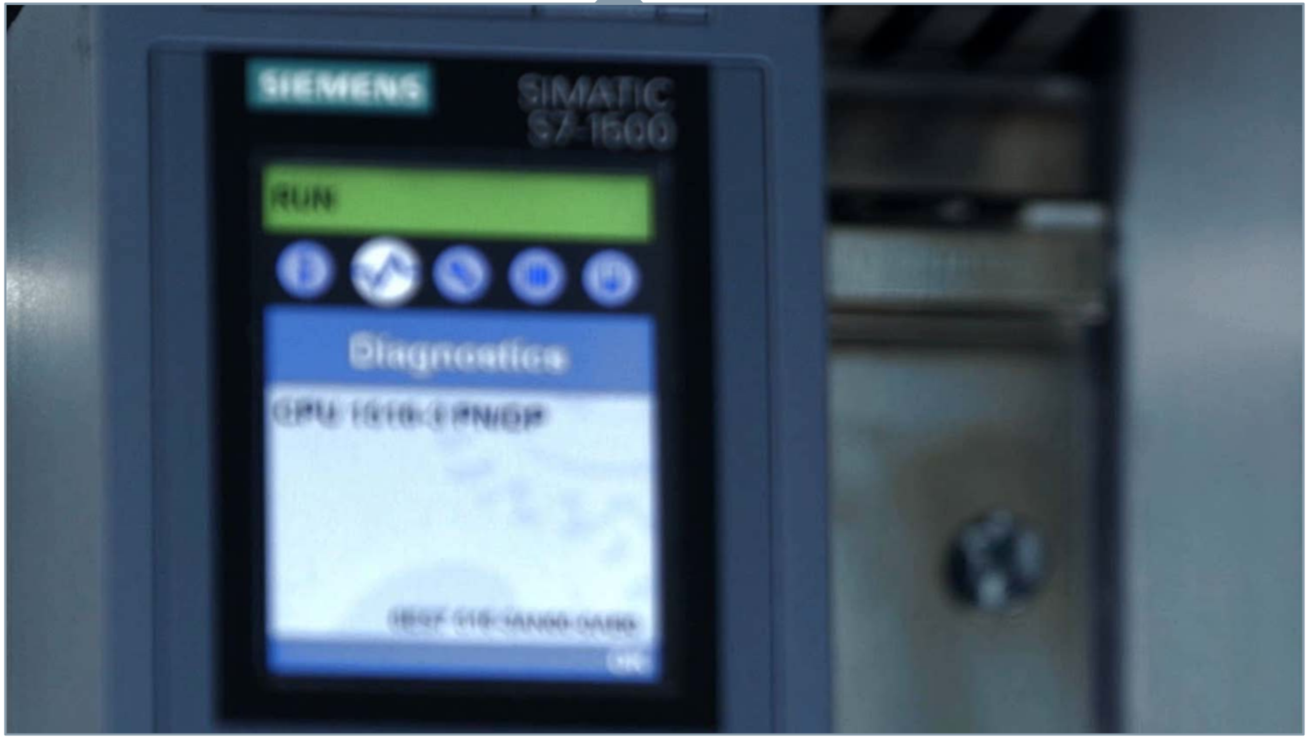




Digital Twin of SIMATIC S7-1500

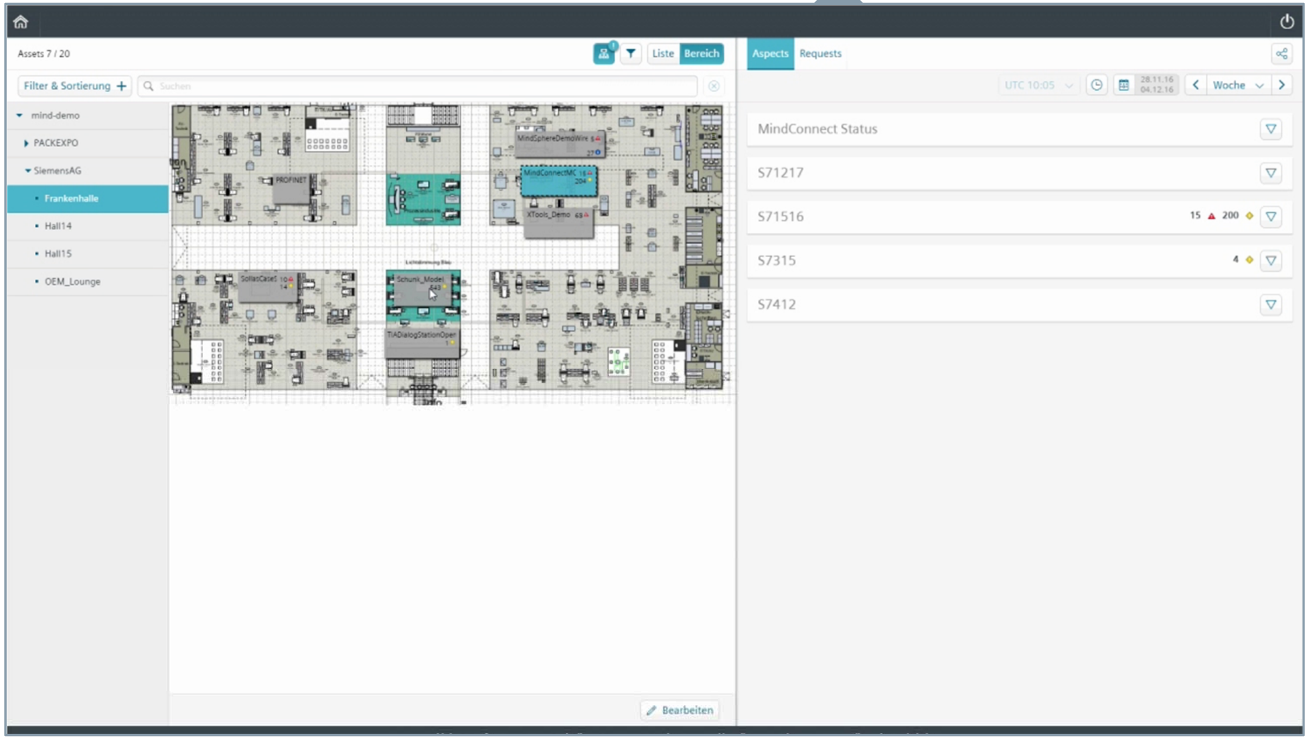
Enable manufacture of individualized products

1 2 3 **4 Production execution** 5

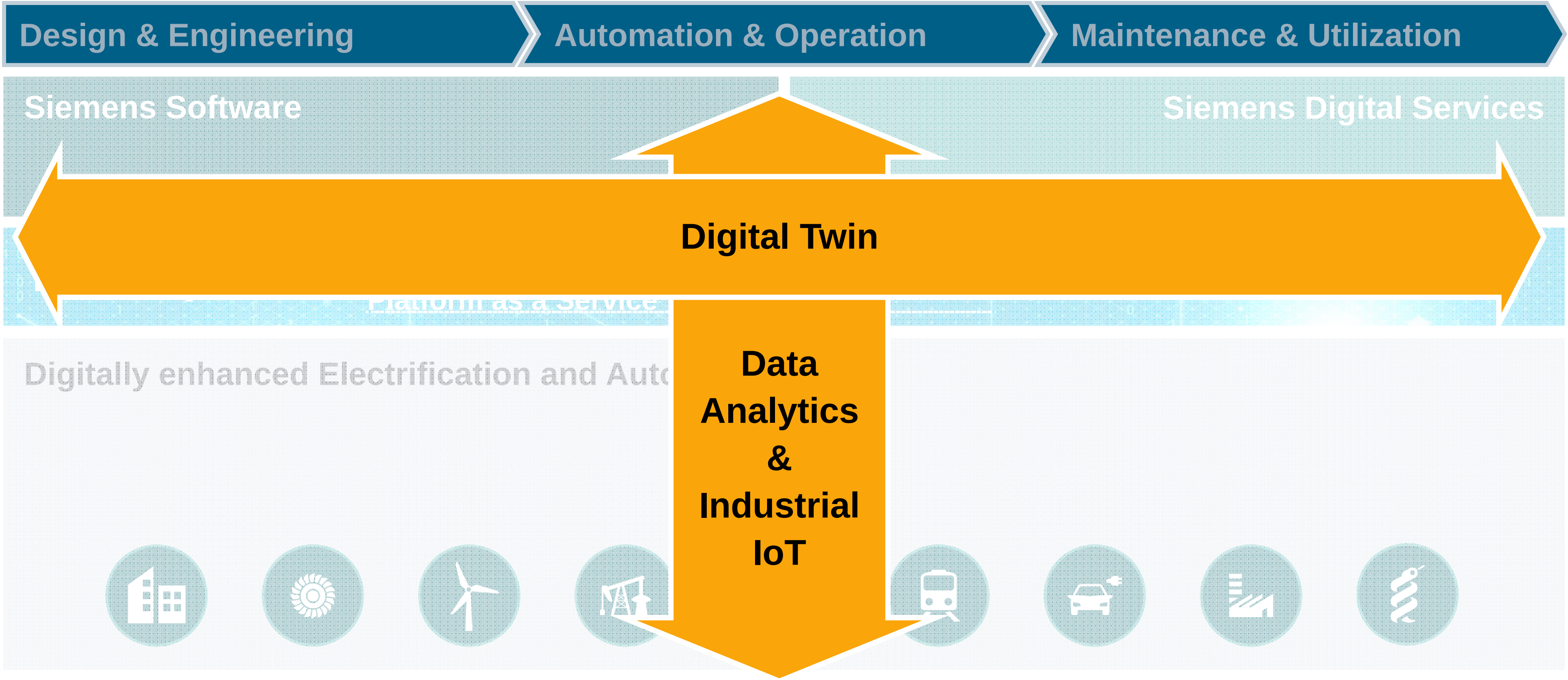


Monitor plant performance

1 2 3 4 5 Service



Bringing it all together –



Bringing it all together – using operations data to nurture the digital twin, and using the digital twin to support data analysis and device intelligence

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In a nutshell: HPC is highly relevant for digital twin – HPC for the Industrial IoT is still a matter of research

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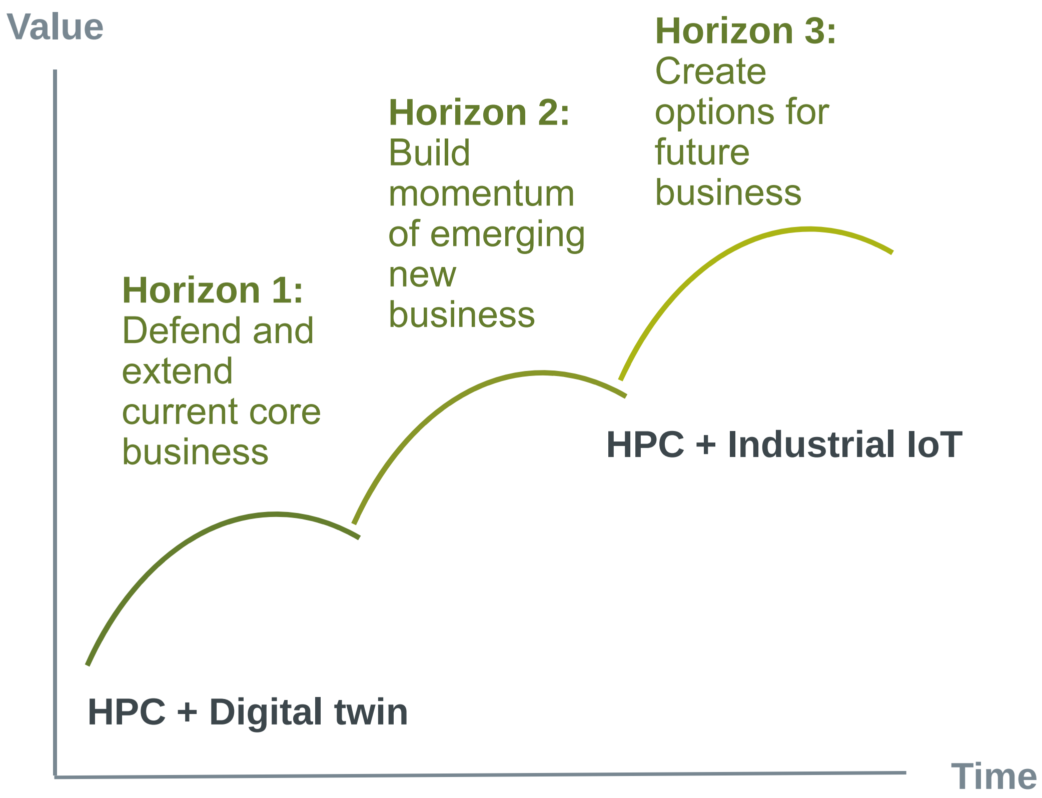

Digital twin

- HPC as key driver for increasingly sophisticated modeling and simulation of value chains

Industrial IoT & data analytics

- Current and foreseeable business impact derives from “pure” data analytics using standard computing resources in the cloud or in the “edge”
- HPC-based data analytics challenges are still in the Horizon 3 time frame; underlying business opportunities remain unclear

Digital twin + Industrial IoT

- Potentially significant contribution of HPC

Thank you for your attention!

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