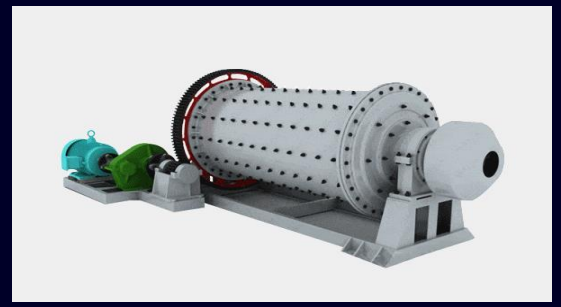
Digital Solutions for Cement Industry



Dr. Fuad Alattar

Senior Vice President, Middle East

Siemens Digital Enterprise Services

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The Digital Revolution

There are more mobile phones than toothbrushes

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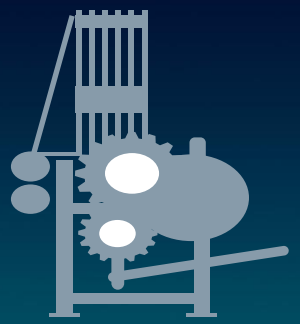
Industry 4.0

The 4th Industrial Revolution

First Industrial Revolution

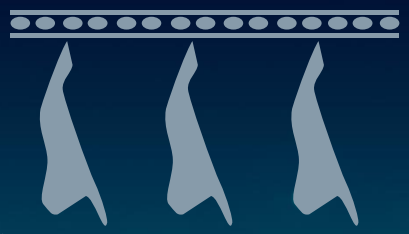
based on the introduction of **mechanical production** equipment driven by water and steam power



First mechanical loom, 1784

Second Industrial Revolution

based on **mass production** achieved by division of labour concept and the **use of electrical energy**



First conveyor belt, Cincinnati slaughterhouse, 1870

Third Industrial Revolution

based on the use of electronics and IT to further **automate production**

First programmable logic controller (PLC) Modicon 084, 1969

Fourth Industrial Revolution

based on the use of **cyber-physical systems** in **dynamic production networks**

First approaches of melting of virtual and real world of production

1800 | 1900 | 2000 | Time

Mechanization | **Electrification** | **Automation** | **Digitalization**

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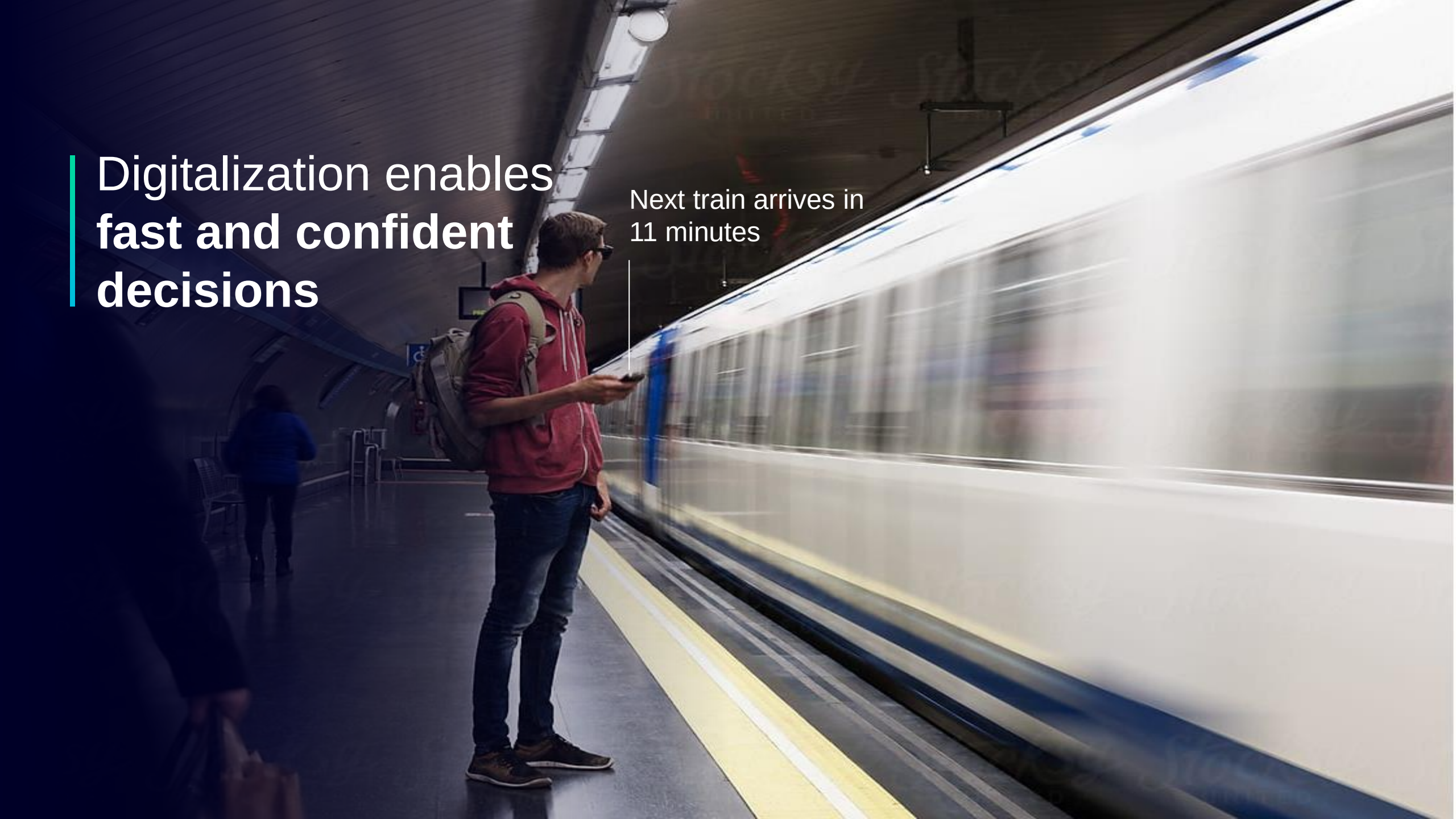
Digitalization enables **fast and confident decisions**



Digitalization enables **fast and confident decisions**

Multiple factors are bringing urgent challenges in the cement industry

Cost Reduction

- Integrated control strategy
- Integrated engineering
- Consistent quality
- Efficient use of resources

Energy Efficiency

- Efficient Motors
- Alternative fuel sources
- Heat recovery
- Process optimization

Environment Protection

- Regulations
- Emission Reduction
- Worker Safety
- CO2 Reduction

Capital Efficiency

- High production availability
- Flexible operations
- Inventory control
- Global partnering

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Multiple factors are bringing urgent challenges in the cement industry

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safe
quality
smart
flexible
compliant
adaptable
personalized
faster
scalable
connected
efficient
integrated
secure
profitable
global
sustainable

SIEMENS

Navigate fast and flexibly, using the power of data

connected

profitable

adaptable

safe

personalized

efficient

quality

integrated

smart

faster

global

flexible

scalable

secure

sustainable

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SIEMENS

Navigate fast and flexibly, using the power of data

connected

profitable

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global

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secure

sustainable

compliant

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Five key business drivers in the cement industry

Cost *Reduction*

Energy *Efficiency*

Environment *Protection*

Capital *Efficiency*

Flexibility
- Faster capacity expansion
- Flexible, modular operations
- Multiproduct facilities

Speed
- Faster approvals
- Faster batch release
- Smart modular standards

Quality
- More effective compliance
- Better process control
- Data integrity & consistency

Sustainability
- Increase energy efficiency
- Reduce carbon emissions
- Reduce water consumption

Efficiency
- Lower waste
- Improved productivity
- Improve equipment utilization

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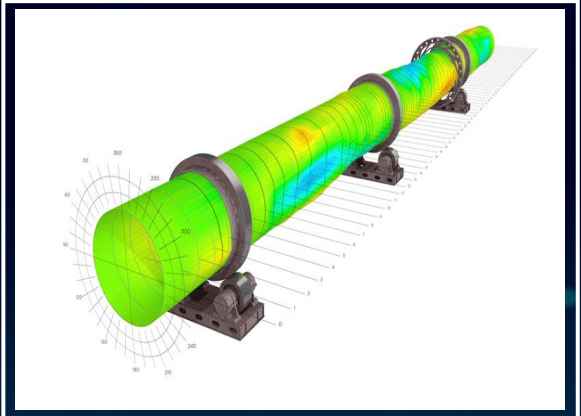
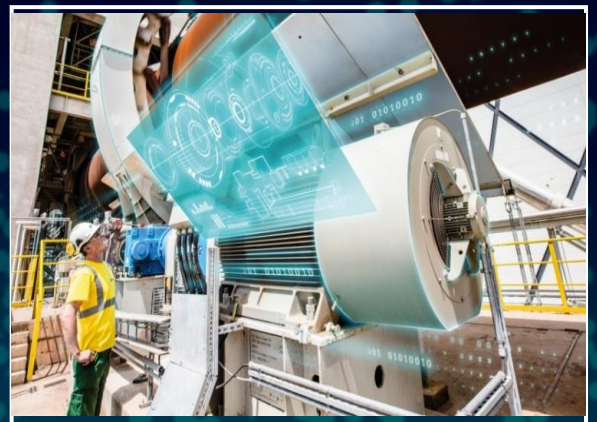
Driving our Focus Topics with our key customers through co-creation

- Flexibility
- Speed
- Quality
- Sustainability
- Efficiency



Digital Twin & Simulation

Paperless Manufacturing



Smart Maintenance

Continuous Manufacturing

Energy Efficiency

Remote Diagnostic & Virtual Commissioning

IT & OT Cybersecurity

IIOT, Cloud & Edge

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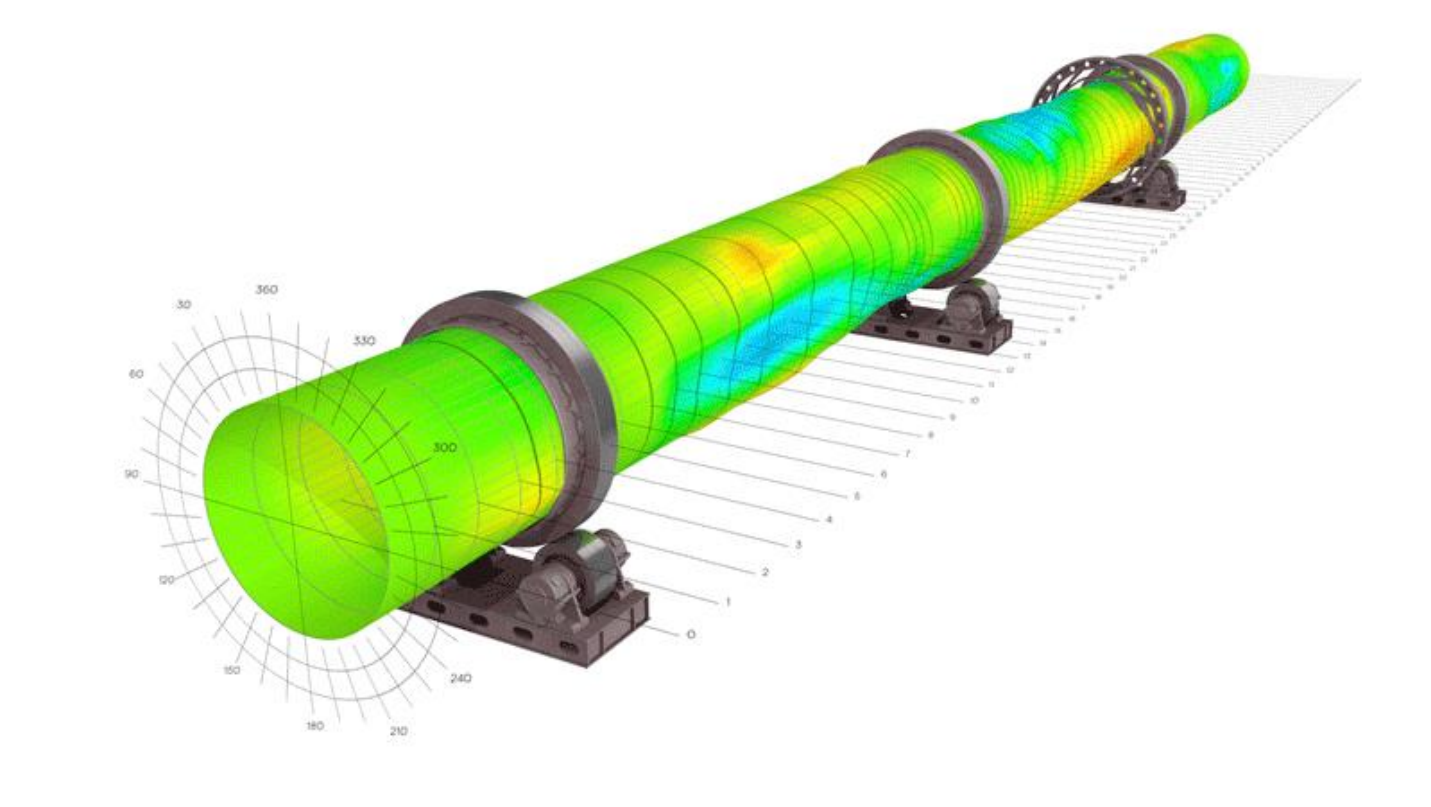
DIGITAL TWIN AND SIMULATION

Digital twins to **win the race against time**



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Digital Enterprise
The comprehensive Digital Twin approach

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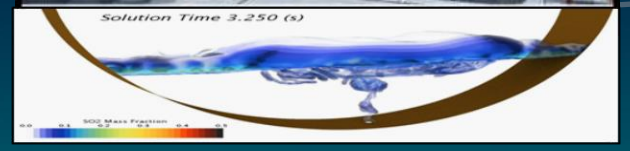
Enabling Predictive Engineering Analytics

Test data

3D SIMULATION



SIMULATION

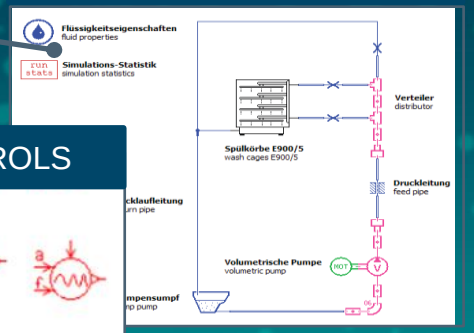
Simulation data

Customer Usage data

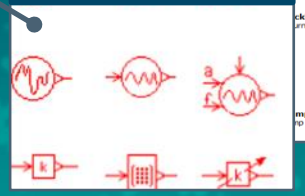
TEST MODELING

Historical data

1D SIMULATION



CONTROLS



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Mapping between Real and Virtual Siemens World

Real World

HMI: PCS 7 OS Server/WinCC

Automation System (AS)

SIMATIC S7

Remote IO/ devices

Actuators/ Sensors

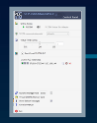
Plant/ Machine

Virtual World

HMI: PCS 7 OS Server/WinCC

Software-in-the loop Emulation of AS

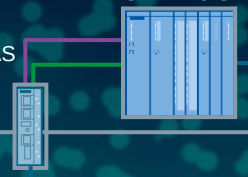
PLCSIM Adv.



SIMIT VC – Virtual Controller

Hardware-in-the loop
PROFIBUS or PROFINET via SIMIT Unit

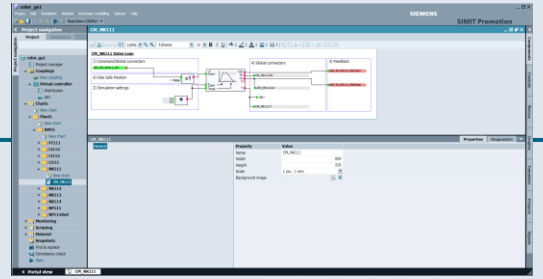
Real AS



SIMATIC S7

Simulation of Signals

SIMIT



Simulation of Drives/Signals

Simulation of technological behavior

SIMIT

Process behavior w/o chemical reactions

High fidelity chemical process simulators

3D or discrete event driven simulators

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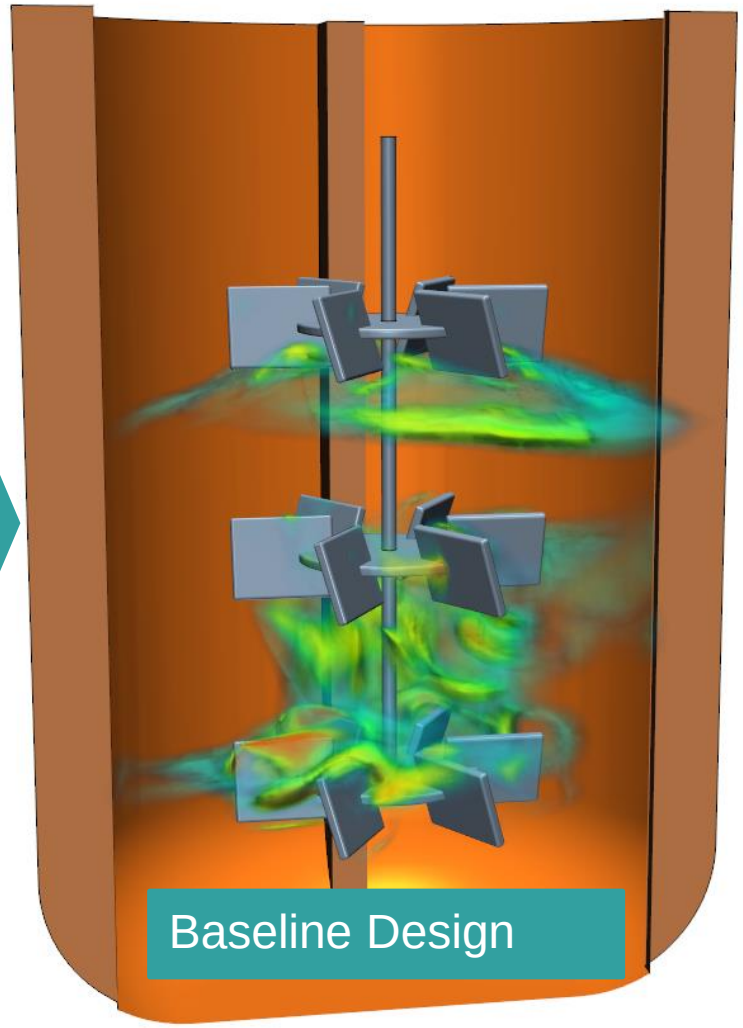
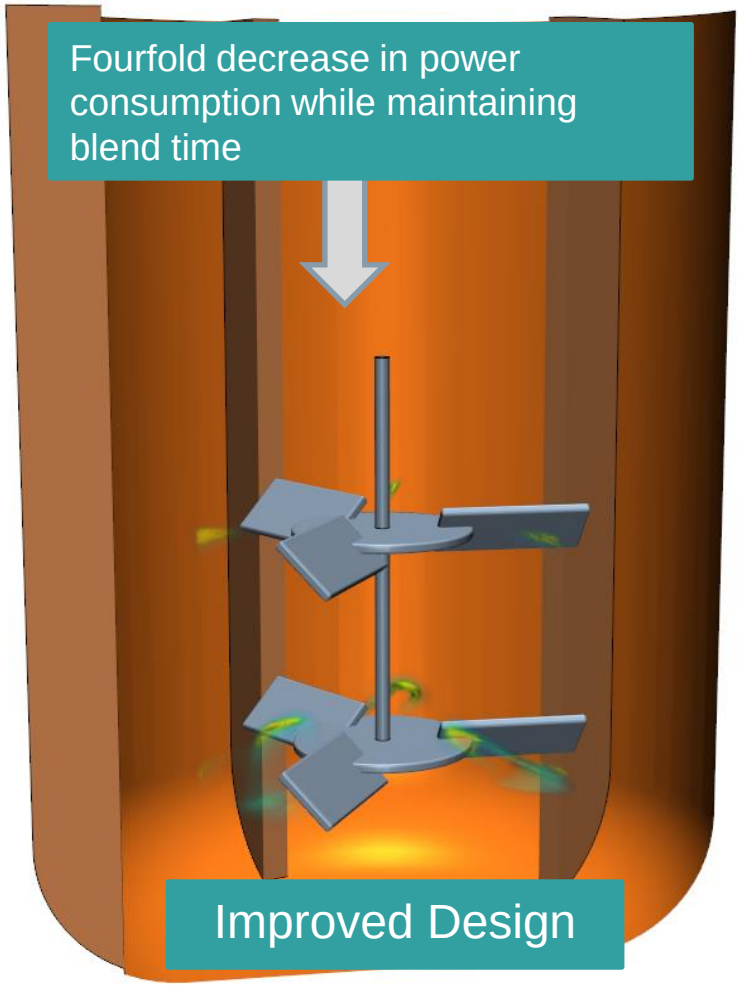
Equipment Design - Simcenter for Mixing Reactor Performance

Optimizer processes: explore design and operating conditions

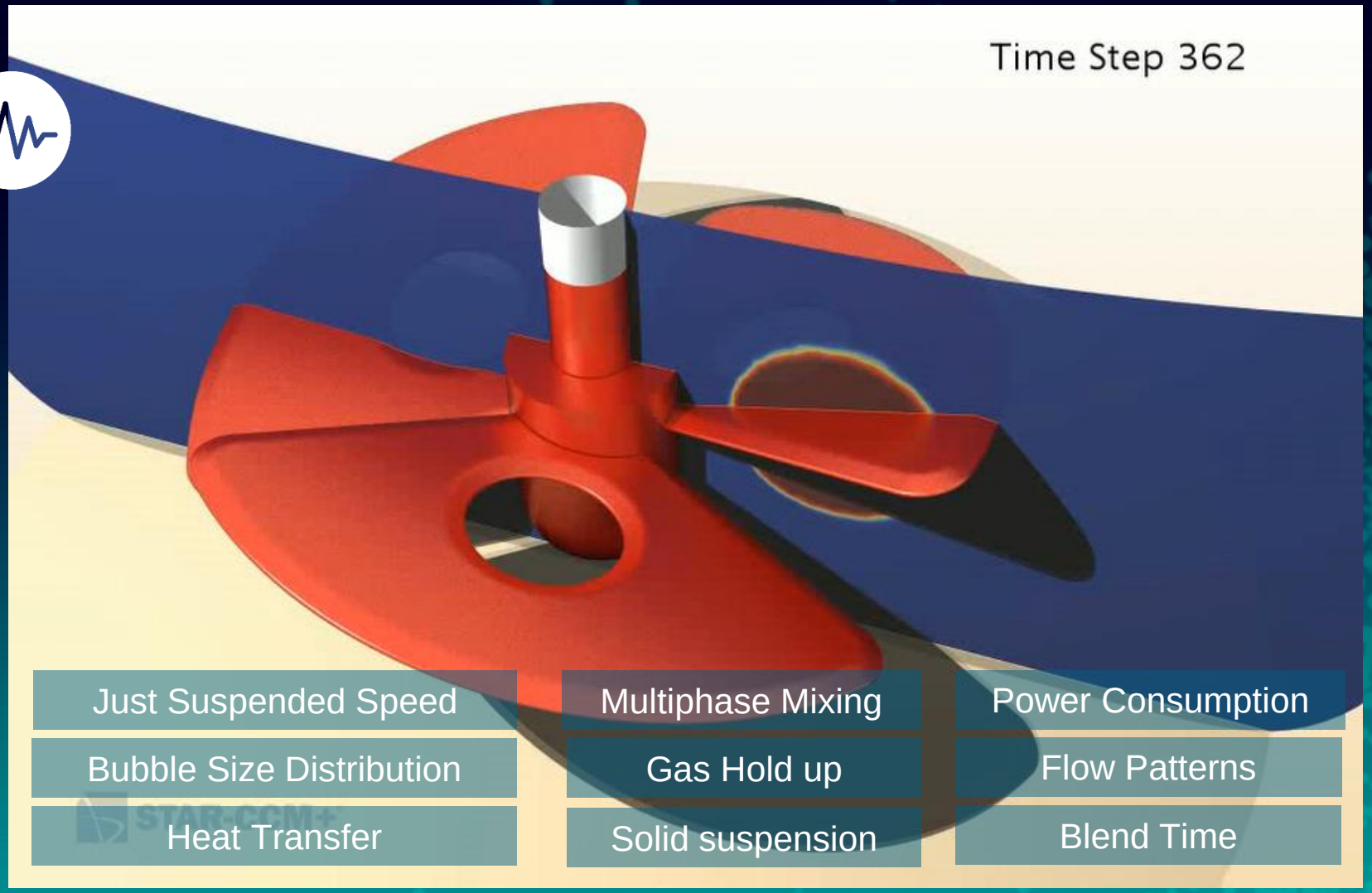
- Evaluate effect of design change
- Evaluate effect of operating condition change
- Understand correlation of multiple variables
- Balance counteracting parameters





Equipment Design - Simcenter for Mixing Reactor Performance

Covering a wide range of performance indicators



Just Suspended Speed	Multiphase Mixing	Power Consumption
Bubble Size Distribution	Gas Hold up	Flow Patterns
Heat Transfer	Solid suspension	Blend Time

Mixing Performance

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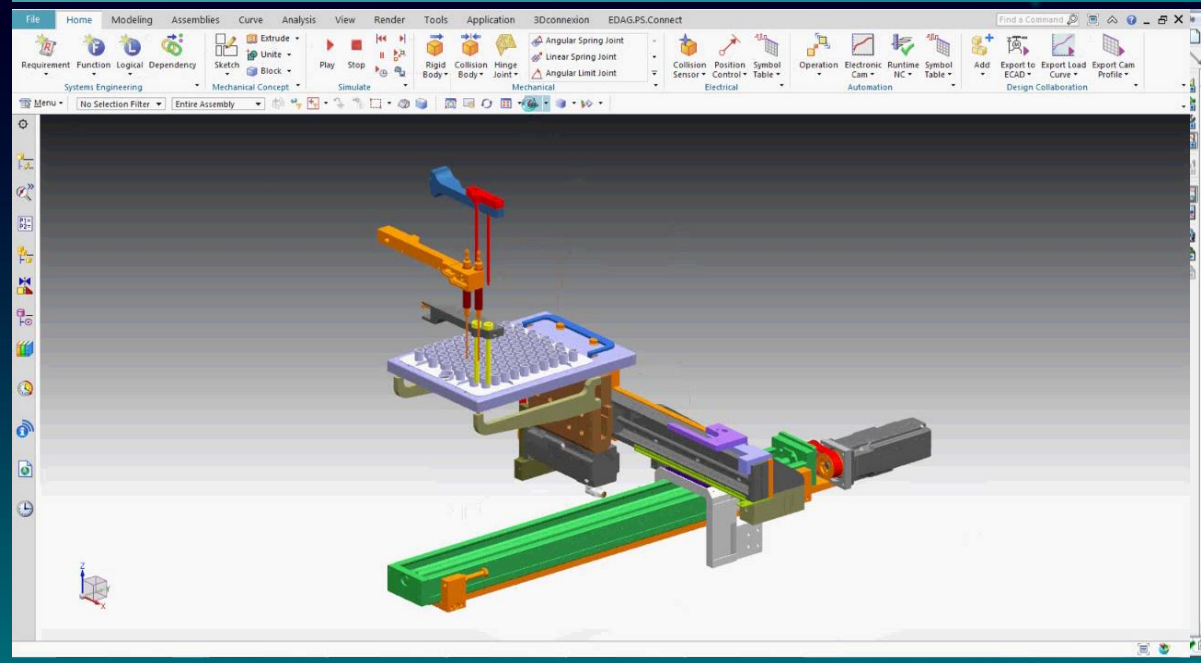
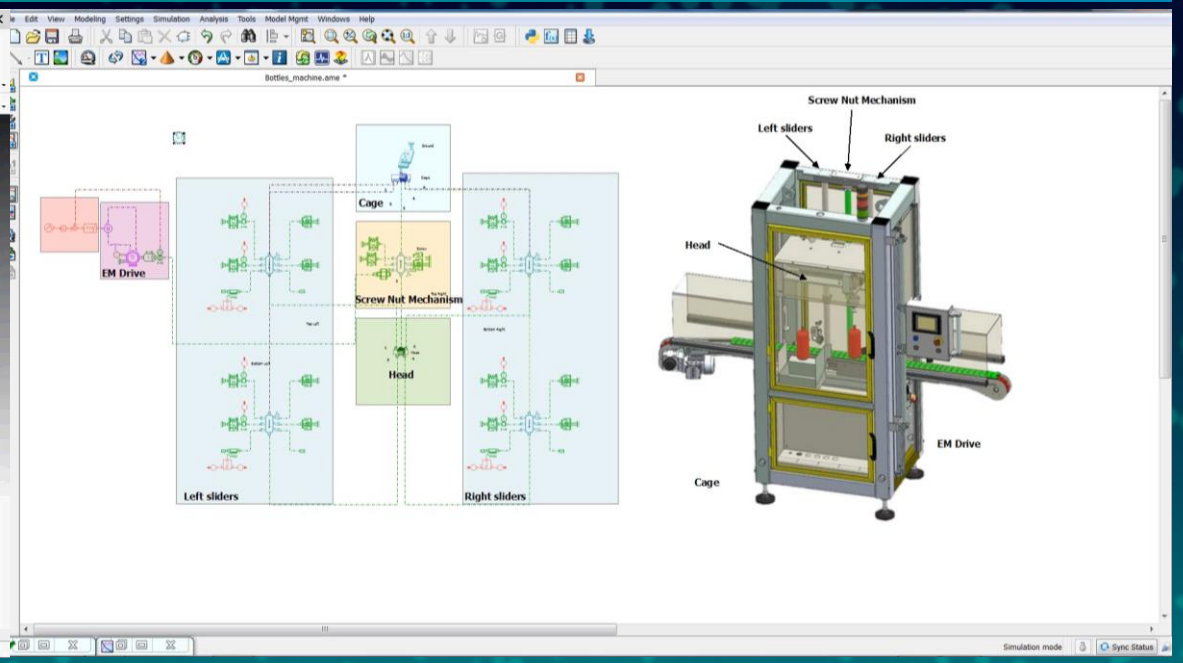
Production Digital Twin
Production Simulation – Automated Machinery

Unit Operation Design / Validation





Machine Design

Machine Performance Optimization

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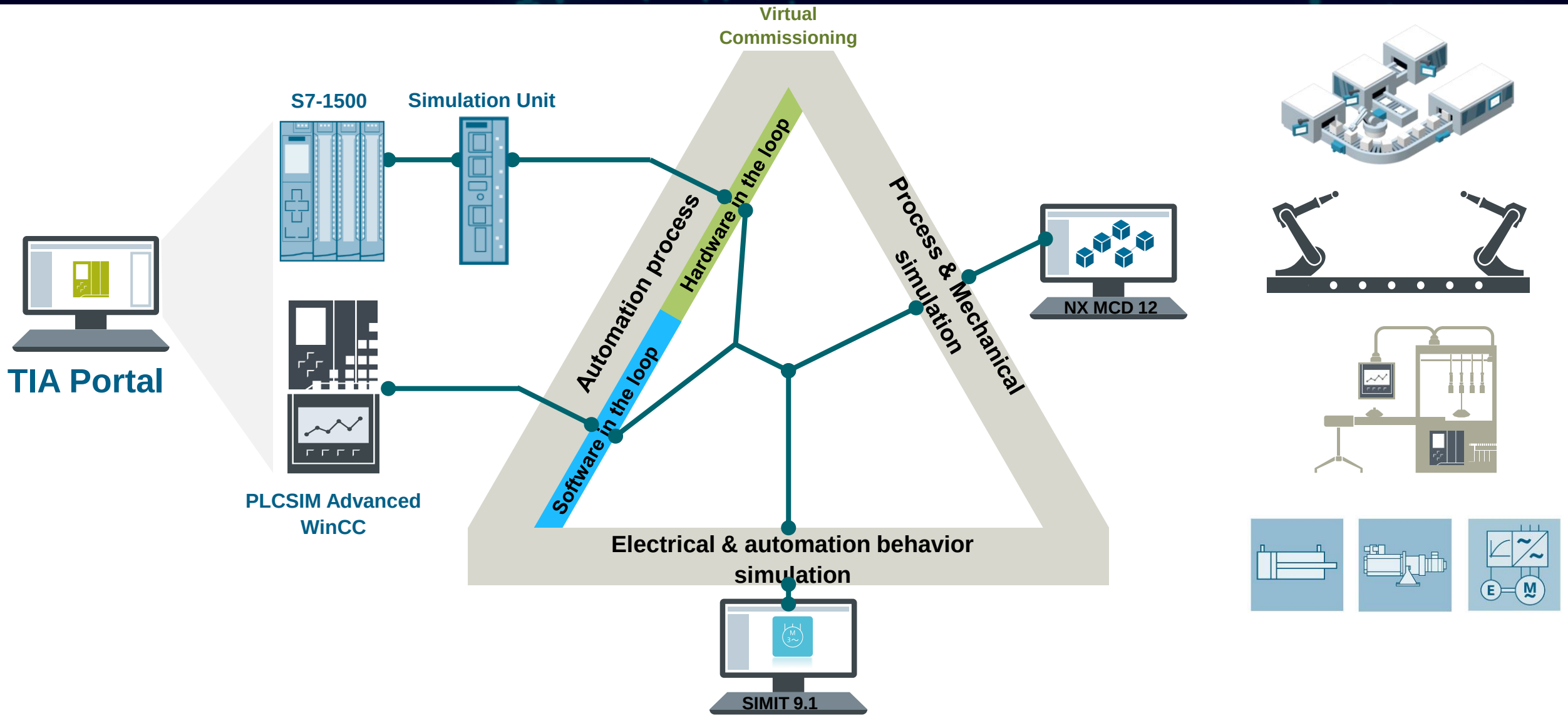
Virtual commissioning

Switching HiL ← → SiL



Closed Loop Manufacturing
Automation Design & Virtual Commissioning

Use the Machine Model to generate and validate the automation code…

…and in the real world

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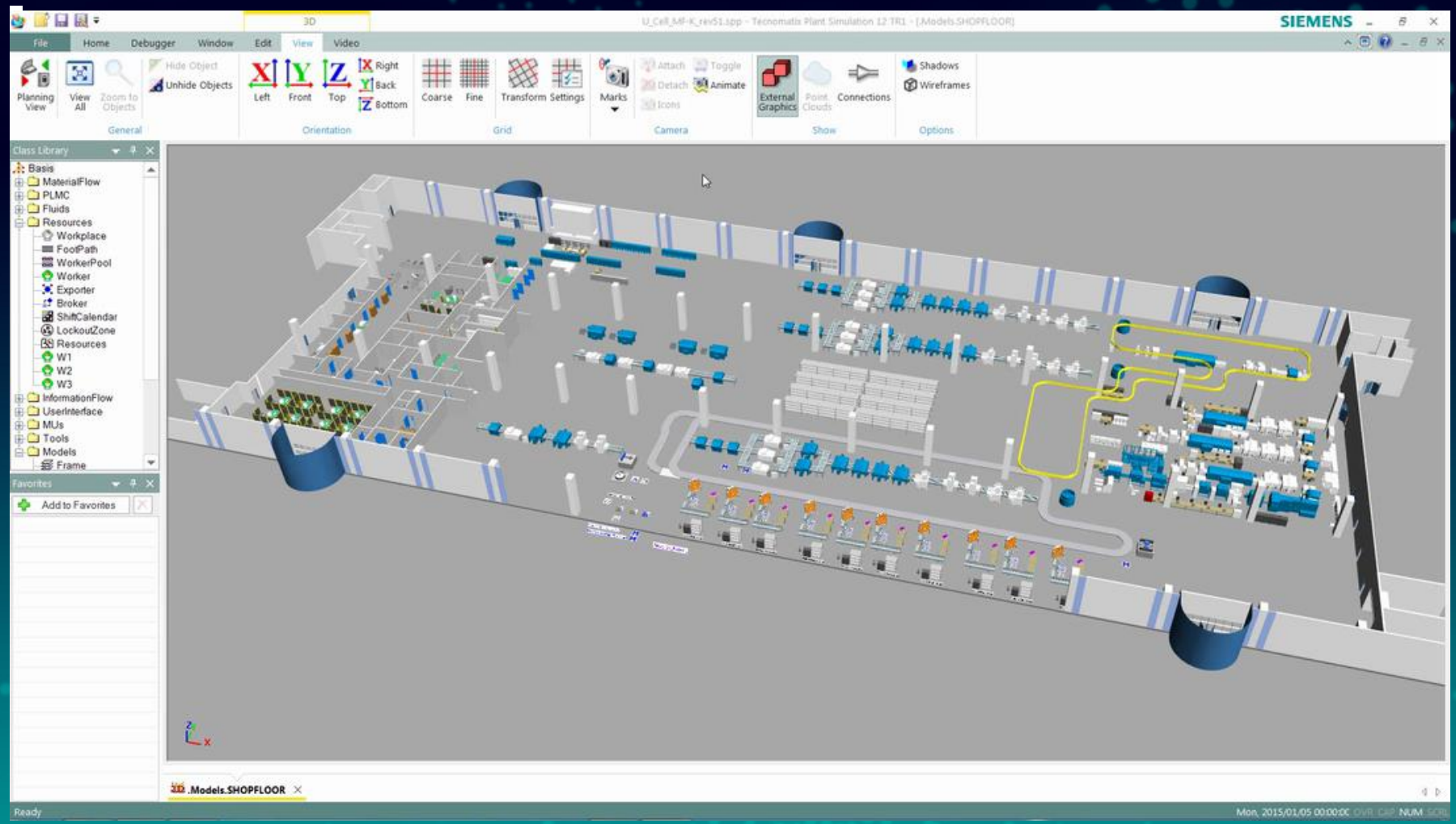
Extending the Digital Twin to cover plant and process

Simulate Material & Logistic Flow

Plant Simulate



1 2 3 4 5

Extending the Digital Twin to cover plant and process

Simulate & Program Robotics

Process Simulate

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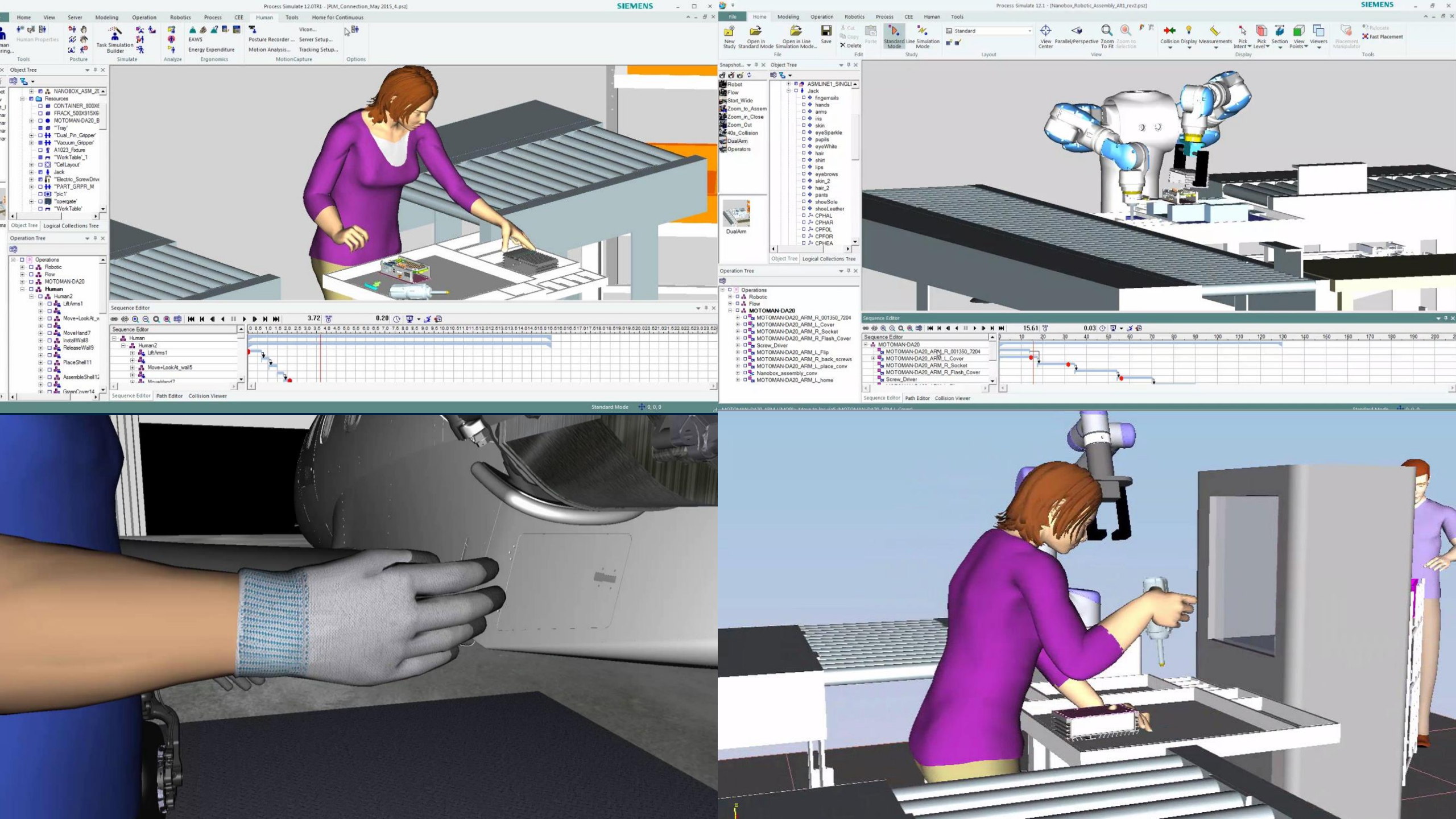
Process Simulate 12.0TR1 - [PLM_Connection_May 2015_4.psz]
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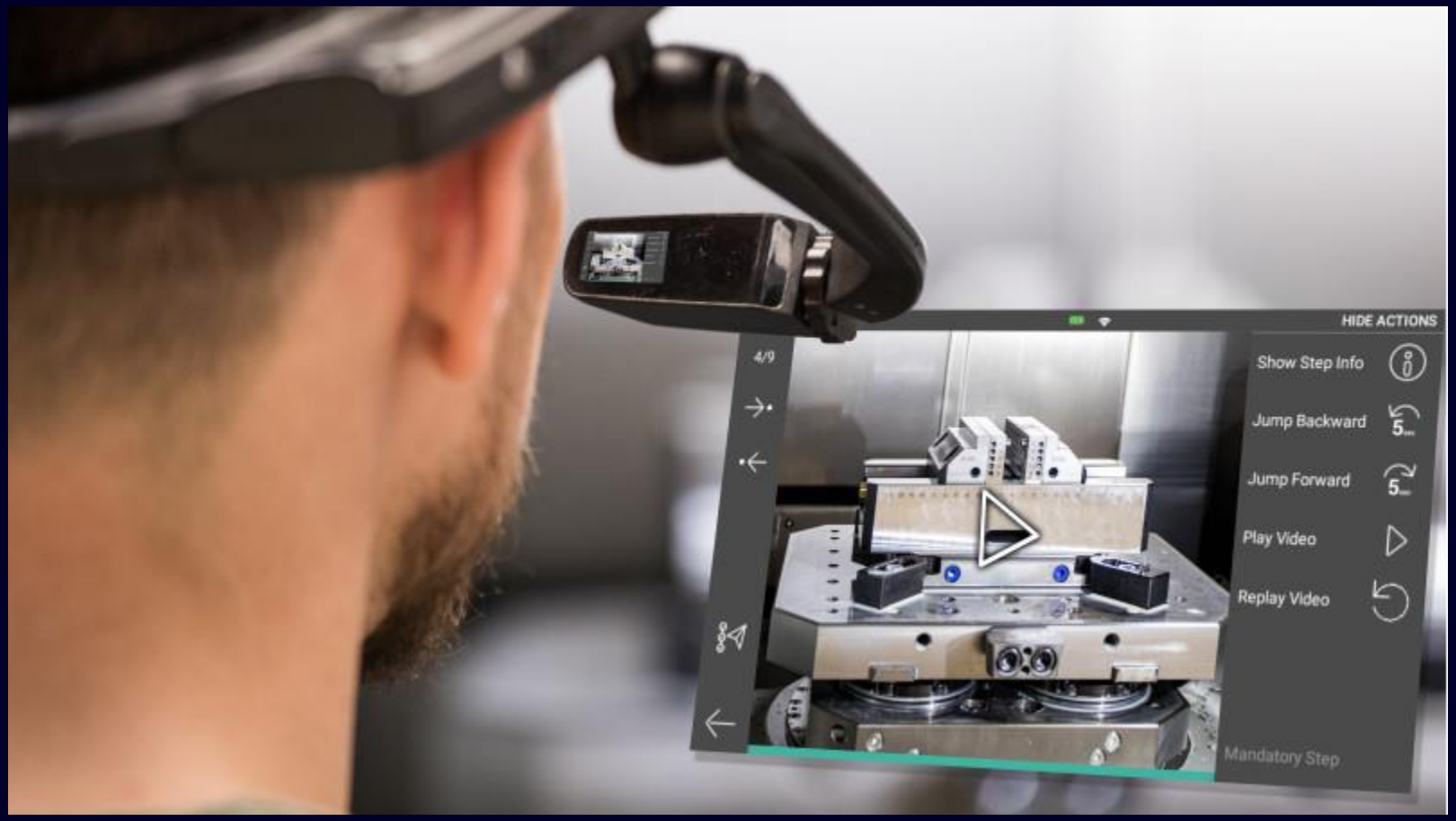
Process Simulate 12.1 - [Nanobox_Robotic_Assembly_Alt1_rev2.psz]
Object Tree
Operation Tree
Sequence Editor
Path Editor
Collision Viewer
Logical Collections Tree
Standard Mode

Remote Diagnostic



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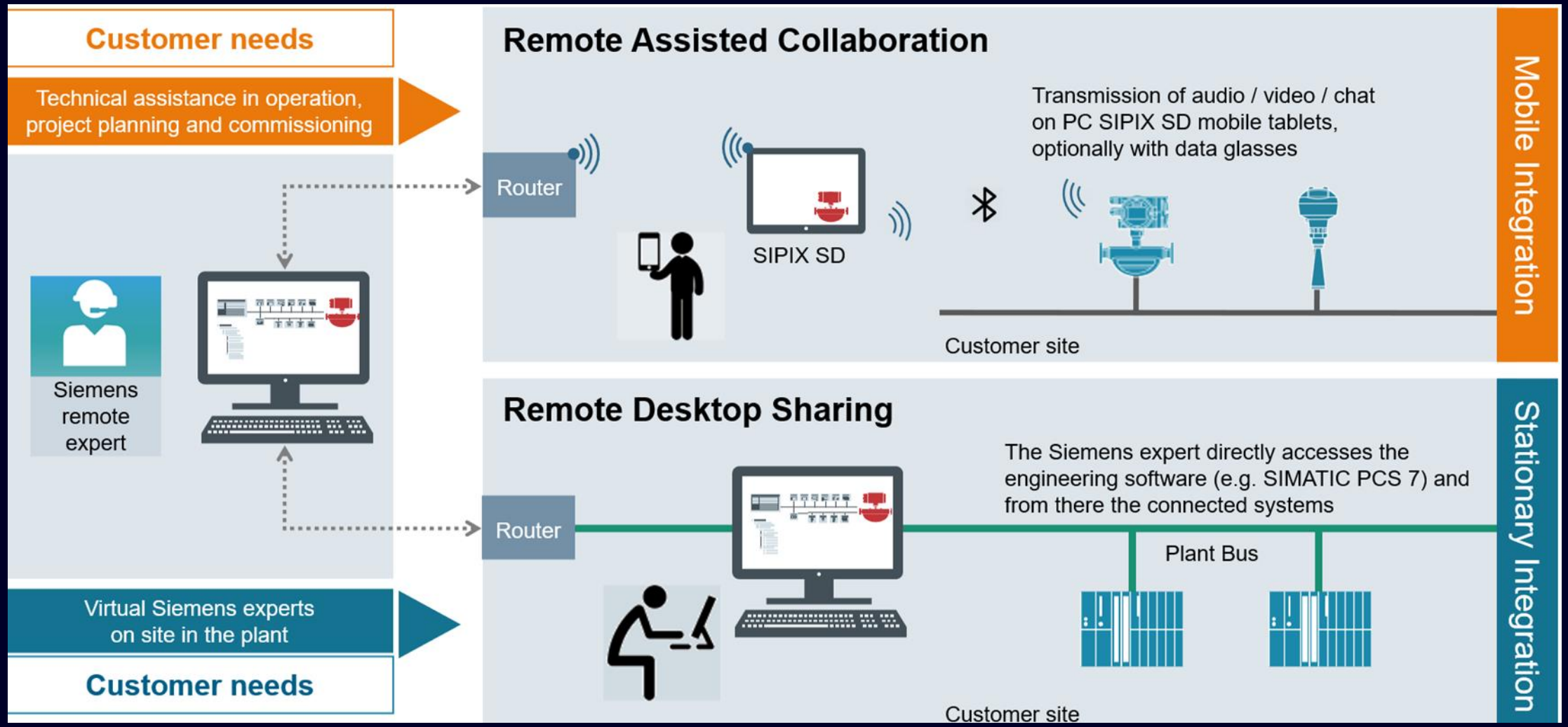
Remote Diagnostic



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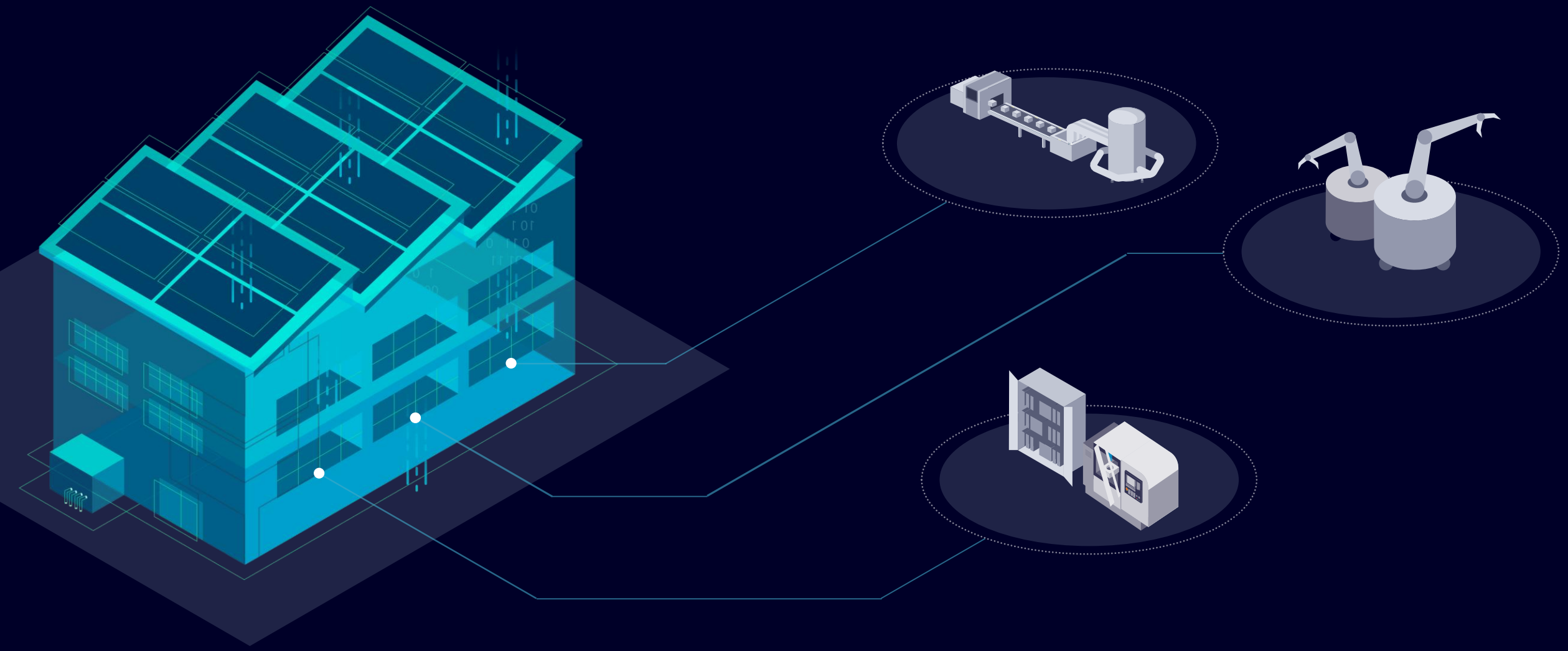
Industrial Cybersecurity

Siemens University

Yesterday we had islands of communication



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Today
everything is
connected ...

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… and

at risk

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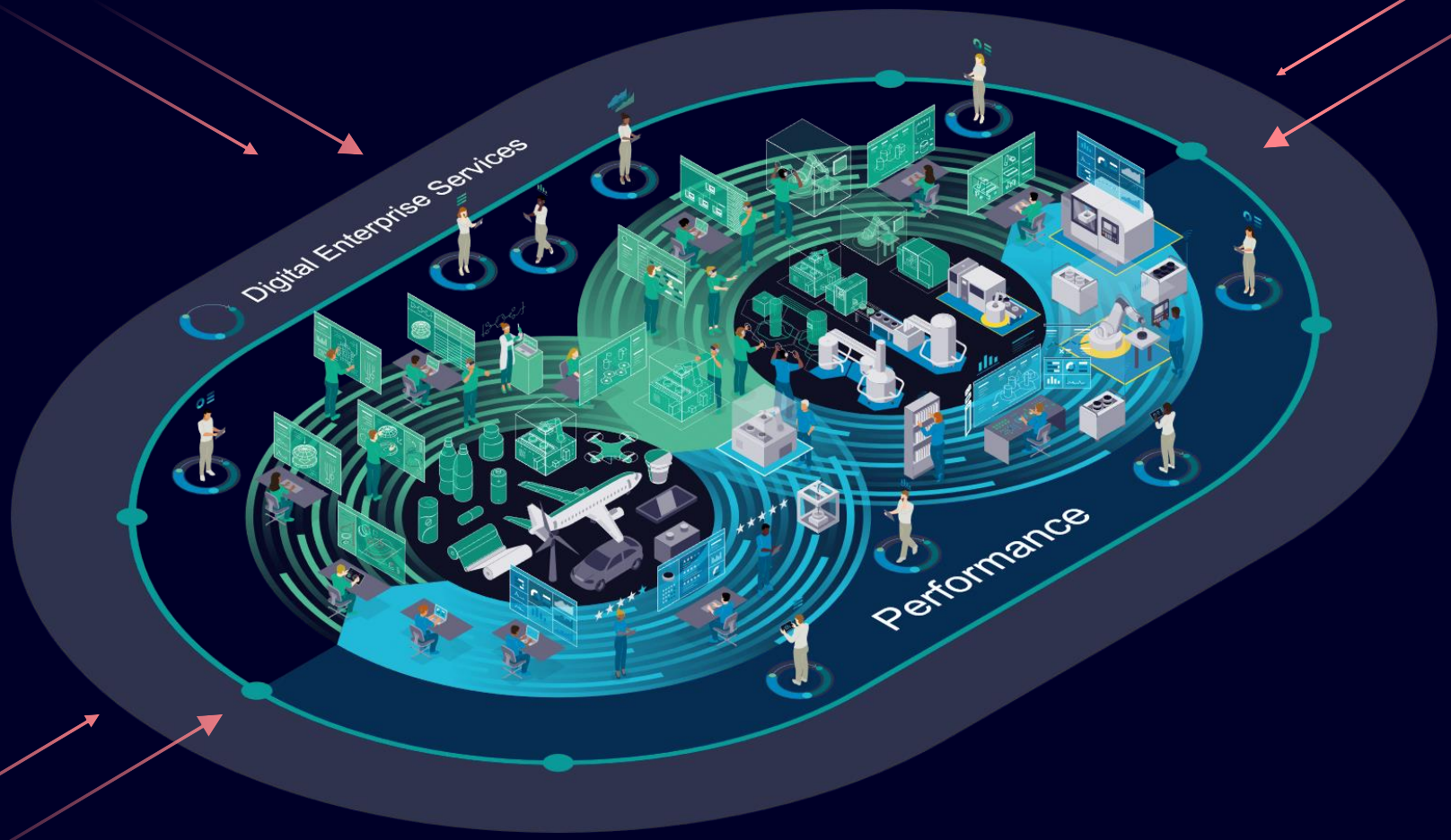
Production systems are part of the IoT
This means IT/OT integration across all areas and layers

IT/OT collaboration means:

- **More connectivity**
- **More data**
- **New cyber-risks**



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IT/OT integration across all areas and layers

Cybersecurity is a must have in IT **and** OT!

Information Technology **(IT)**

Operational Technology **(OT)**

- Cloud
- Software for vertical integration
- Edge
- Controller/Automation platforms
- Field devices

Low-code app development

Communication platforms

Cybersecurity

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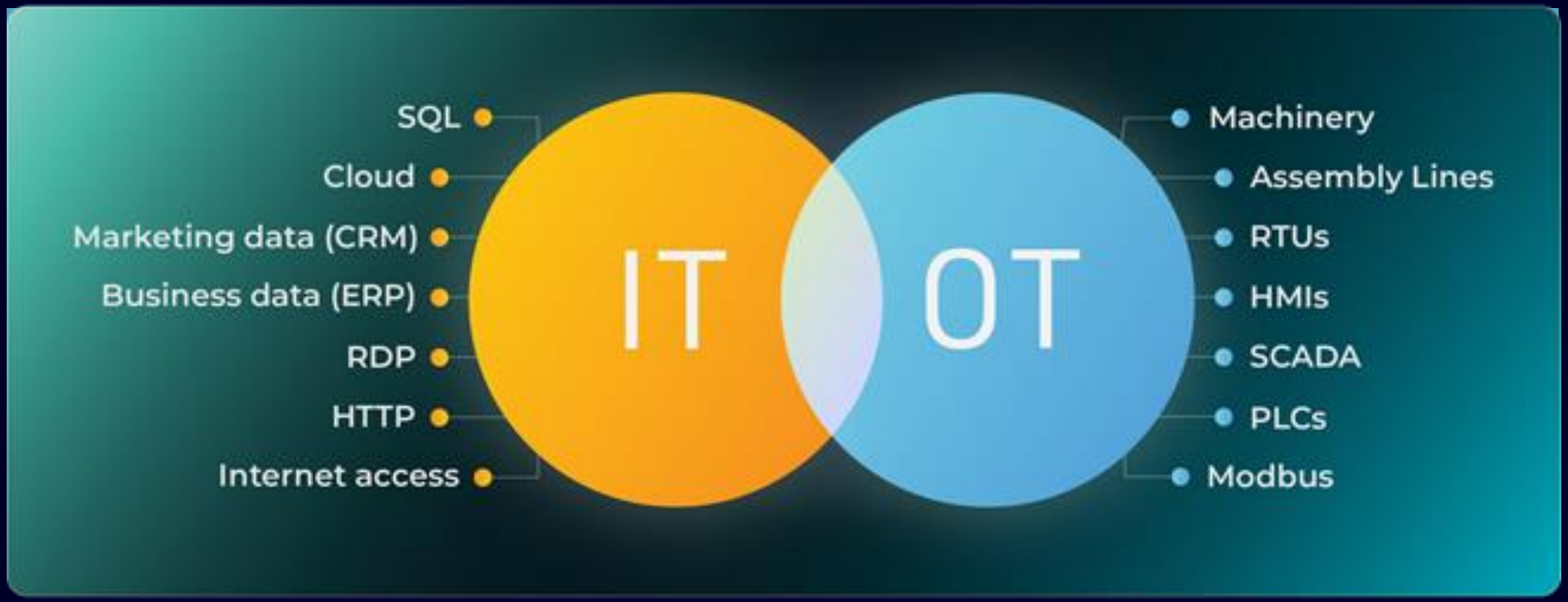
IT/OT integration across all areas and layers
Cybersecurity is a must have in IT **and** OT!



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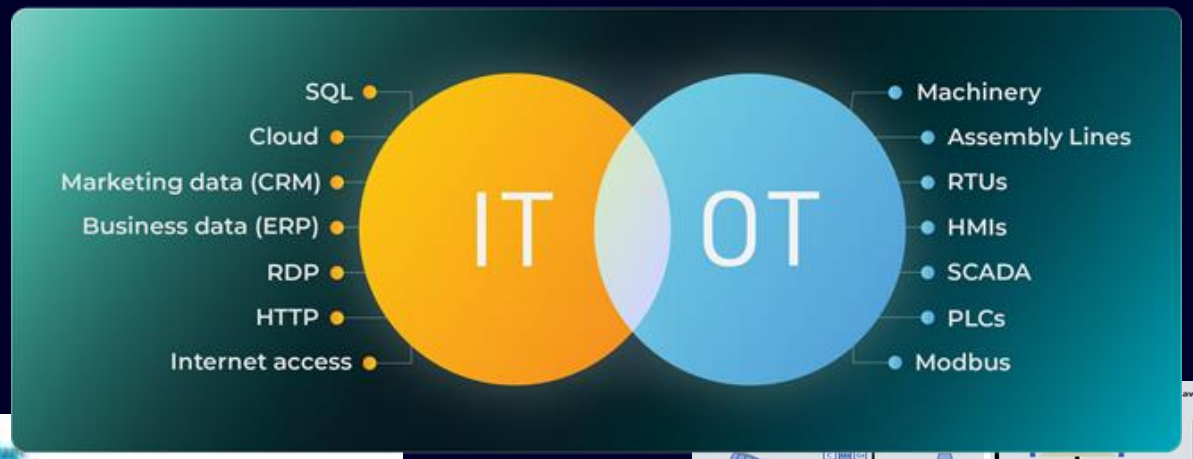
IT/OT integration across all areas and layers
Cybersecurity is a must have in IT **and** OT!

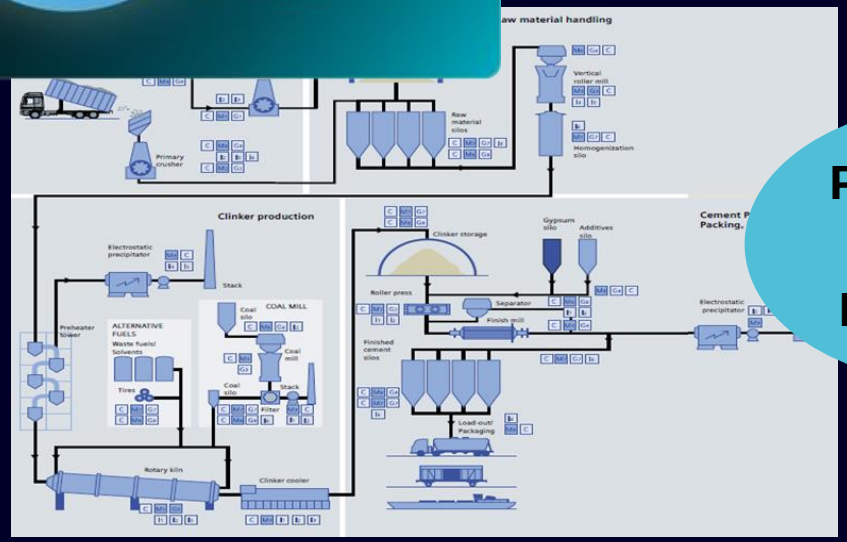
IT Security

OT Industrial Security

IT - Centric Endpoints



IT - Centric Endpoints



Production - Centric Endpoints

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IT/OT integration across all areas and layers
Cybersecurity is a must have in IT **and** OT!

IT Security

100%

IT - Centric Endpoints

- Windows/Unix/Linux based
- IP Addressable
- Assets Lifecycle 3-5 years
- Easy to scan and assess
- Patching each month or less
- Priority for Confidentiality

OT Industrial Security

~20%

IT - Centric Endpoints

- Windows/Unix/Linux based
- IP Addressable
- Assets Lifecycle 3-5 years
- Easy to scan and assess
- Patching each month or less

~80%

Production - Centric Endpoints

- Multi-vendor / Proprietary
- Scanning sensitivity
- Assets Lifecycle +15 years
- Hard to assess / Requires ICS knowledge
- Patching every 6-24 months (vendor dictates process)
- Priority for Safety & Availability

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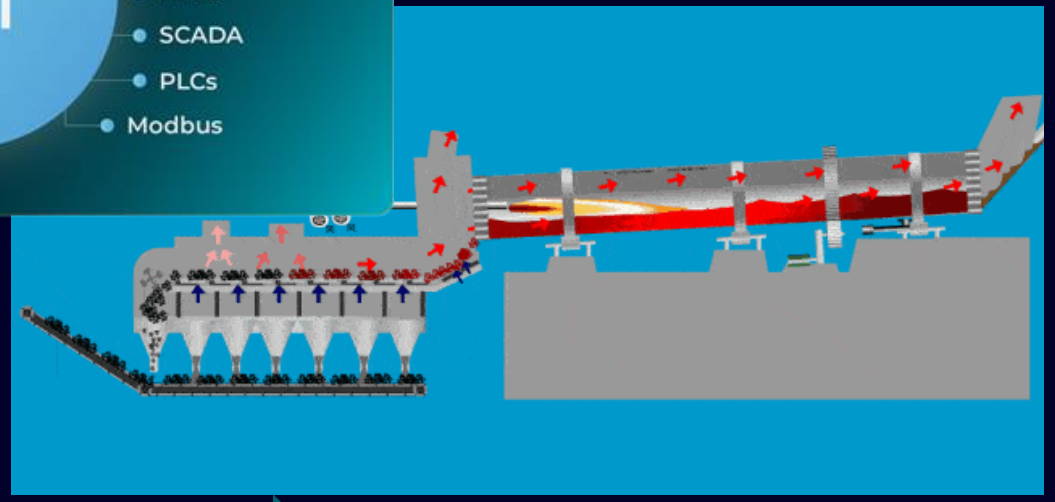
IT/OT integration across all areas and layers
Cybersecurity is a must have in IT **and** OT!

IT Security	OT Industrial Security



Shall we blindly apply IT Security on OT?

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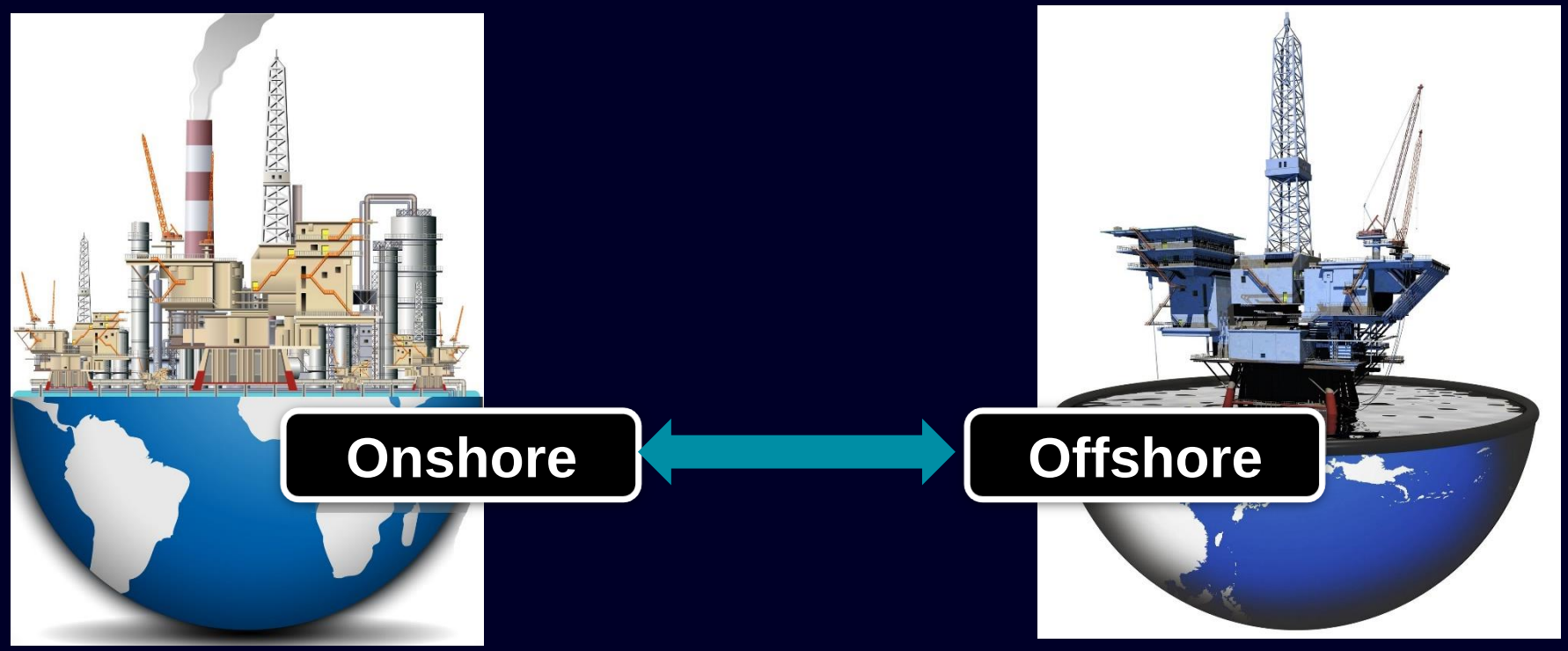
Case Study (1)
IT Security Vs. OT Industrial Security

Onshore-Offshore Integrated Fibre Optic Network



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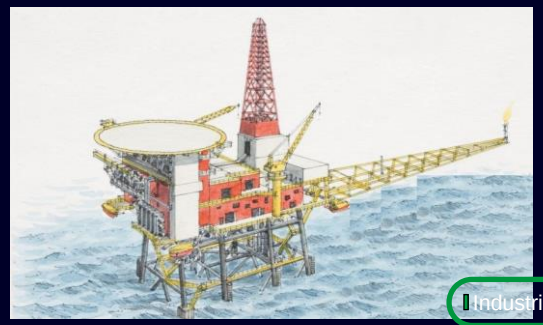
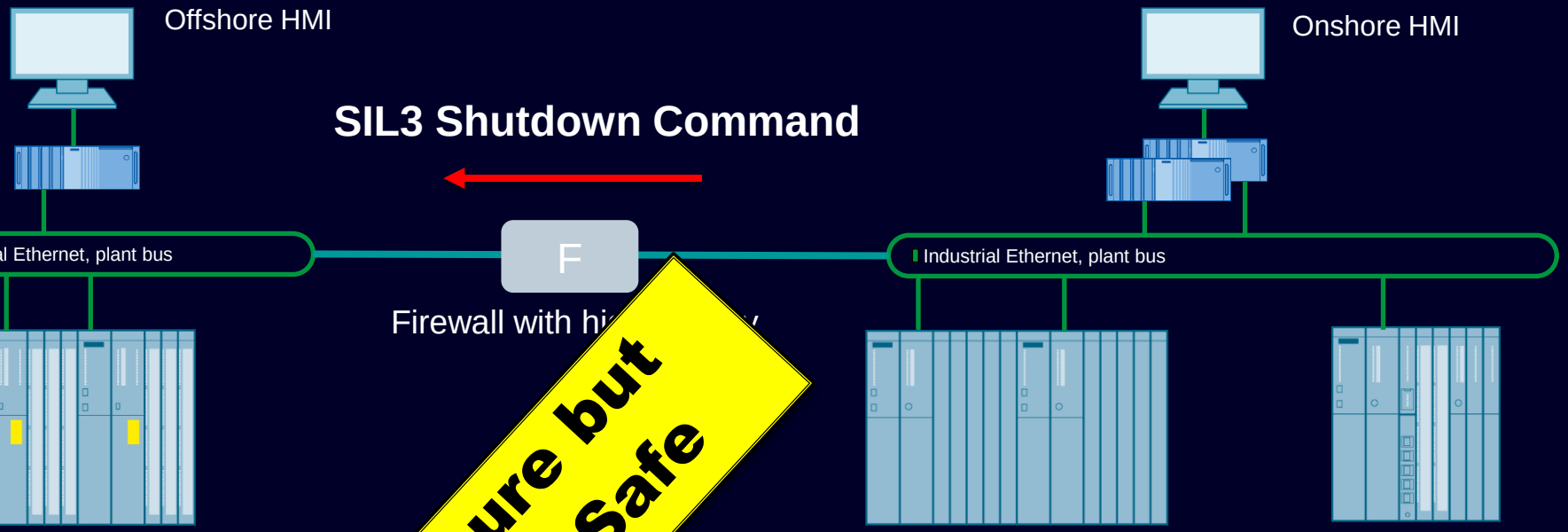
Case Study (1)
IT Security Vs. OT Industrial Security

Onshore-Offshore Integrated Fibre Optic Network



Safety Integrity Levels

Safety Integrity Level	PFD: Probability of failure on demand per year (Demand mode of operation)	1/PFD: Risk Reduction Factor
SIL 3	$>=10^{-4}$ to $<10^{-3}$	10000 to 1000
SIL 2	$>=10^{-3}$ to $<10^{-2}$	1000 to 100
SIL 1	$>=10^{-2}$ to $<10^{-1}$	100 to 10



Secure but NOT Safe

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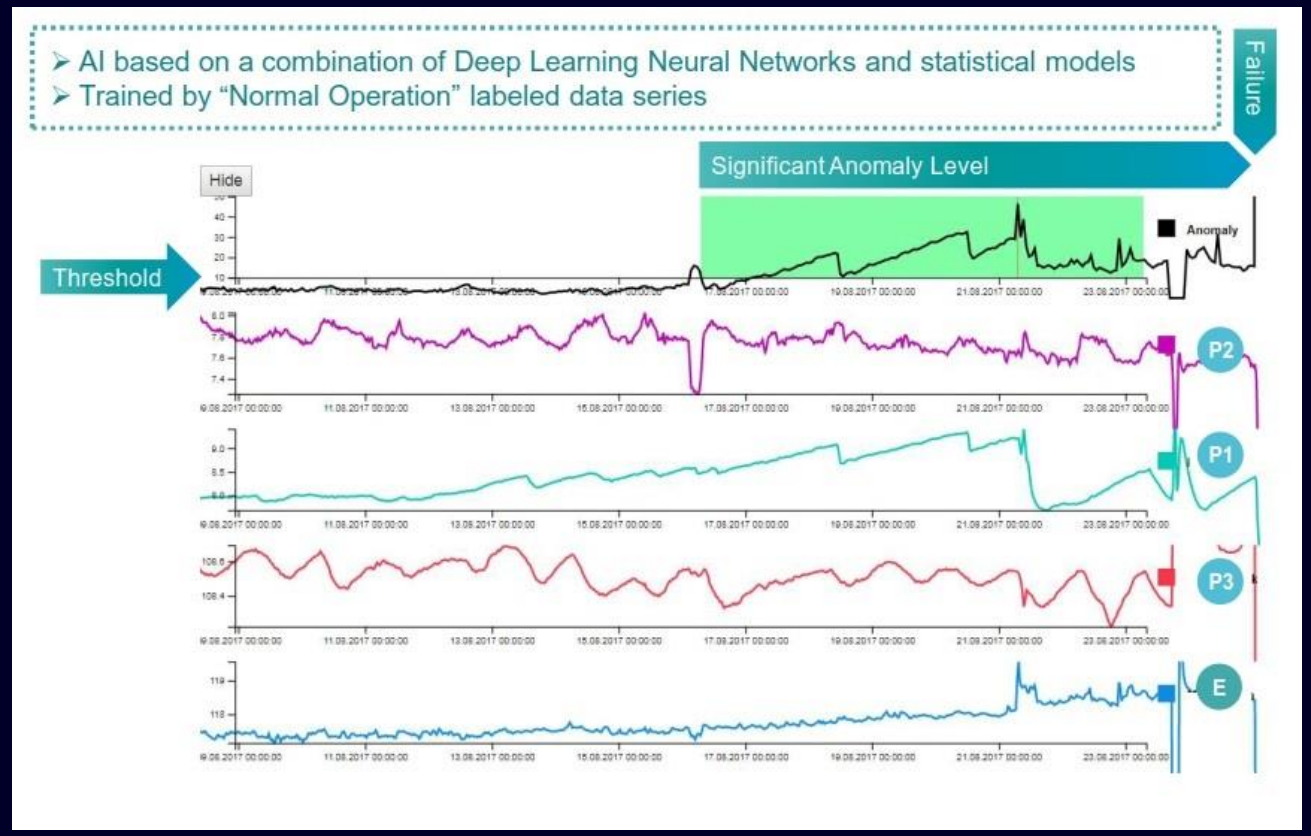
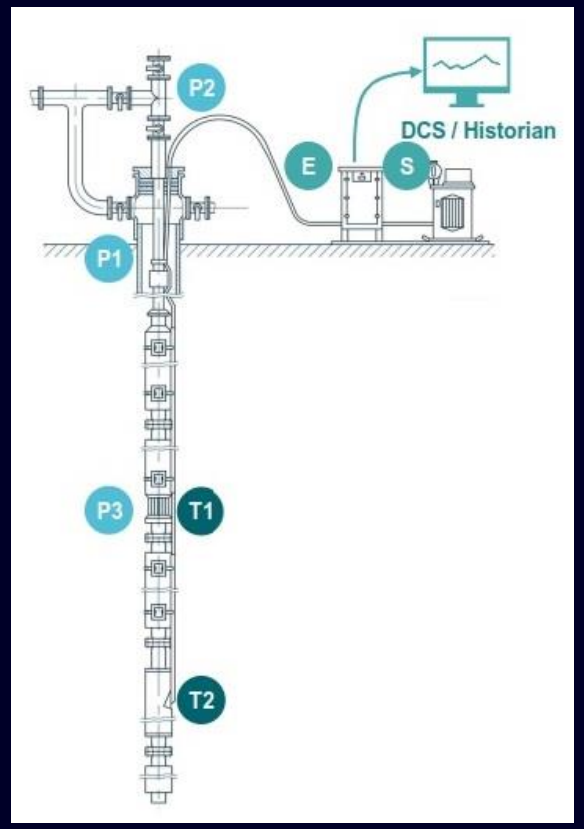
Case Study (2)
IT Security Vs. OT Industrial Security

Predictive Maintenance for Electrical Submersible Pump





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Case Study (2)
IT Security Vs. OT Industrial Security

Predictive Maintenance for Electrical Submersible Pump

zigbee

- Industrial Wireless Sensors are specified for downstream sensors
- Industrial Wireless Protocol **Zigbee PRO** is selected for raw data transmission
- Zigbee PRO **high security configuration** is implemented

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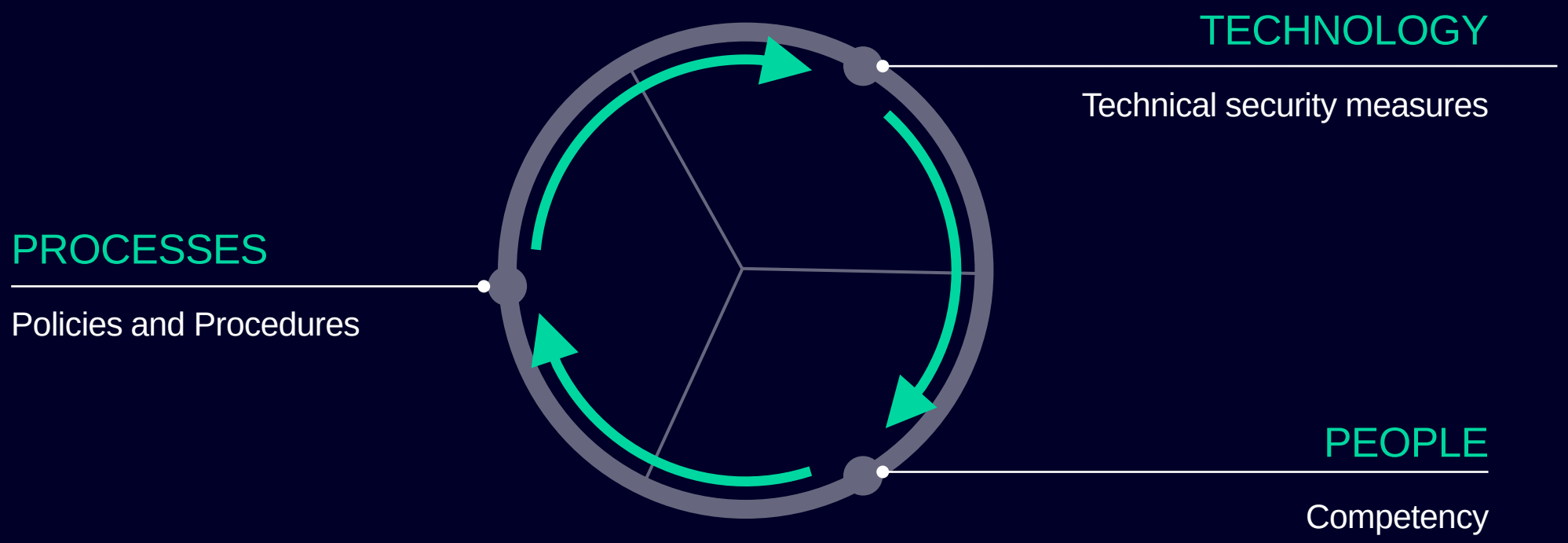
A holistic Cybersecurity approach is guided by three main pillars
People, Technology and Processes



A holistic security protection concept has to include technology, processes and people

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A holistic Industrial Security concept based on Defense in Depth principle

Security threats demand action

Plant security

- Physical access protection
- Security Policies
- Security monitoring

Network security

- Cell protection, perimeter network and trusted zones
- Firewalls and VPN

System integrity

- System hardening
- Patch Management
- Authentication and access protection

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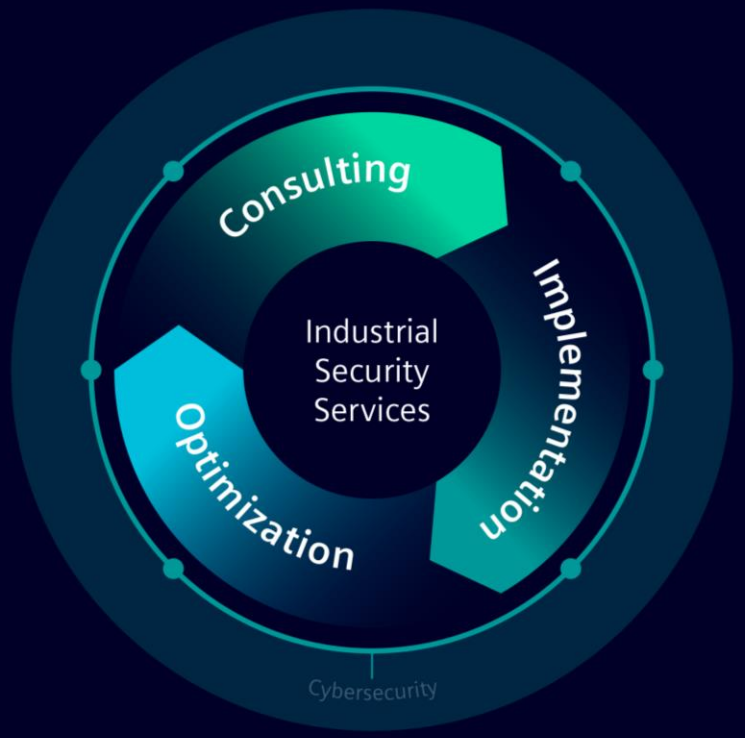
Industrial Security Services: End-to-end approach



Security Consulting

- Security Assessments
- Scanning Services
- Industrial Security Consulting

Transparency about the current security status

Security Implementation

- Security Awareness Training
- Industrial Next Generation Firewall
- Endpoint Protection
- SIMATIC DCS / SCADA Infrastructure
- Industrial Automation DataCenter
- Industrial DMZ Infrastructure

Increased security level by closing security gaps

Security Optimization

- Industrial Anomaly Detection
- Industrial Vulnerability Manager
- Patch Management
- SIMATIC Security Service Packages

Long-term protection through continuous security management

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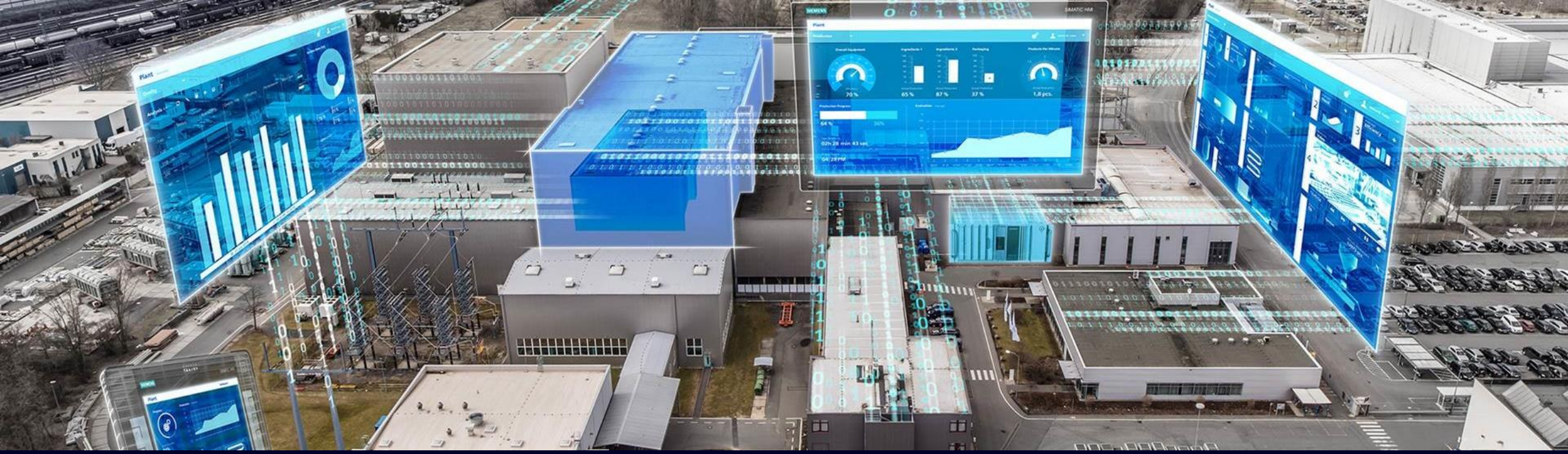

Energy Efficiency

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Roadmap to Energy Efficiency

Awareness	Analysis	Feasibility	Implementation	Sustainability
Energy Management System Consultancy	Holistic Energy Audit Decarbonization Audit	Focused Energy Audit	Project Implementation with Energy Saving Guarantee	Continuity of Energy Savings with Energy Monitoring System

5 steps to sustainable energy efficiency

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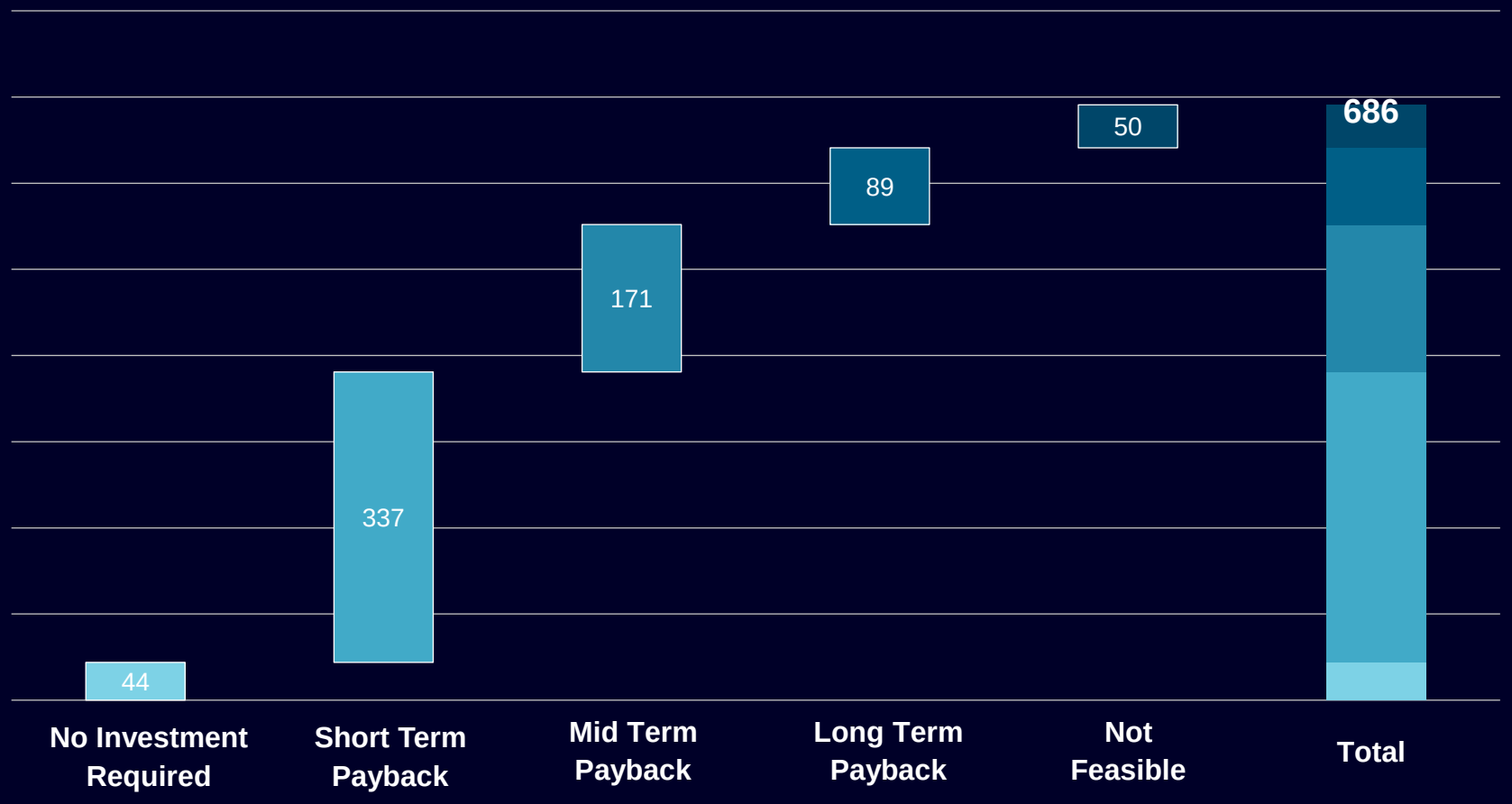
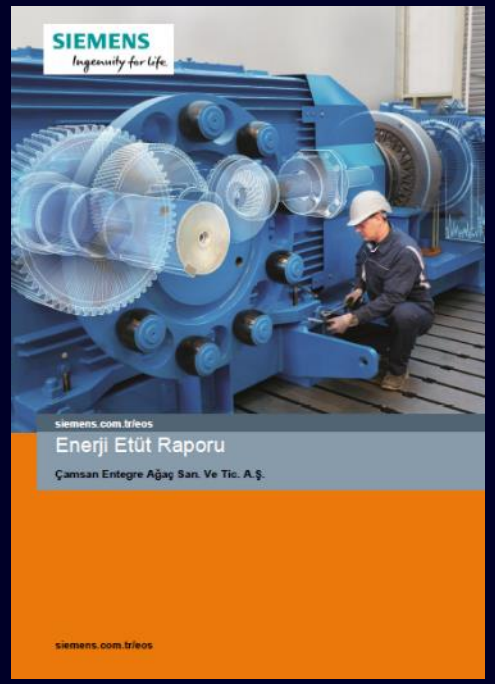
Holistic Energy Audit Results





* Audits completed in last 3 years

381 projects with <u>short term payback</u> or <u>no investment required</u> – 55% of all projects

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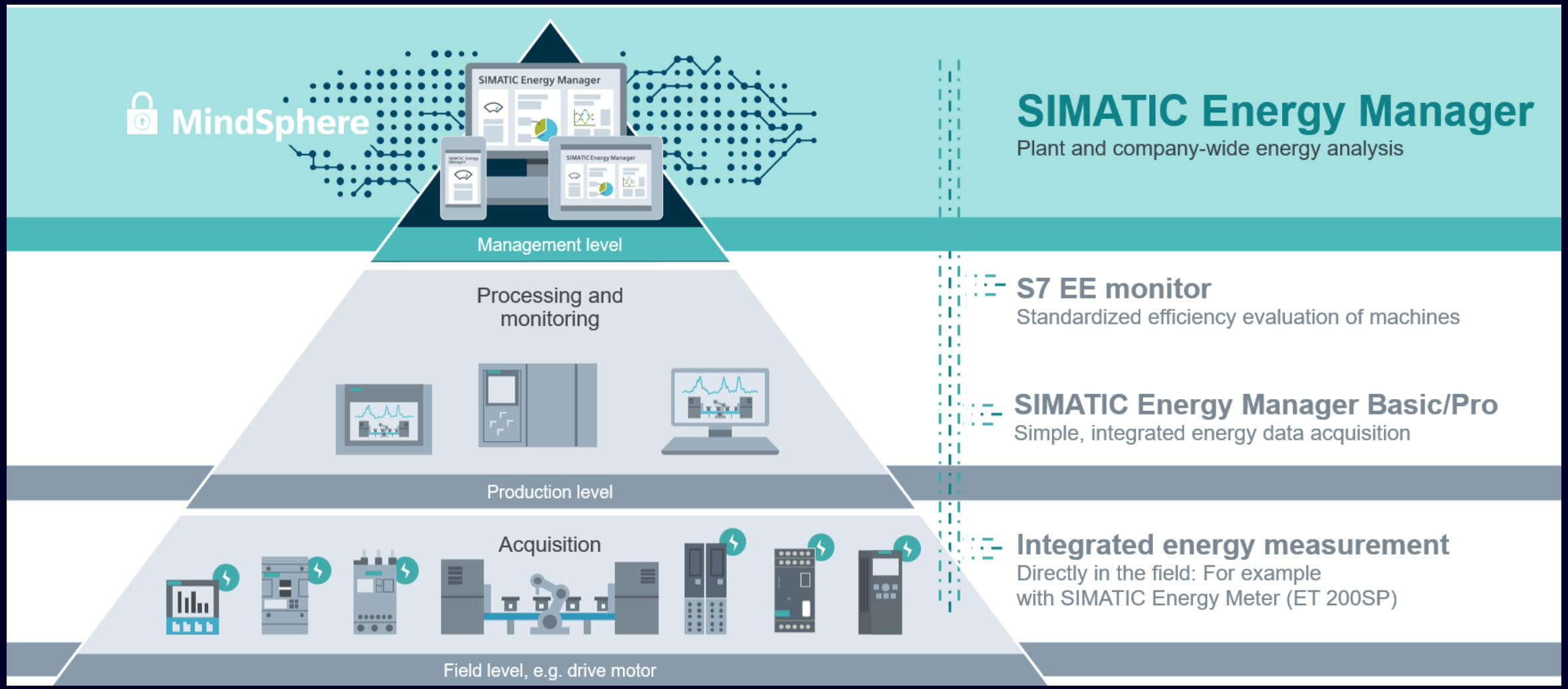
Energy Manager
On-premise and on-Cloud



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Energy Manager
On-premise and on-Cloud

date	counter value	consumption value
28.11.2017	2.252	4.113,92
08.11.2017	1.890	493,92
01.10.2017	1.630	2.970
01.09.2017	1.333	1.080
01.08.2017	1.225	2.150
01.07.2017	1.010	1.600
01.06.2017	850	2.500
01.05.2017	600	1.500
01.04.2017	450	1.500

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Senseye – Predictive Maintenance

Fix industrial problems before they occur

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Senseye – Predictive Maintenance

- Integrate PdM **seamlessly into infrastructure** and **gain remote access** to assets
- **Automate** equipment condition monitoring and report on maintenance activity
- **Monitor key machine parameters** such as vibration, noise, etc. to gauge machine health
- Cloud-based analytics **provide real-time insight** on machine condition
- **Initiate maintenance** and prevent minor problems from leading to major breakdowns
- **Reduce CapEx** and preventive service regimens on parts and replacements
- Perform machine diagnostics and prognostics to **predict remaining productive life** of equipment

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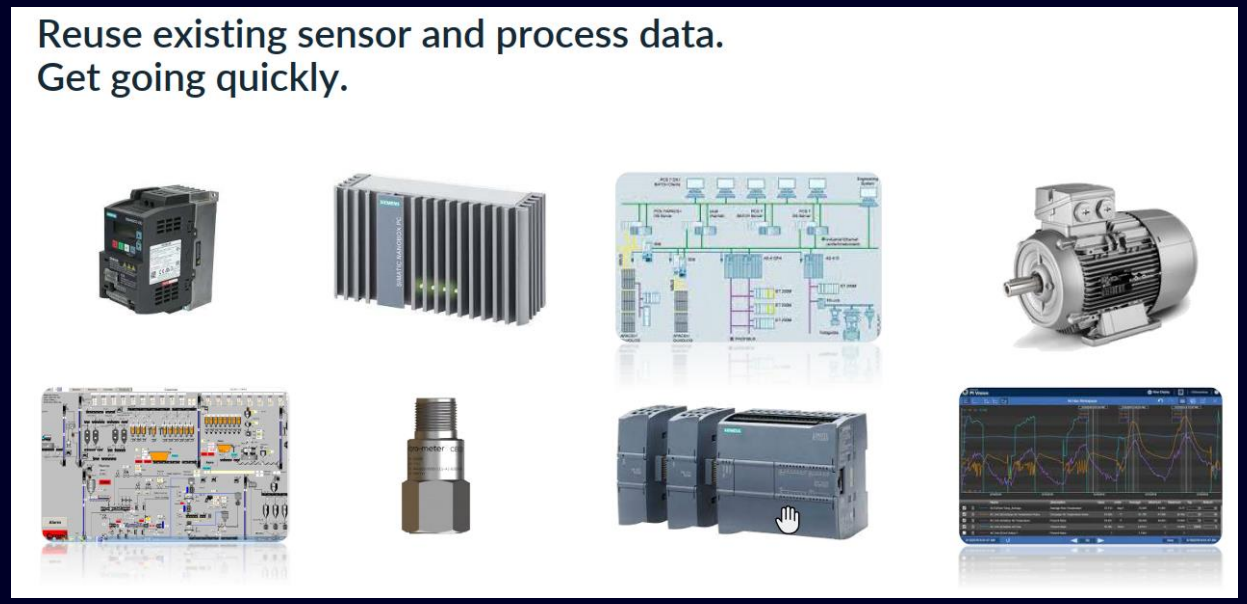

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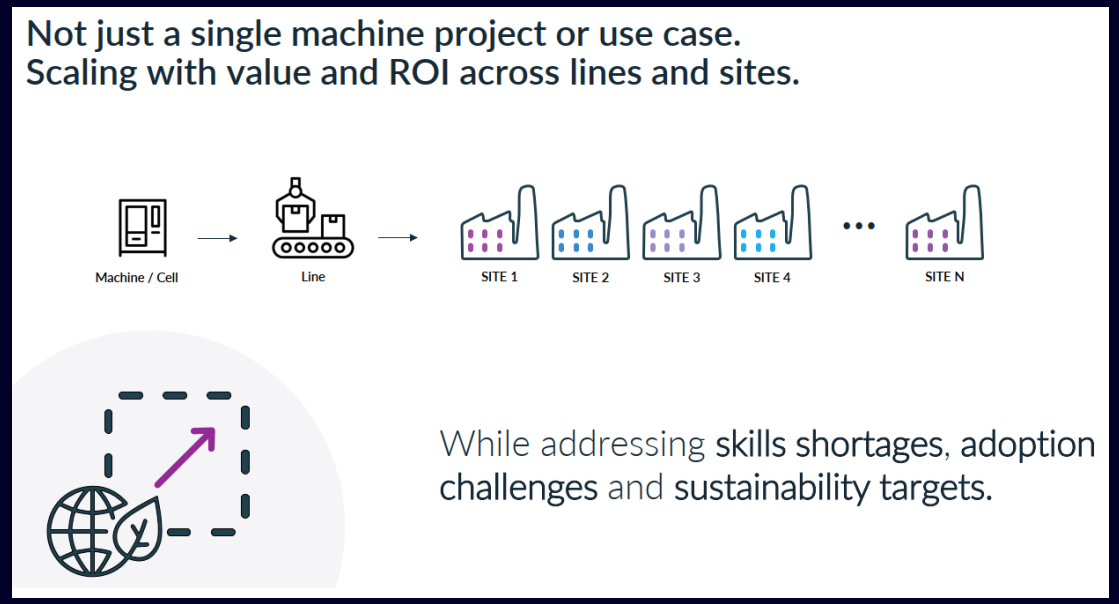

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SAM - Speech Assistant for Machines

Interact with machines through SAM

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SAM - Speech Assistant for Machines

Consumer assistants

[1]

Alexa. Google Assistant. Siri. Bixby. Cortana. Robin, Lyra, Databot, Hound?

Close the shutter

Turn on the radio

Tell me the weather forecast

Navigate to …

Industrial Application

SAM
The Industrial Smart Assistant

- Voice Recognition
- Knowledge Management
- Based on industrial components
- Connectivity to production systems
- Reliable behavior for commands
- Offline

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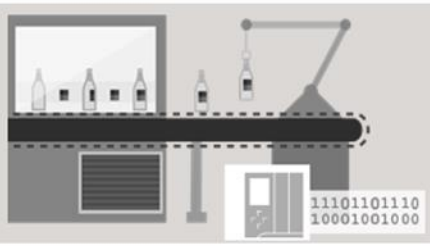
SAM - Speech Assistant for Machines

Import R&D Info

Machine Design



TIA Project

TIA V16

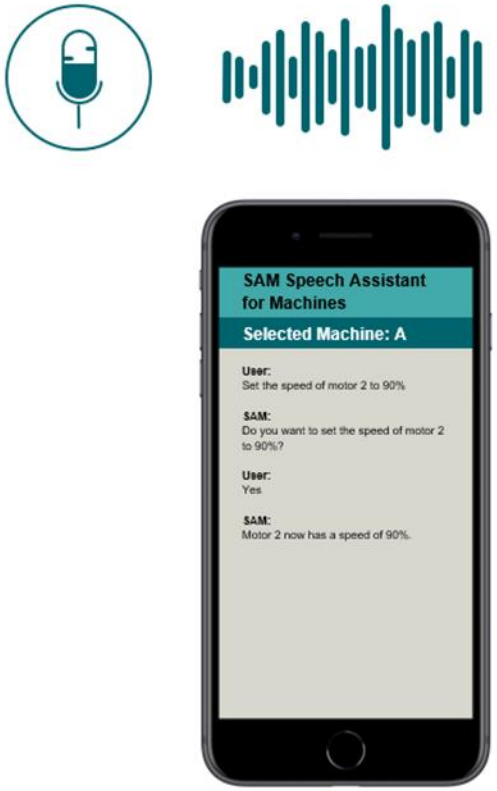
Documents

Manage & Configure

SAM Edge App

- Configure missing questions
- Map tags from process
- Start AI model training

Work with SAM



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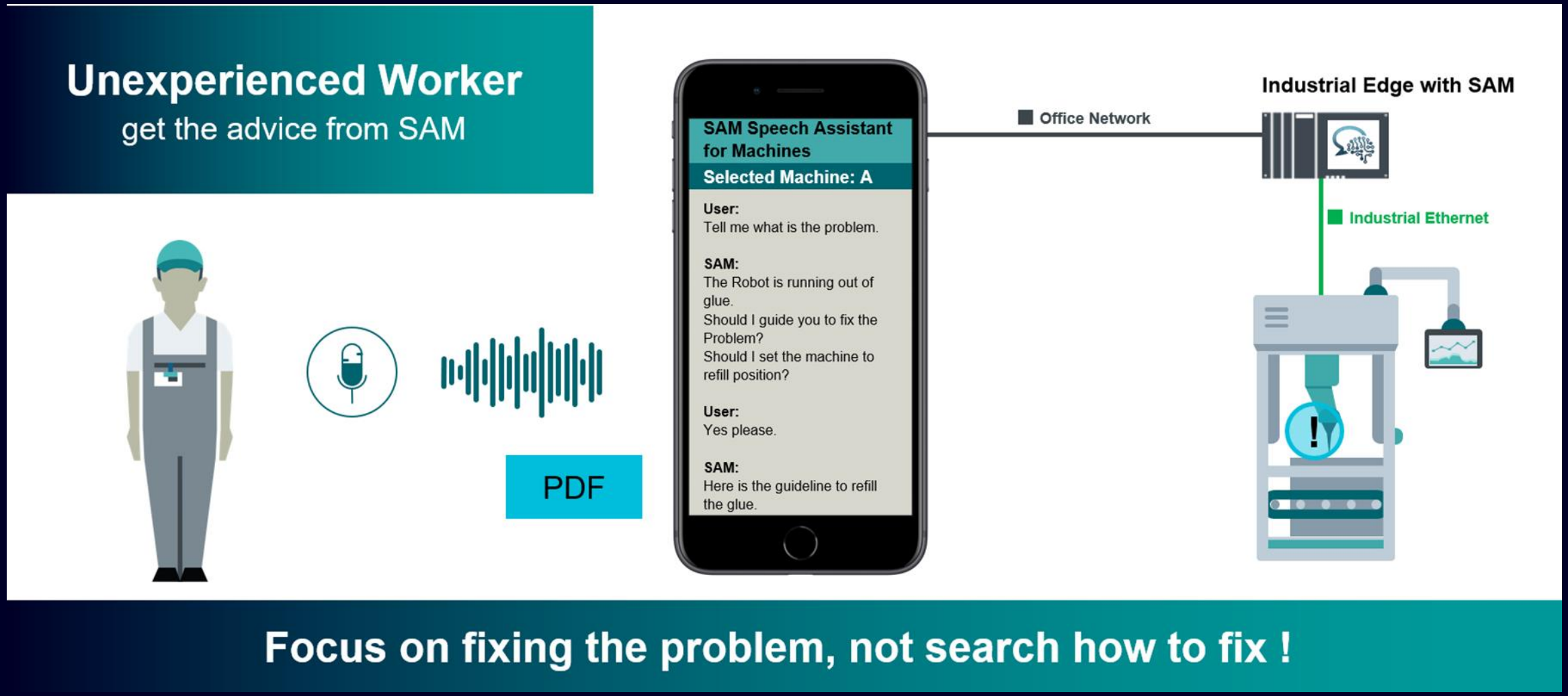

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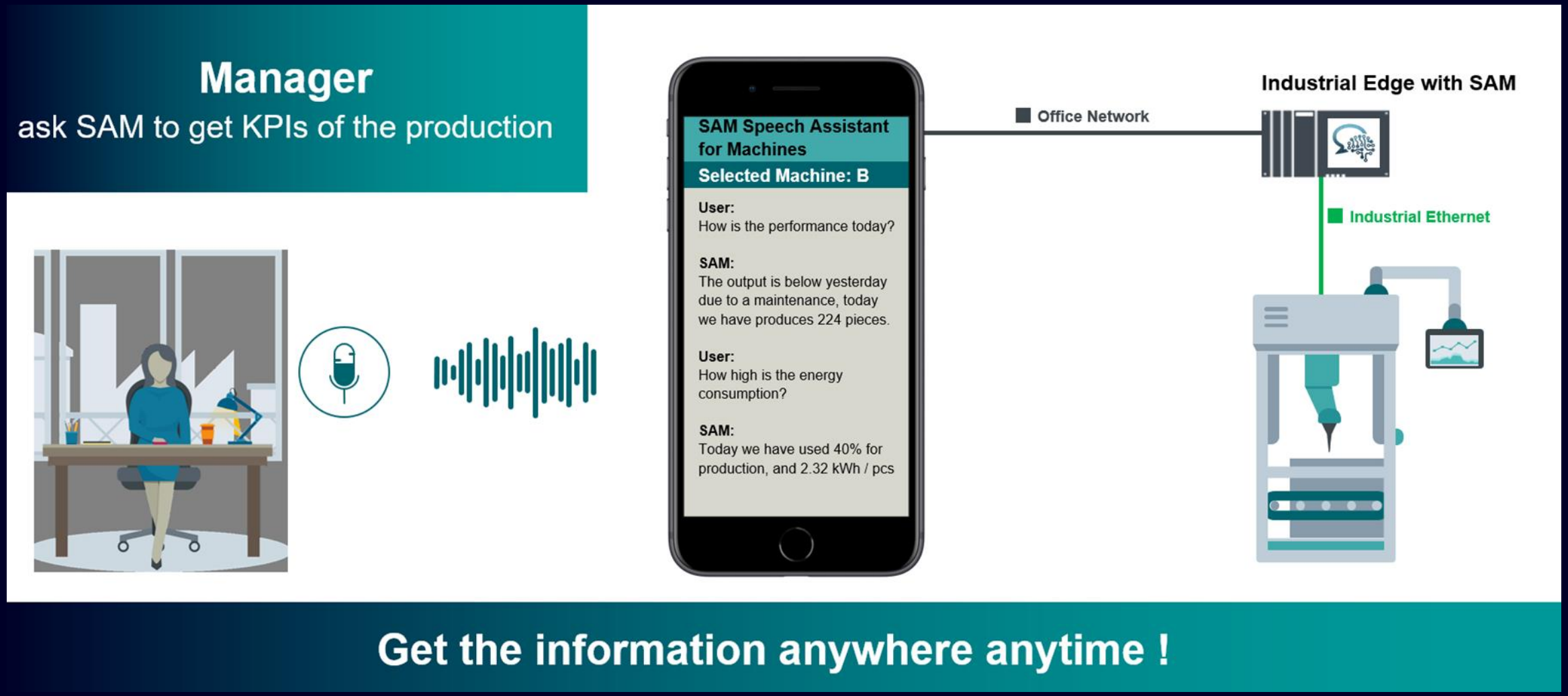

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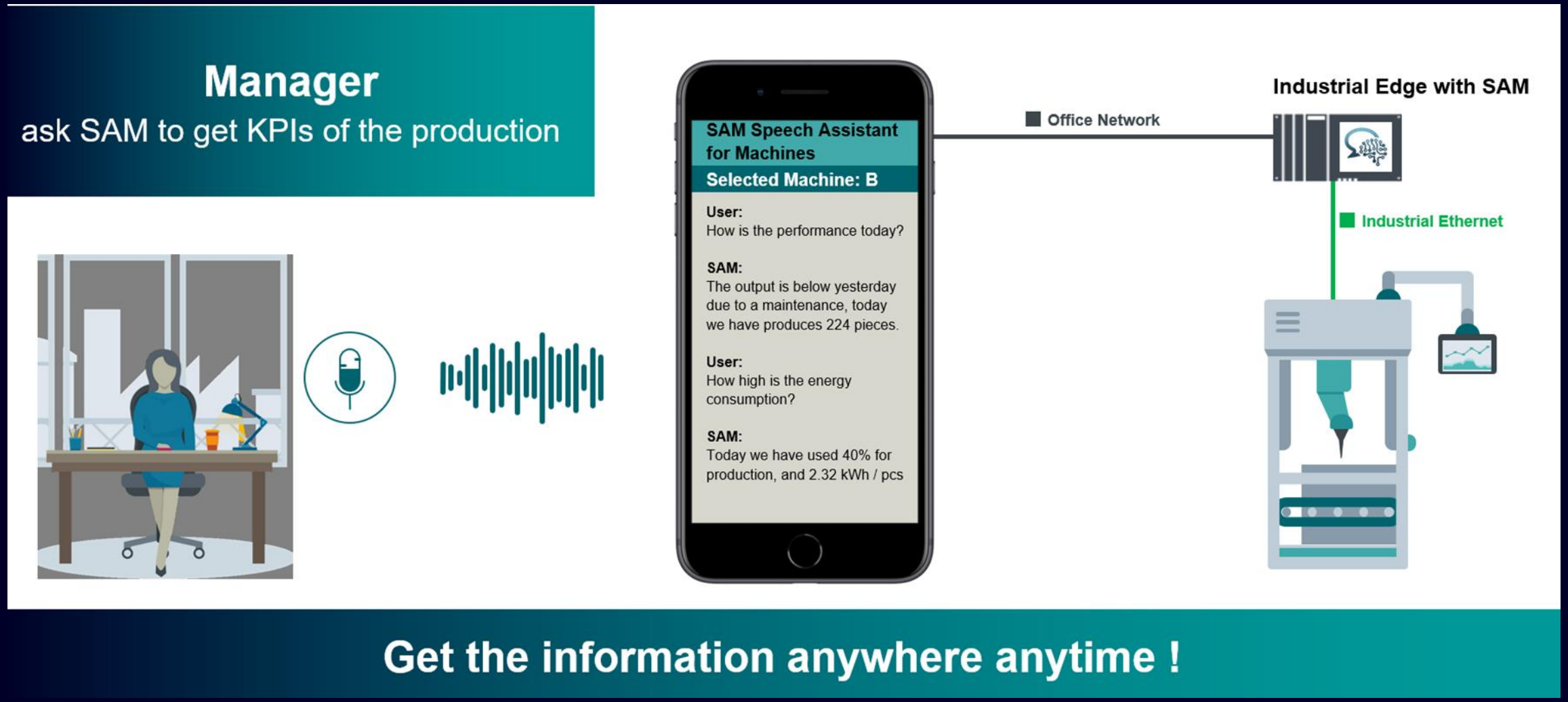

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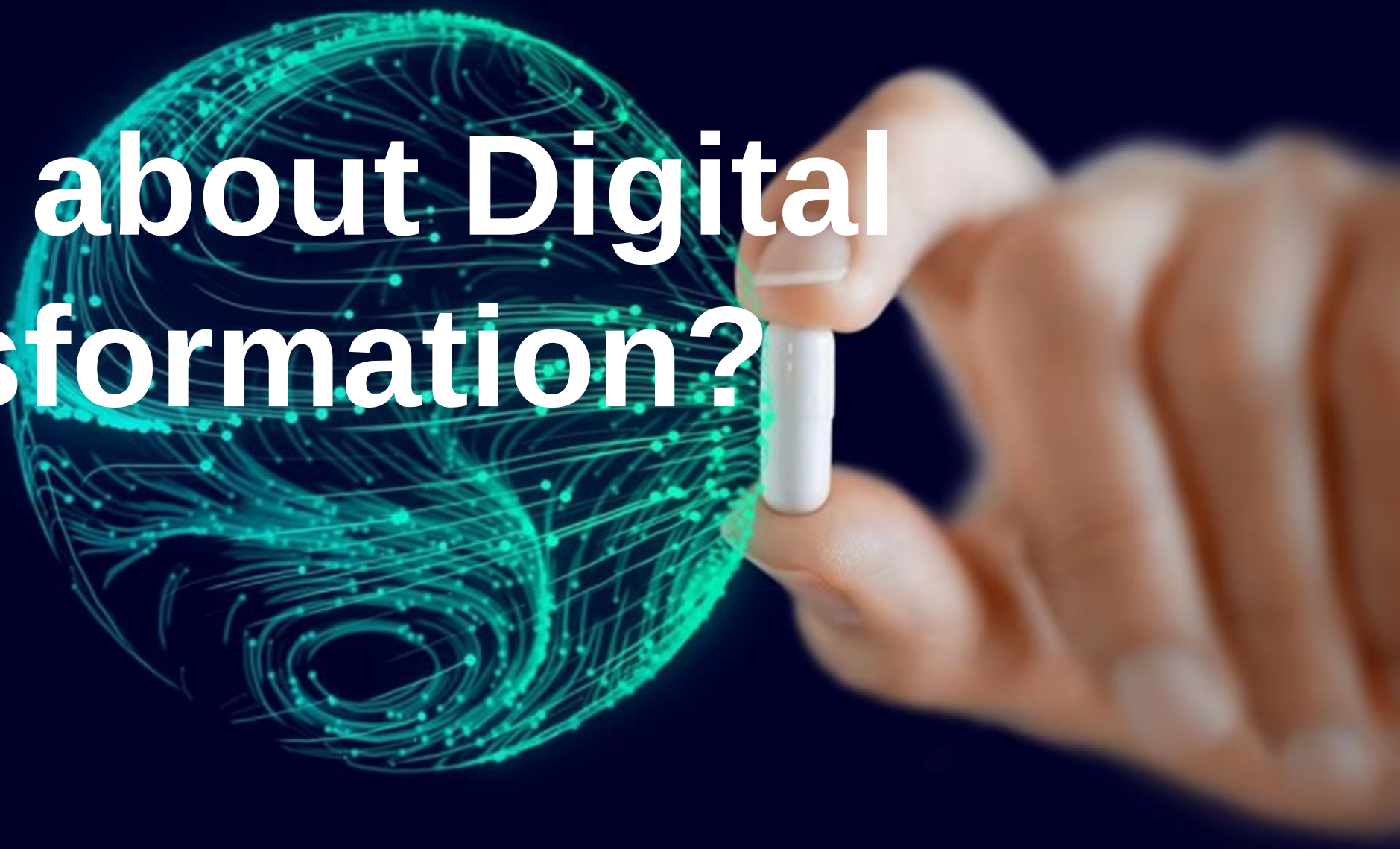
Backup Slides

What about Digital Transformation?



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Digital transformations is not easy, and industry is still waiting on an easy digitalization concept

63%

of digitalization projects fail!

Digitalization challenges

86% have avoided critical projects due to complexity of legacy systems

45% don't know where to begin to adopt IoT

40% struggle to find digital partners with experience in their industry

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Most digital transformations fail, but the world is still waiting on an easy digitalization concept

Digitalization challenges

86% have avoided critical projects due to complexity of legacy systems

45% don’t know where to begin to adopt IoT

40% struggle to find digital partners with experience in their industry

Key to success

Easy — Simple access to the latest technologies that are easy to integrate, adopt, and build upon

Flexible — Modular and interoperable concept to pick products, solutions, and services throughout the entire lifecycle

Open Eco-system — Ecosystem bringing together best-in-class players across the market

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A new way is needed …

Siemens Xcelerator open digital business platform

Digital transformation made Easy, Flexible and Open

Easy

simple to access the latest technologies that are easy to integrate and adopt and that can be built upon and combined

Flexible

a modular and interoperable offering, where you can pick what products, solutions and services you need

Open

an open ecosystem bringing together the best-in-class players in the market and open technology providing digital and IoT-enabled offerings from Siemens, partners and third parties

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Introducing Siemens Xcelerator

A comprehensive, curated **portfolio** that includes digital and IoT-enabled offerings from Siemens, and certified partners

A continuously growing, powerful **ecosystem** of partners

A **marketplace** to explore, educate, exchange and transact alongside a community of customers, partners and experts