Accelerate Robotics Performance & Digital thread

Digital Industry Software
Simulation Portfolio Sales
Team Leader

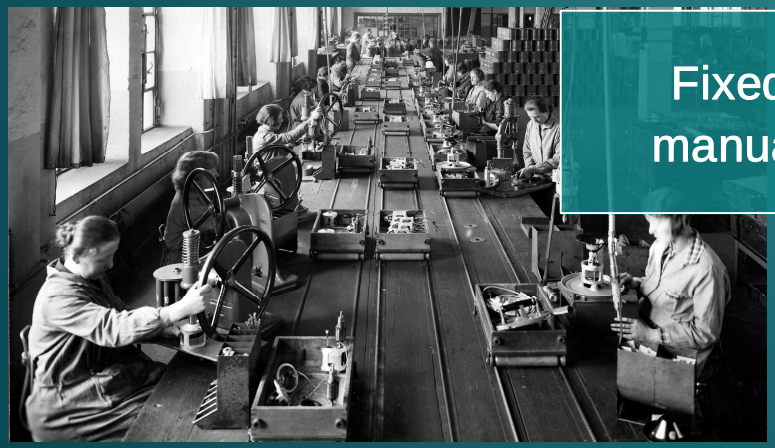
최승현

SIEMENS

The way forward: highly flexible and autonomous

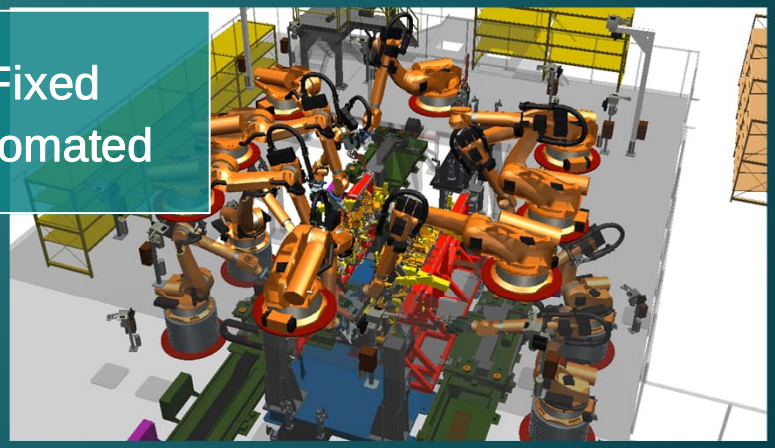
Flexible manual

Flexible autonomous



Fixed manual

Fixed automated



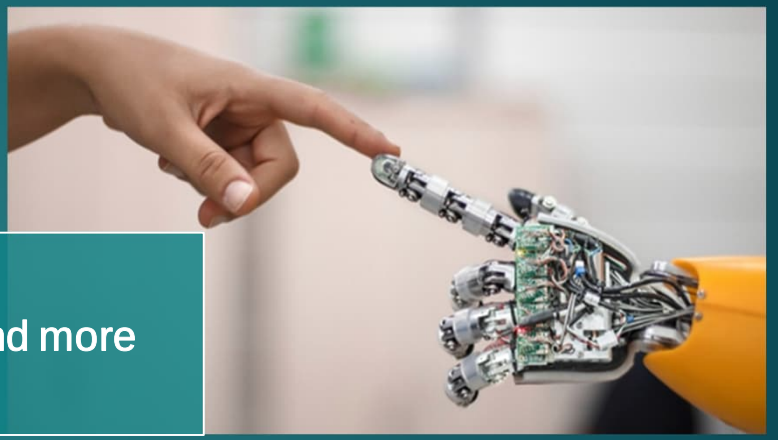
Flexibility

Automation & Autonomous

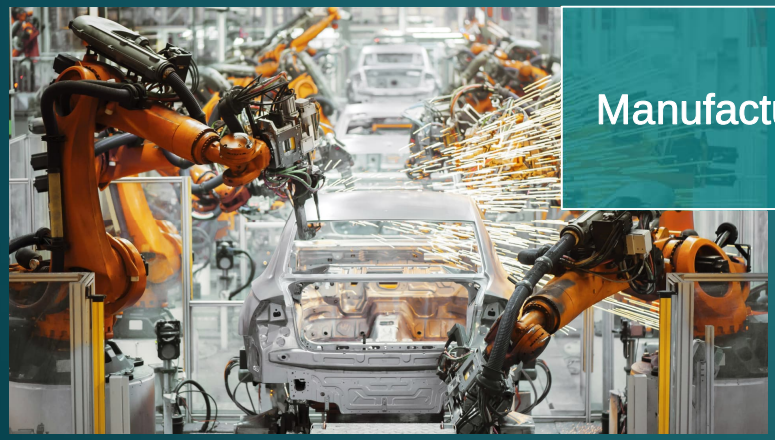
SIEMENS

Robots are everywhere… some examples

Medical



…and more



Manufacturing

Logistics

SIEMENS

Key Trends / the future is

PERSONALIZED
FLEXIBLE

SMART
CONNECTED

HIGH-TECH
SUSTAINABLE

GLOBAL
COST-EFFECTIVE

SIEMENS

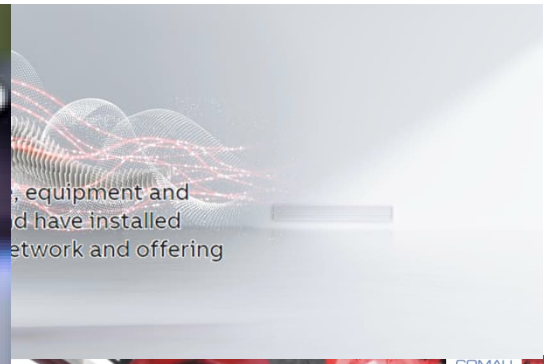
Robot arm for sorting of blood sam
hospital personnel and e

A Kawasaki robot for every applic

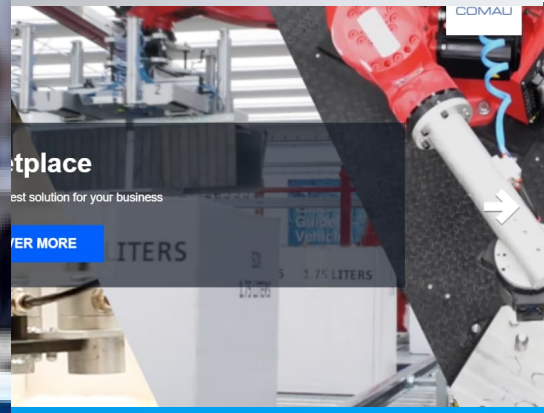
Industrial R

Top performers for sma

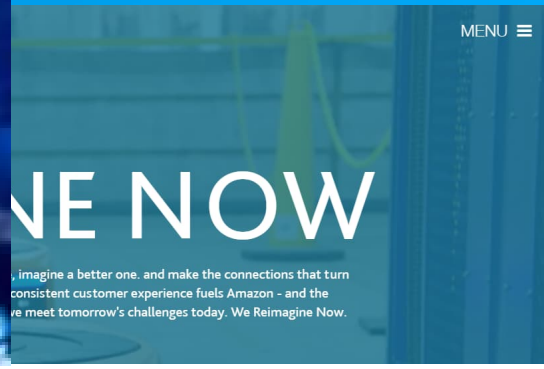
Robotics Evolves by Taking up New Challenges



, equipment and
d have installed
etwork and offering



et of tools to deploy more
ells, faster.



Future manufacturing market requires speed, flexibility, quality, which yields obvious gaps across all industries

Increasing Product Complexity	Increasing Cost Pressure	Reduce Time to Market	New Paradigms for Flexible Plants	Increasing Automation in Assembly
Impact on complexity of the entire process	Cost of material and energy	Quick product change with minimum delays	Less experienced workforce with high mix production	Replace manual 4D jobs

”Although 86% of companies plan to deploy advanced robots in their operations within the next three to five years, only 20% have created a holistic target picture and a comprehensive implementation roadmap.”

BCG Global Advanced Robotics Survey, January - February 2019

SIEMENS

Explosion of

Complexity

로봇이 과로사..?

SIEMENS

로봇이 과로사..?

SIEMENS

Digital Transformation with a Comprehensive Digital Twin

Ideation

Realization

Utilization

SIEMENS

Closing the Loop with a Comprehensive Digital Twin

Feed back insights to continuously improve product and production

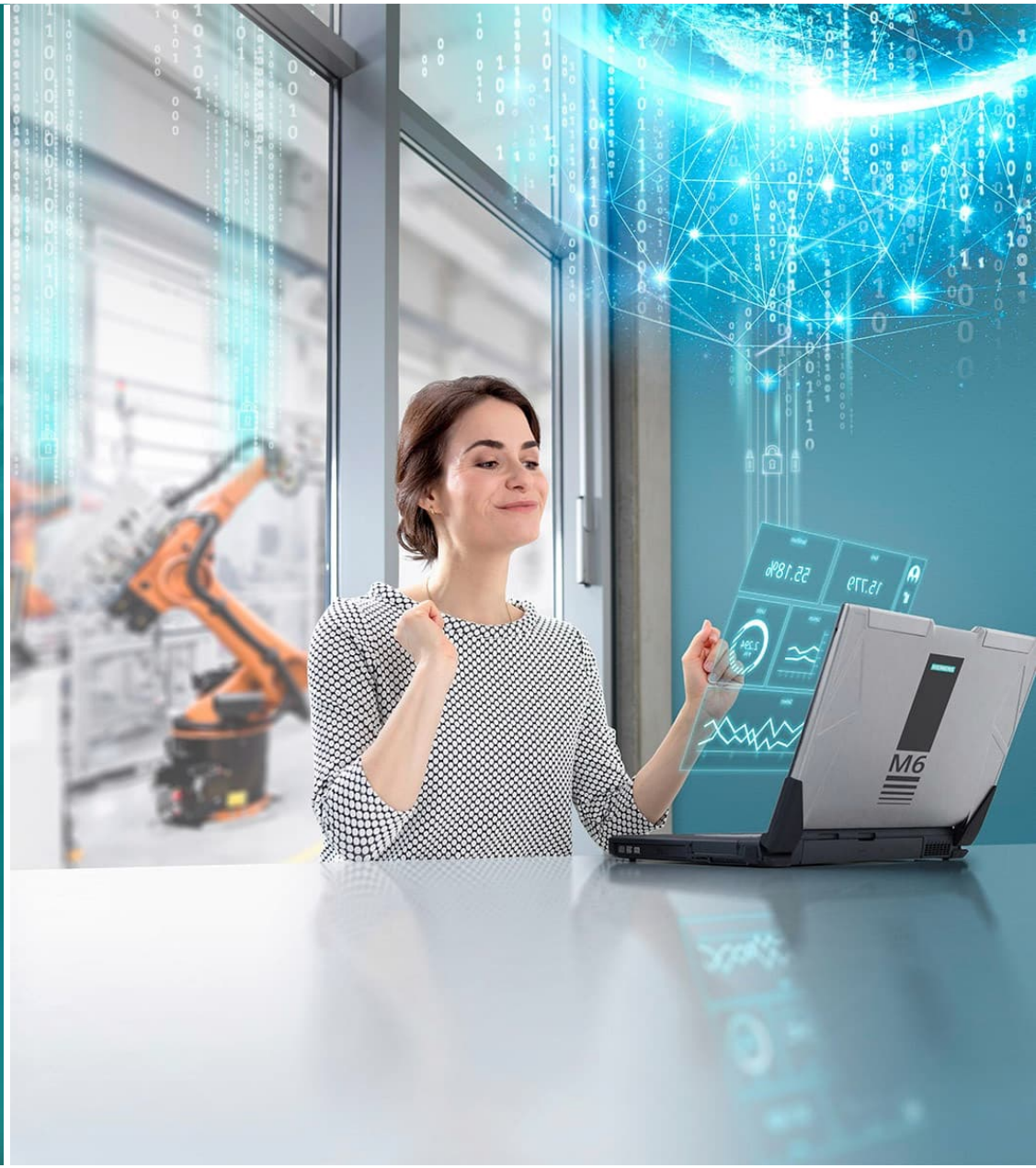
SIEMENS

HOW CAN YOU

offer a flexible solution with high-tech performance faster?

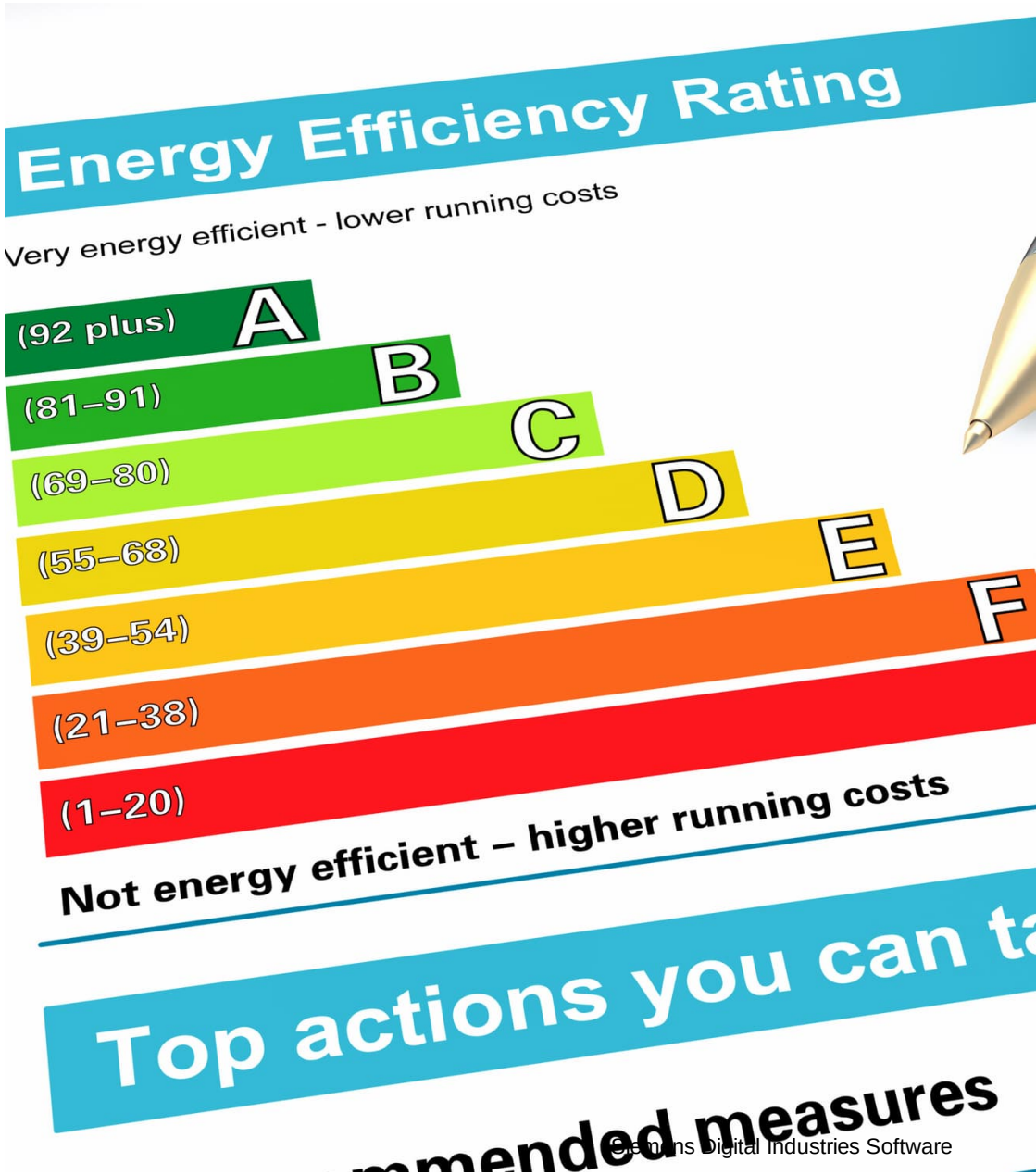
HOW CAN YOU

know your product performance in real time?



HOW CAN YOU

design energy efficient products without compromising on performance?



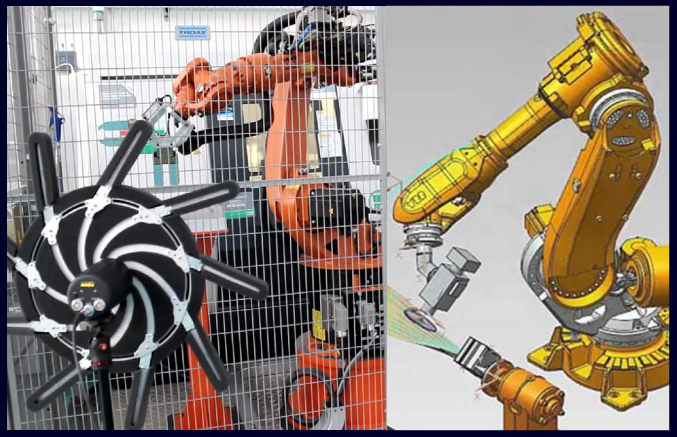
HOW CAN YOU

launch increasingly complex products faster?

Business value from reliable

Digital Twins

Simulation & Testing
enhanced capabilities

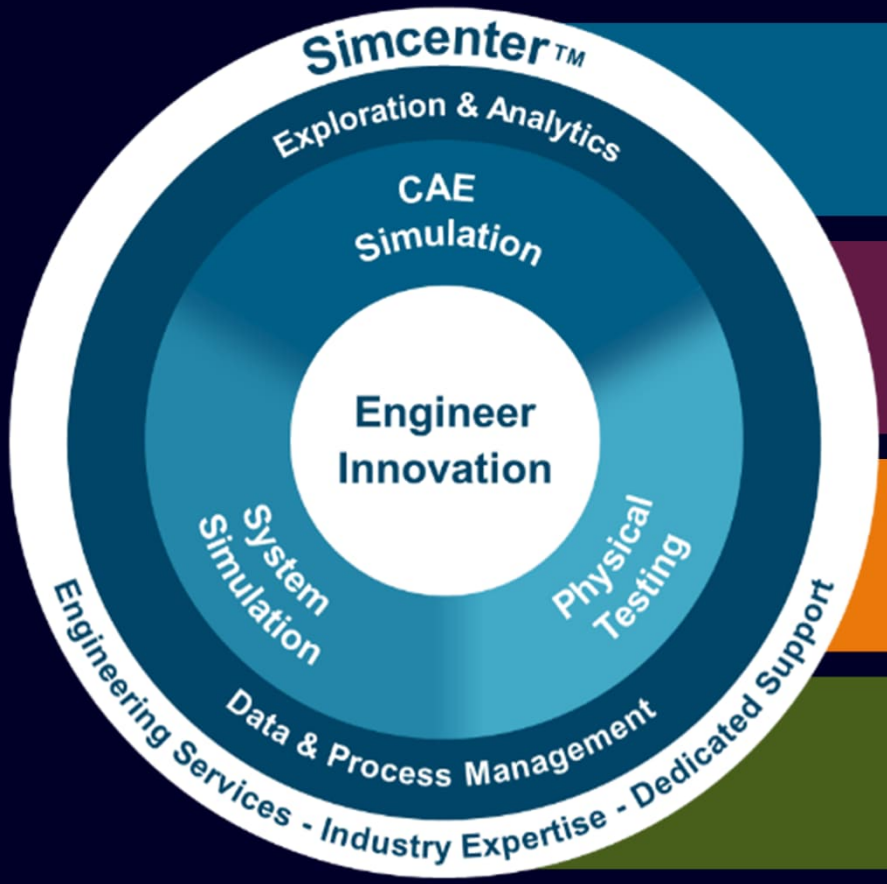


Multi-discipline
integrated & scalable solutions

Industry specific
know-how & best practices

SIEMENS

Simcenter Portfolio
Engineer innovation for Robots performance



Performance
Throughput, Production rate, Precision/Accuracy

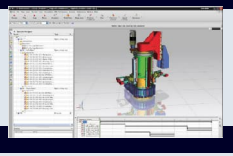
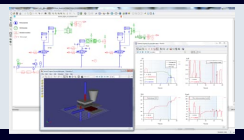
Reliability
Safety, Durability, Maintenance, Contaminants, N&V, Thermal

Smarter Machines
Autonomous, Oper. Assist. & Pred. Maint., IOT, EMC/EMI

Efficiency
Energy, Material, Wear, Waste

SIEMENS

Performance within the Siemens digitalization solutions

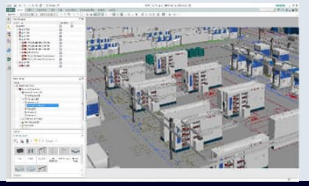
Production Plants		Plant Simulation	
Production Cells		Process Simulate	
Machines		Mechatronic Concept Designer	
Machines & Components		Simcenter Amesim	
Components & Periphery		SIMIT	
Automation		PLCSIM Advanced & WinCC	

SIEMENS

Performance within the Siemens digitalization solutions

Production Plants

Layout validation → Logistic verification → Throughput verification → Time validation

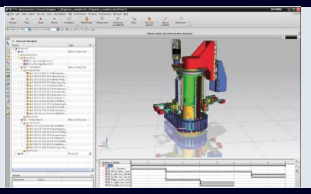


Production Cells

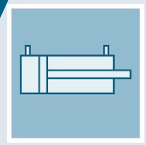
Geometry validation → Kinematic validation → Time validation → Cell Automation

Machines

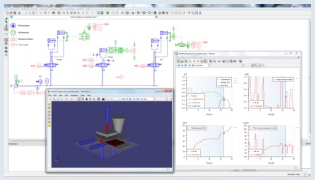
Mechanical design → Sensors & actuators selection → Machine Automation → Mechatronic Validation



Machines & components

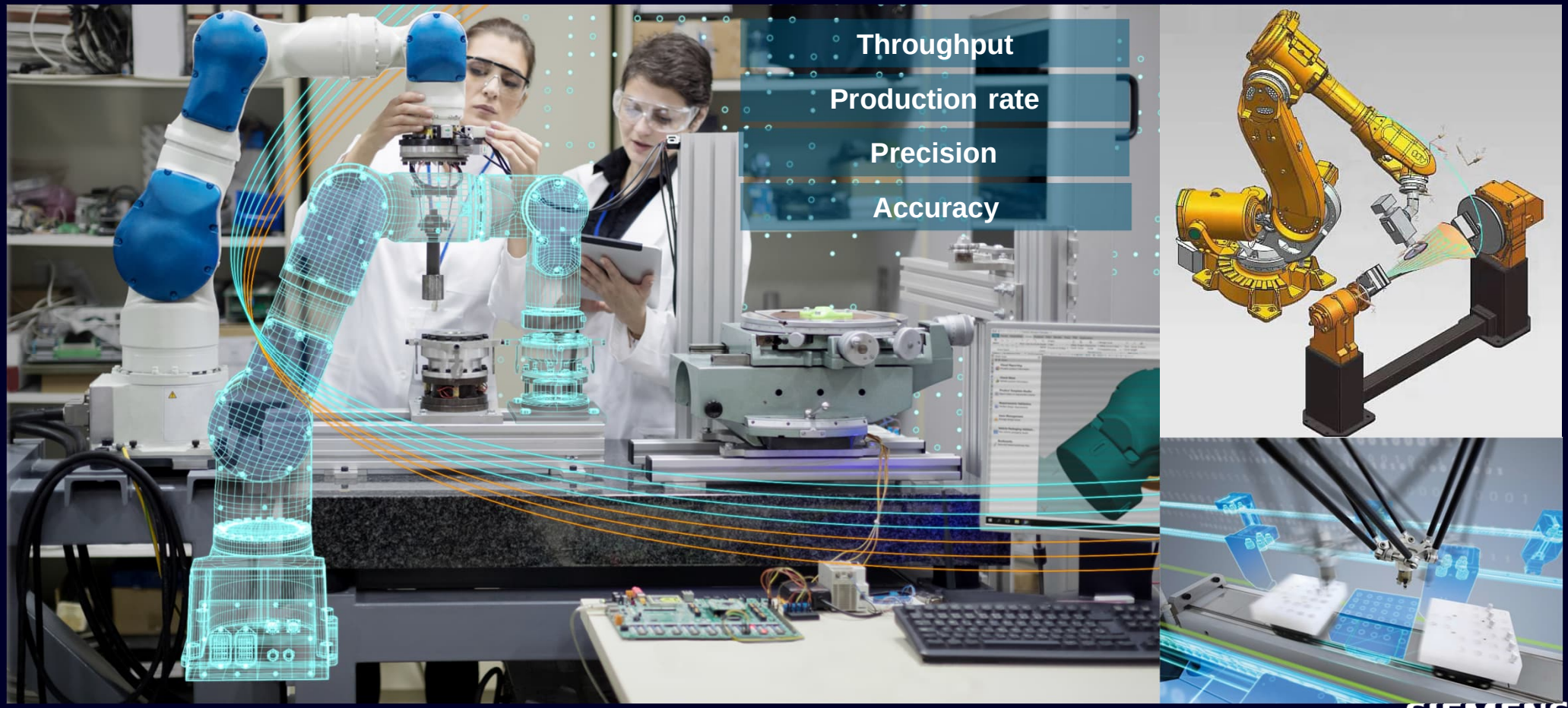


Multiphysics interactions → Component sizing → Design optimization → Energy losses & power consumption



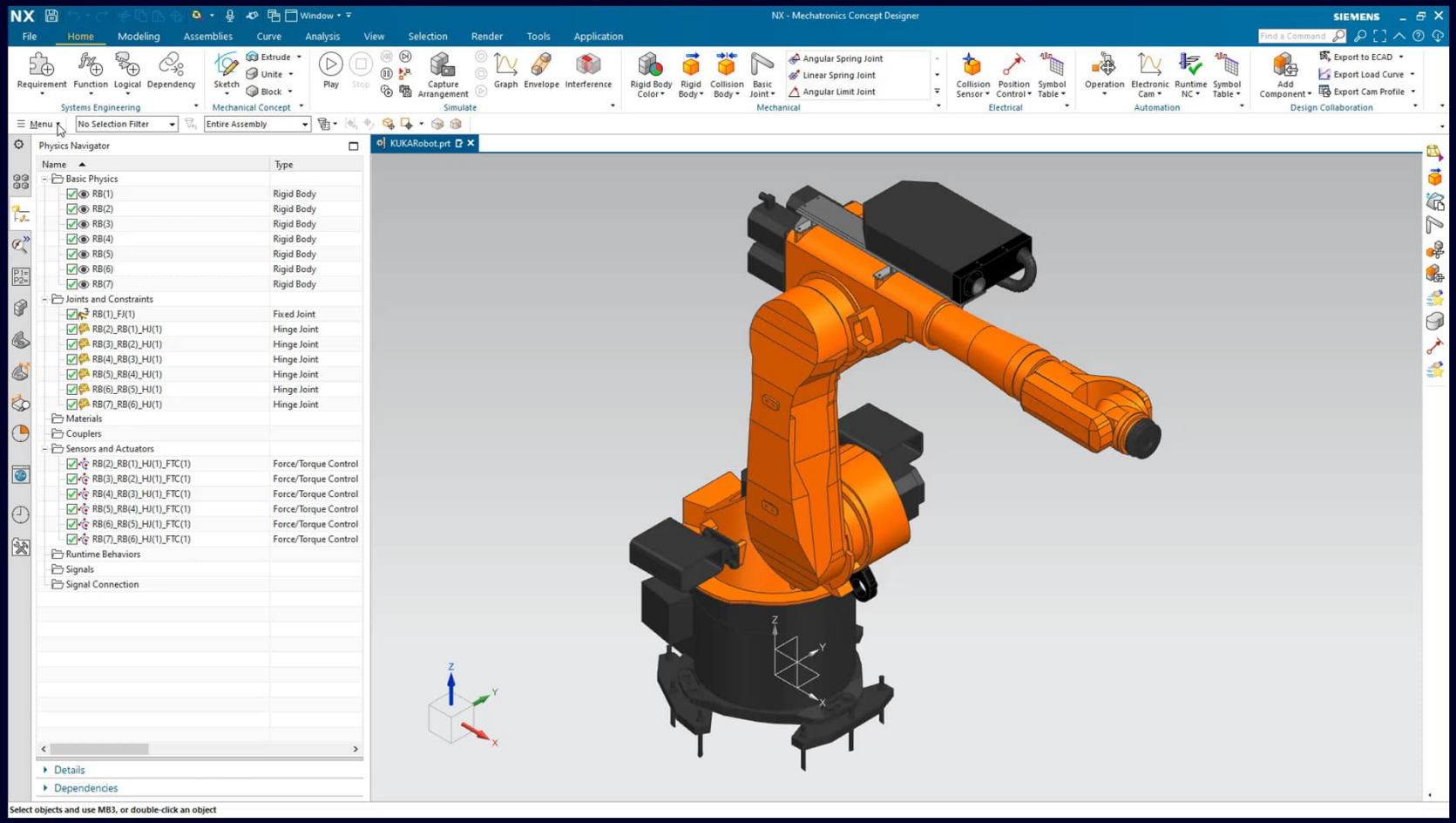
SIEMENS

Simulation for Robots Performance
Covering a wide range of applications



SIEMENS

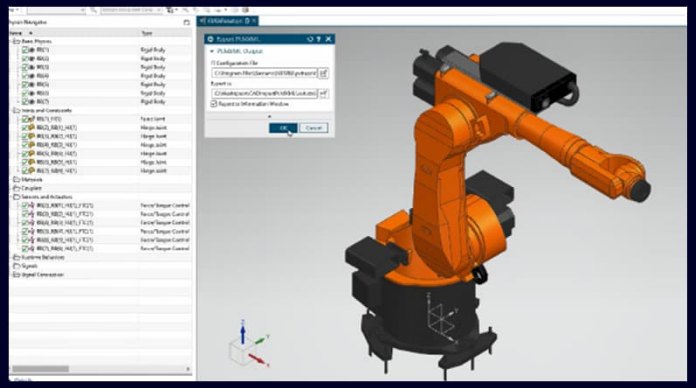
From NX MCD to Simcenter Amesim workflow



SIEMENS

From NX MCD to Simcenter Amesim workflow

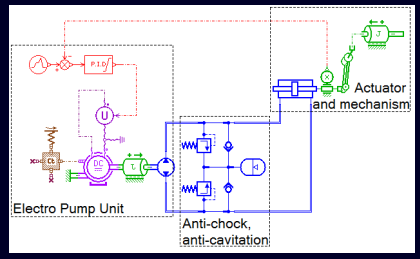
MCD



Main Purpose

- Debug machine kinematics and validate machine functioning
- Motion of rigid bodies (it requires 3D data)
- Easy animation and virtual commissioning of machines
- SiL bundle SIMATIC Machine Simulator to include telegram simulation of drivers
- Kinematics, collision check and material flow 3D

Simcenter Amesim



Main Purpose

- Analyze and optimize multiple KPIs (cycle time, energy consumption, vibrations, motion accuracy...)
- Optimize the PLC control parameters
- Multi-phsyics (thermal, mechanics, electric and lfuids) system simulation (mainly 1D, it requires component parameters but not necessarly CAD data)
- Virtual multi-physic system integration (machine or process) in a single 1D environment
- Possible 3D animations of physics usign simulation results

SIEMENS

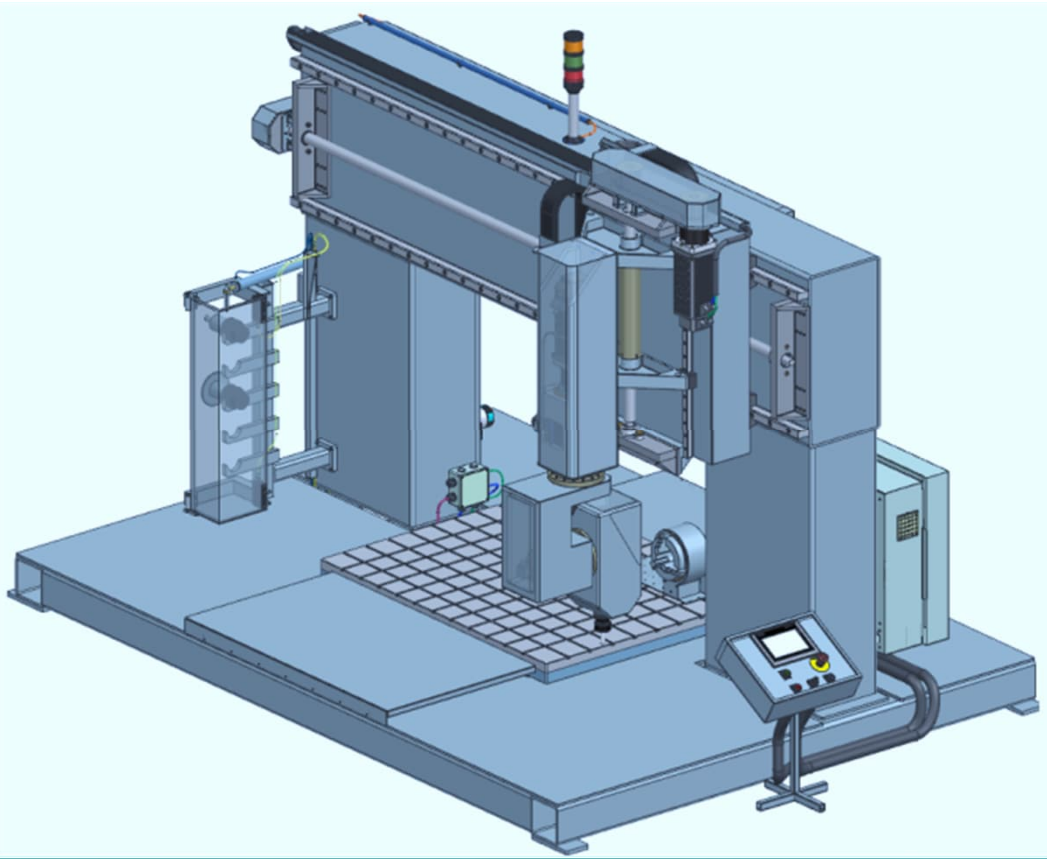
Design challenges:

Optimal **sizing of components** to reach desired performances

Truly multiphysic simulation of the complete system (fluid, thermal, electrical, mechanical)

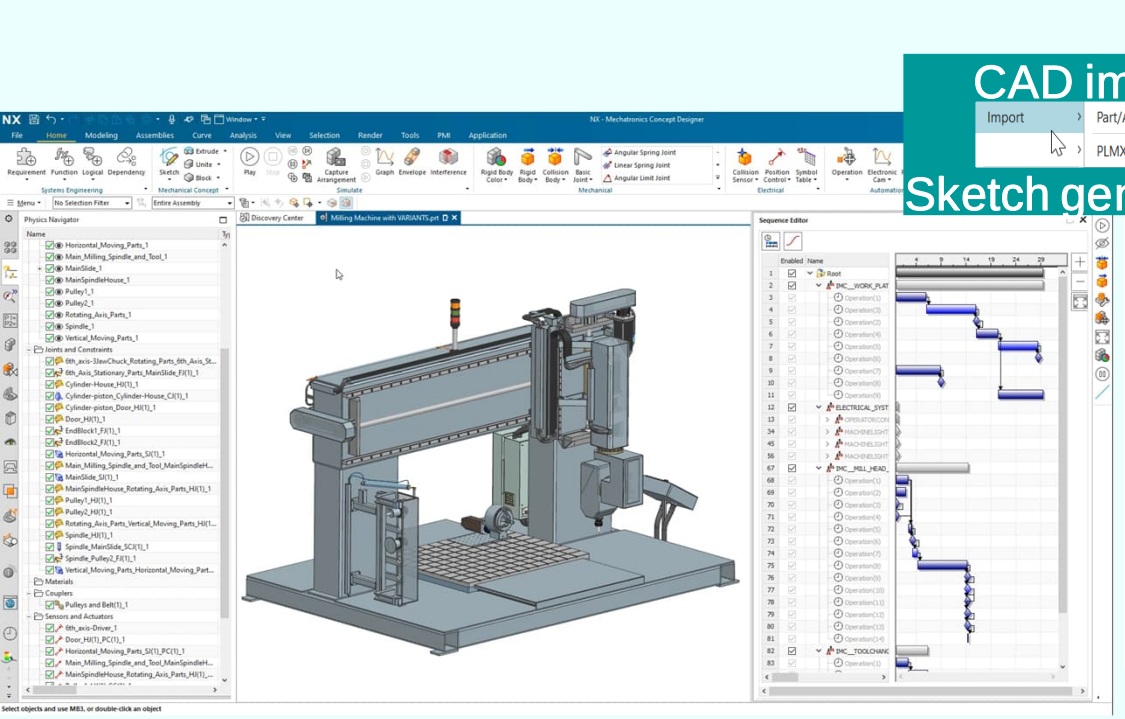
Trade-off between performance and energy consumption

Evaluate **PLC code** modification impact on performances



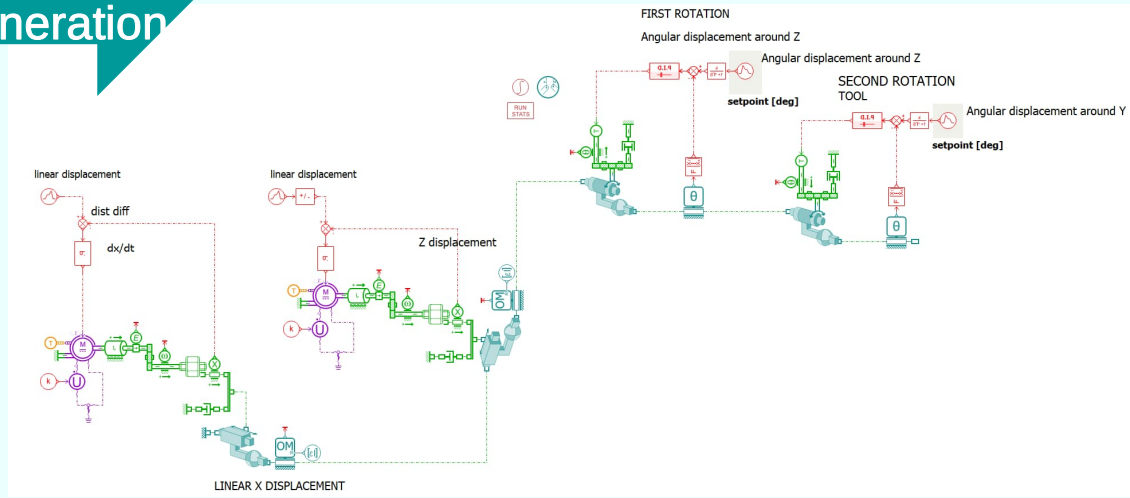
CNC machines

Main axis motion control and energy consumption



CAD import

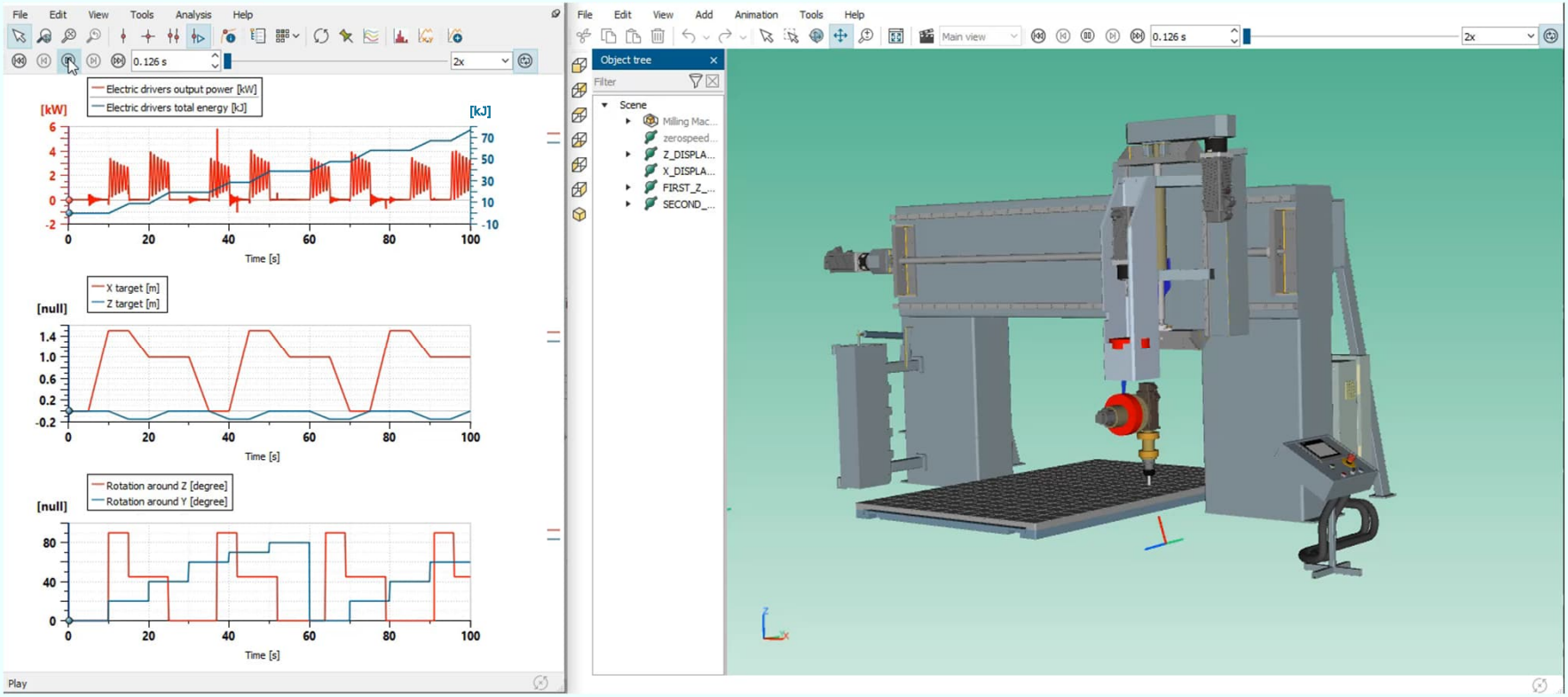
Sketch generation



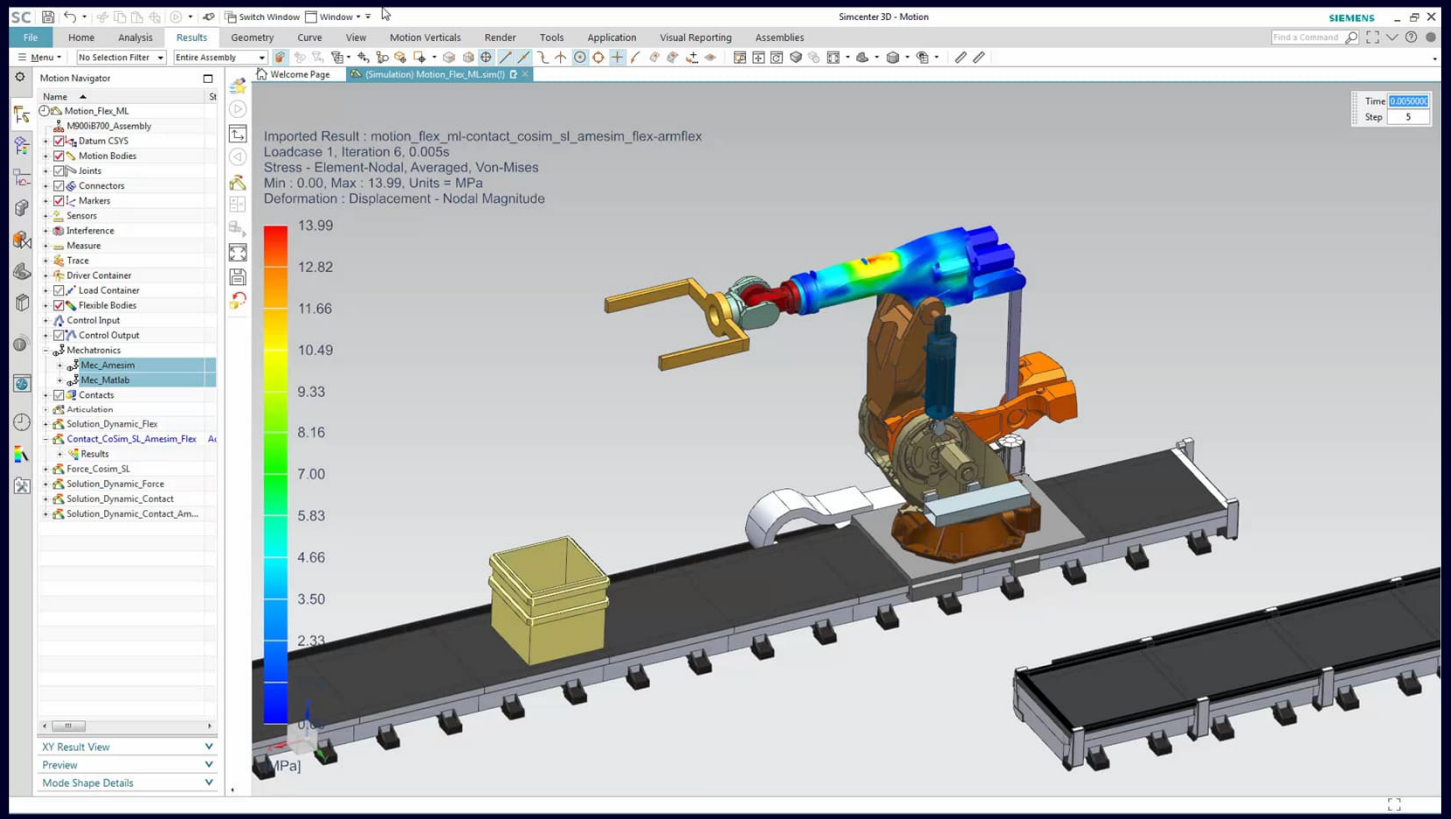
SIEMENS

Main axis motion control and energy consumption

- Simcenter Amesim – CAD animation with simulation results -



High-fidelity models for MIL in SIL and HIL applications
Simcenter 3D Motion & Simcenter Amesim



Holistic simulation including Dynamics, Actuation and Controls

Co-simulate with Simcenter Amesim & Simcenter 3D Motion

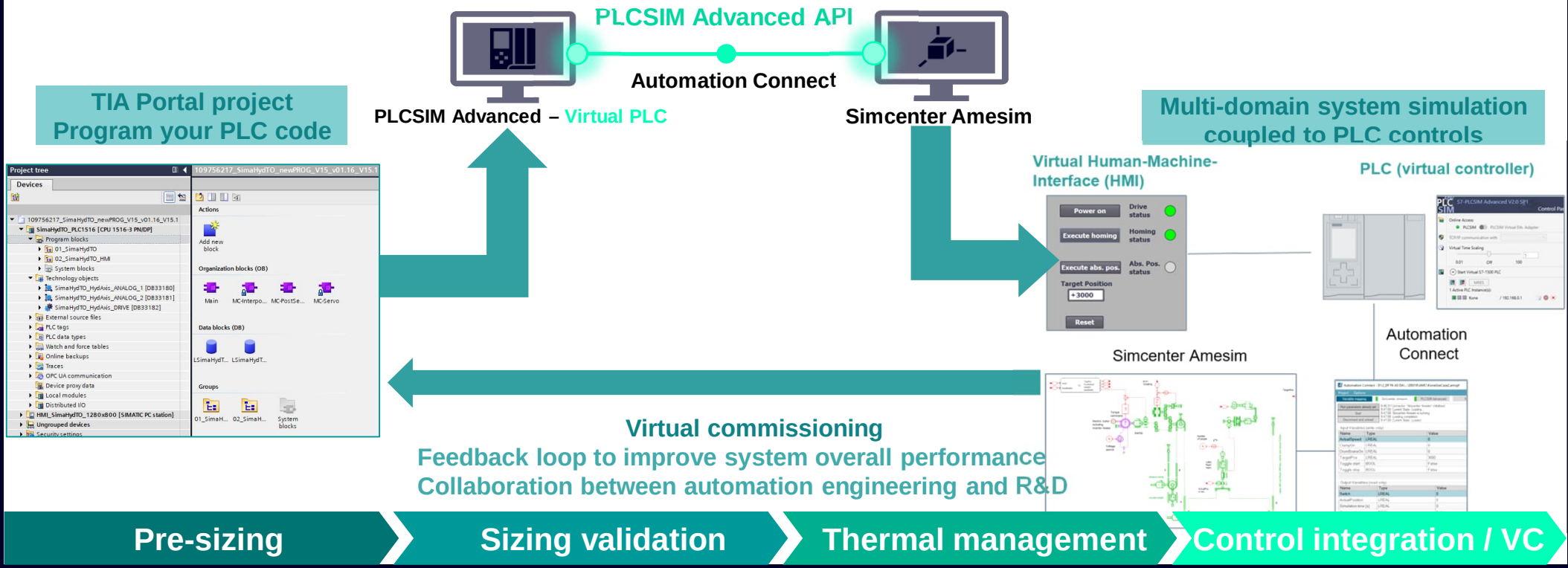
Exploit the systems potential by simulating the real behavior And assess risk

SIEMENS

Virtual Commissioning
Validate electric drives control logics with **PLCs** in SiL/HiL

Objective: Simcenter Amesim connections to PLCs and electrical libraries with RT compatibility

Approach: Evaluate control accuracy, cycle times and acceleration/deceleration control profiles in SiL (virtual PLC) and HiL (real PLC) environments

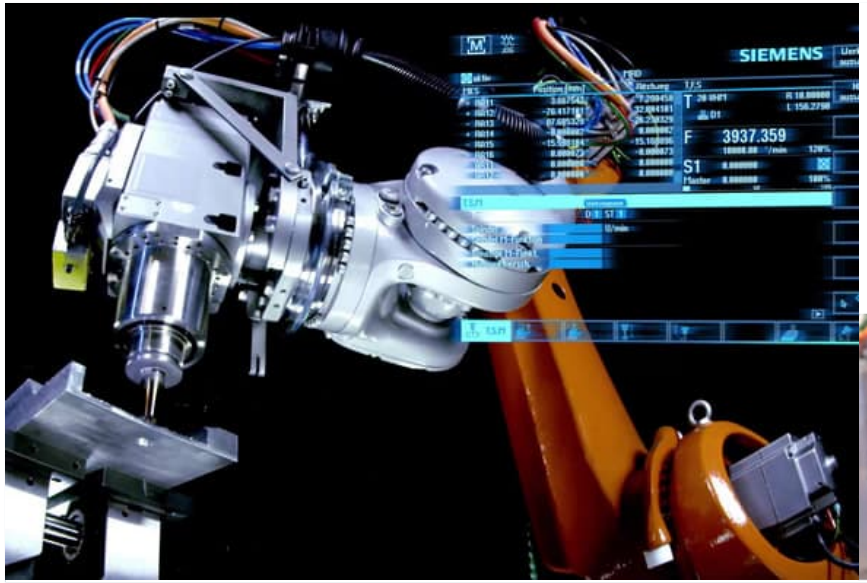


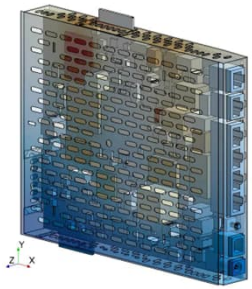
Pre-sizing | Sizing validation | Thermal management | Control integration / VC

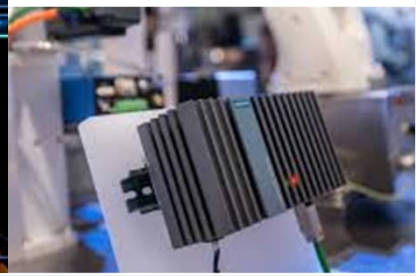
SIEMENS

Robotics: Joints and Electronic devices
Dust accumulation modeling

SIEMENS
Ingenuity for life







Dust accumulation in a factory environment is a challenge. Simcenter helps to select a design with the minimal accumulation.

Challenge
- **Preventing dust ingress and accumulation (Small and many particles)**
- **Important to see interaction with the walls.**

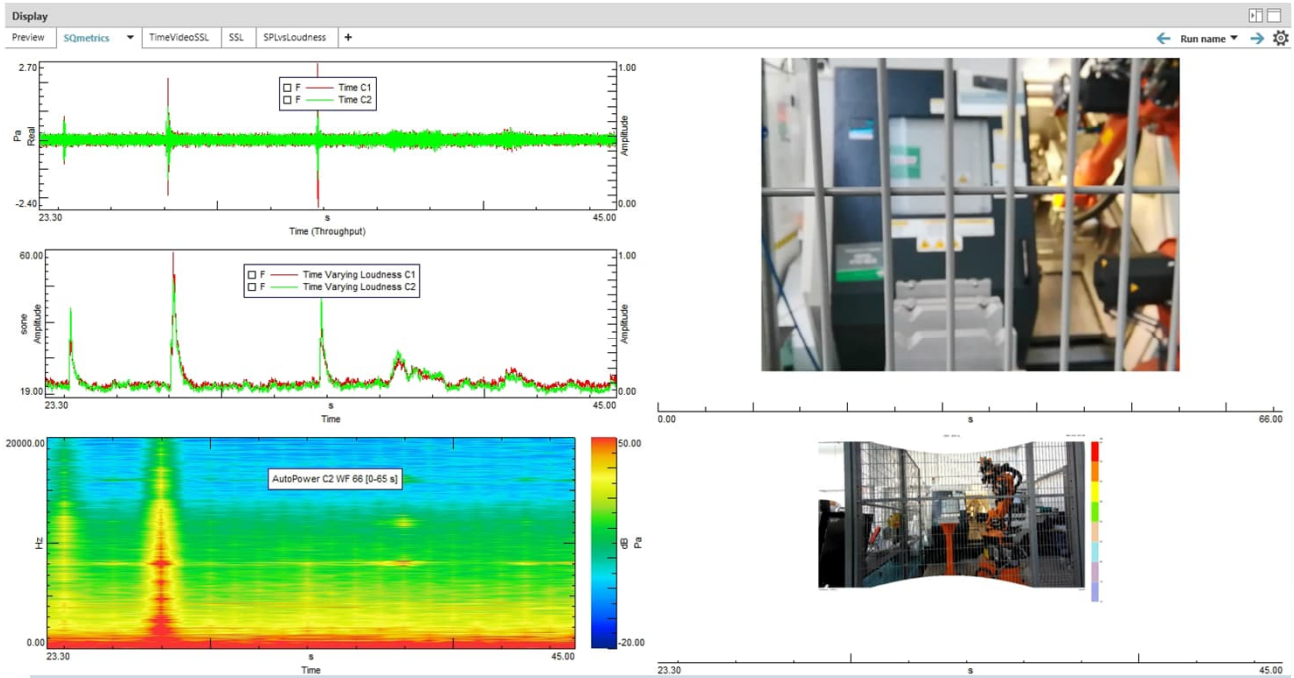
Solution
- **Simcenter STAR-CCM+**

Benefit
- **Run the background flow calculations.**
- **Set up the dust characteristics.**
- **Run the Lagrangian calculations.**
- **Possible body forces (Coulomb, van der Waals)**

Unrestricted © Siemens AG 2020

Acoustic testing
Quickly locate noise sources

SIEMENS
Ingenuity for life



"Quickly locate the main noise sources, to check both in steady state and during transients if the mechanical system behave correctly."

Challenge

- Identify the acoustic hotspots
- Avoid complaints
- Protect brand image

Solution

- Simcenter Testing Solutions for acoustic measurements and analysis

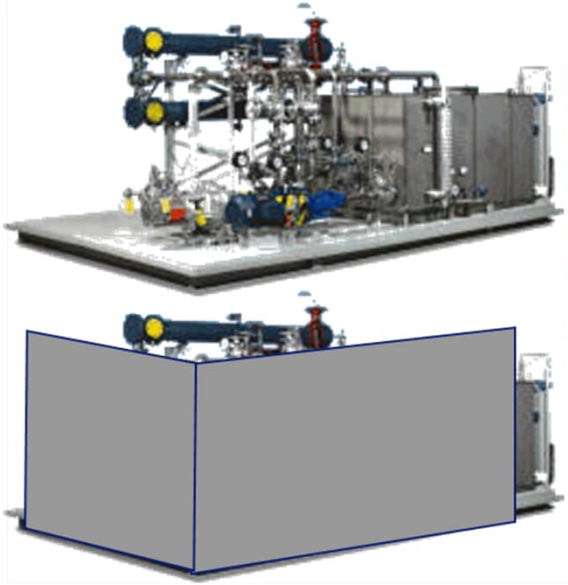
Benefit

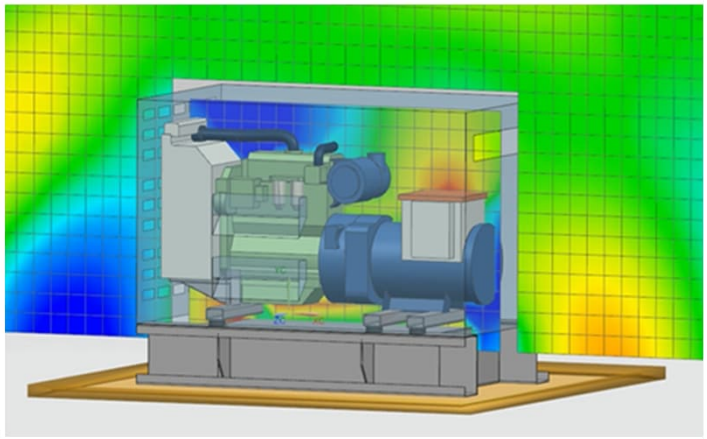
- Relate the acquired signals with the mechanics involved to troubleshoot the machinery.
- Brand recognition
- Quieter environment and operator health

Unrestricted © Siemens AG 2020

Acoustic simulation
Enclosure design

SIEMENS
Ingenuity for life





Challenge
- Minimizing material costs
- Minimizing manufacturing costs
- Minimizing operational costs

Solution
- Simcenter 3D Acoustics
  - Design enclosure for the cell
  - Optimize workshop layout

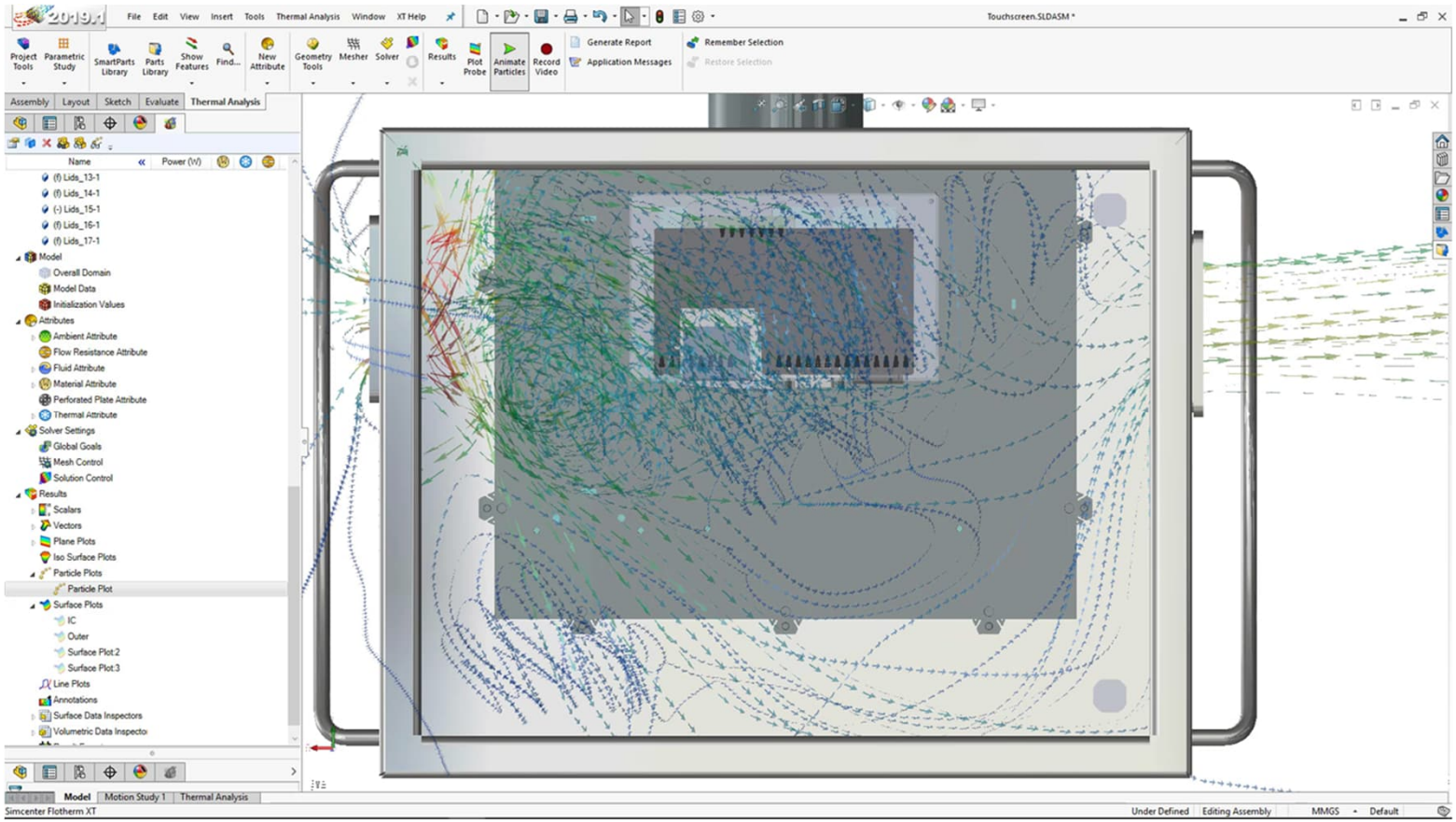
“Efficiently simulate the operation of a device based on either electromagnetic or pure electric fields.”

Benefit
- Realistic simulations for a variety of different applications, including layout definition
- Easy to operate: from CAD to Acoustics
- Get results fast: superior and unique solving technologies

Unrestricted © Siemens AG 2020

Thermal design
Electronics - Control panel

SIEMENS
Ingenuity for life



Challenge
- Limit overtemperatures condition to avoid downtime.

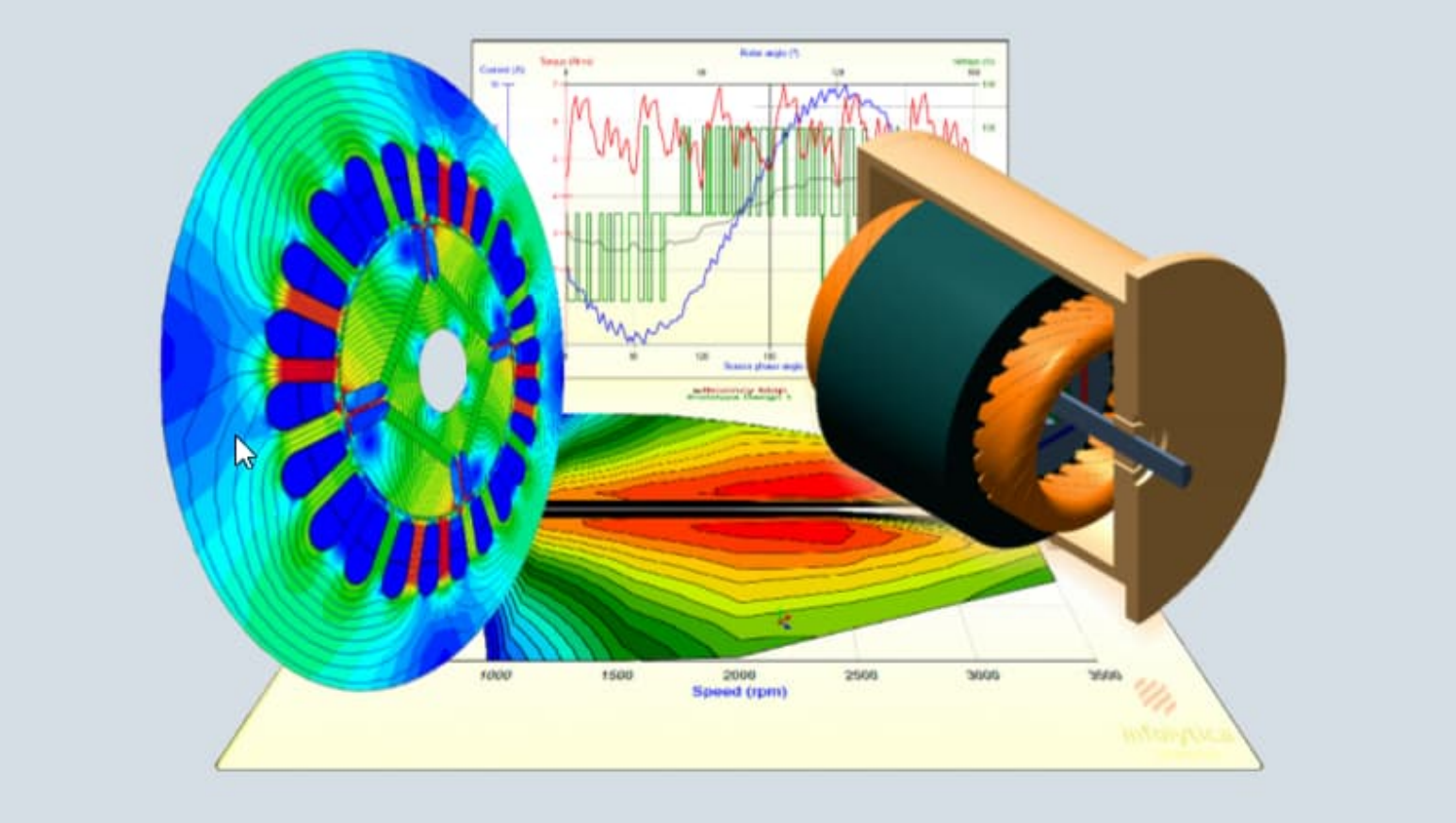
Solution
- Simcenter Flotherm

Benefit
- Ensure the required flowrate for the convection to cool the device,

Unrestricted © Siemens AG 2020

Thermal design
Servomotor

SIEMENS
Ingenuity for life



Challenge
- Limit overtemperatures condition to avoid downtime.

Solution
- Simcenter E-machine design

Benefit
- Combine electromagnetic and thermal analysis early in the design.

Unrestricted © Siemens AG 2020

Electric Cables and Wire Harness Design

Faster and safer process

SIEMENS
Ingenuity for life

Predicting, analyzing, improving positions, movements, stresses using an accurate and robust 3D simulation approach.

Challenge

- Design safer and faster, right at first try, preventing product recalls
- Reduce the iterations between product and manufacturing process designer

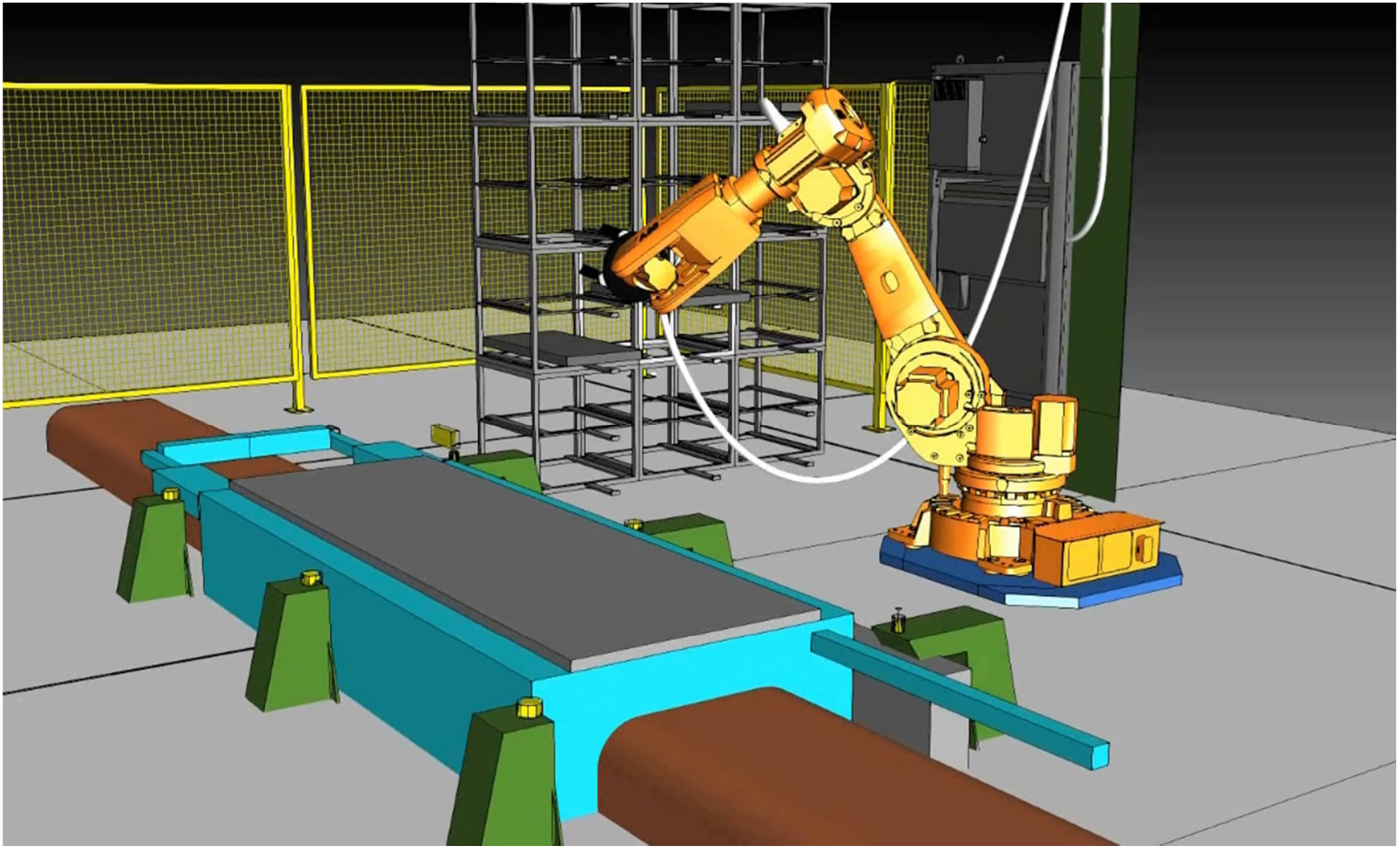
Solution

- **Simcenter Flexible Pipe**: Fast preview/ Instantaneous update, NX Routing link/bundle mounting, Permanent deformation, Complex harness: dynamics, Flat Electric Cables: contact, Plastification during cyclic movements

Benefit

- Reduce production and aftersales costs
- Less iterations → focus on innovation
- Avoid mounting problems

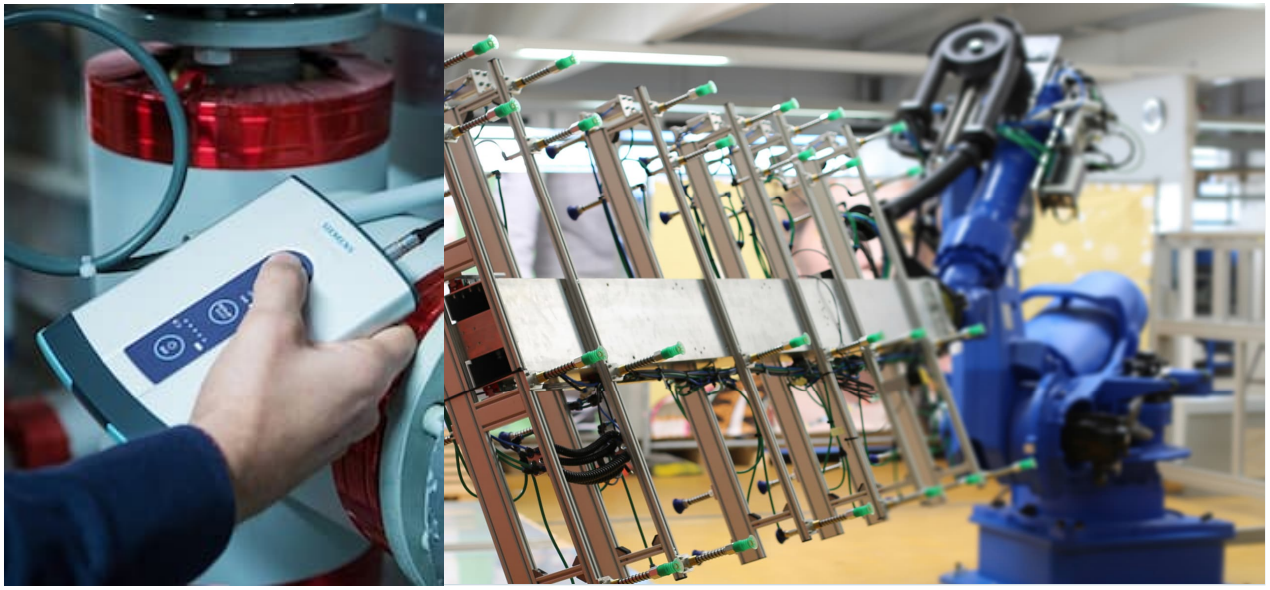
Unrestricted © Siemens AG 2020



Printing plate production machine

Simcenter SCADAS XS – Reduce time/cost for global servicing

SIEMENS
Ingenuity for life



Challenge

- How to avoid costly engineer travel time for simple troubleshooting task
- Need for mobile measurement equipment

Solution

- Application = local vibration troubleshooting by an operator, engineer stays @ HQ
- Product = Simcenter SCADAS XS with tablet and predefined test template

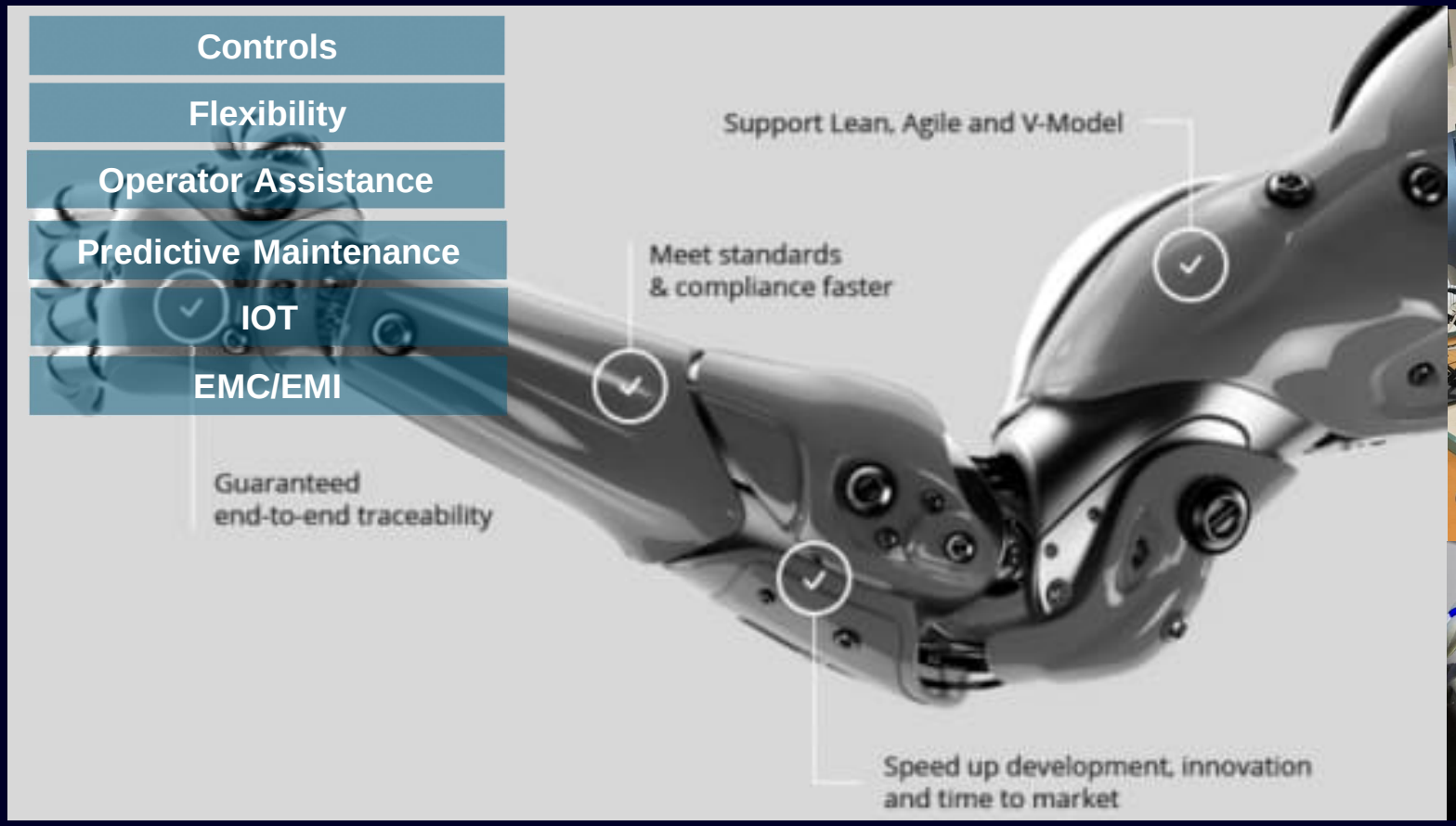
Thanks to the Simcenter SCADAS XS, a typical intervention went from 1 week down to only 2 days.

Benefit

- Simcenter SCADAS XS is shipped
- Operator can do the test
- Engineer only analyzes the data

Unrestricted © Siemens AG 2018

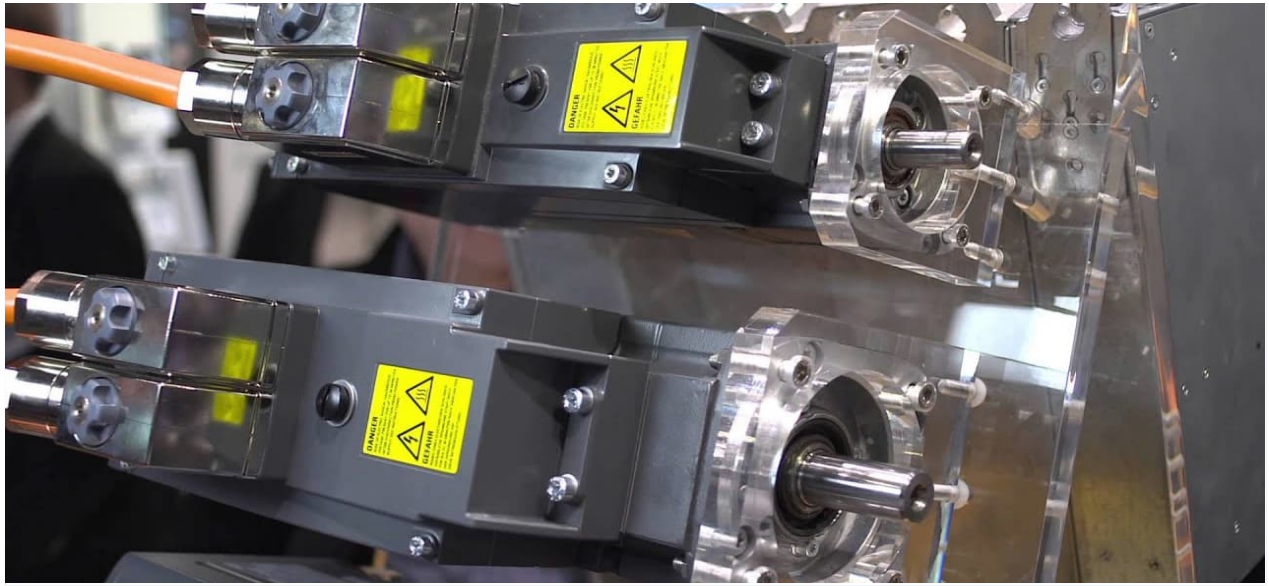
Simcenter for Robots Performance
Covering a wide range of applications



SIEMENS

Electromagnetic modeling
Capture realism through rich set of capabilities

SIEMENS
Ingenuity for life



Challenge
- Multi-discipline analysis of an actuator
- Efficiency & loss prediction

Solution
- Simcenter 3D Low Frequency EM

"Efficiently simulate the operation of a device based on either electromagnetic or pure electric fields."

Benefit
- High Fidelity loss and performance simulation
- Rich material database
- Account for any number of moving components (linear motors, magnetic gears)

Unrestricted © Siemens AG 2020

Electromagnetic modeling
Maximize connectivity – Reduce downtime

SIEMENS
Ingenuity for life

Challenge
- **Maximize performance of connectivity devices; from component (design of antenna's) to full factory layout for connectivity, ...).**

Solution
- **Simcenter 3D High Frequency EM**

"The evolution to Industry 4.0 requires assuring compatibility among the plant equipment and IIoT sensors/actuators."

Benefit
- **Efficiently simulate and address the compatibility and interference (EMC/EMI) concerns of electrical and electronic systems.**

Unrestricted © Siemens AG 2020

Electromagnetic modeling
EMC/EMI issues in Industry 4.0

SIEMENS
Ingenuity for life

“Legacy industrial environment could be not properly designed to install them!.”

Challenge
- **An industrial production environment is typically noisy from Electromagnetic due to abundant presence of electric machines, high voltage cables, power electronics, ...**

Solution
- **Simcenter 3D High Frequency EM**

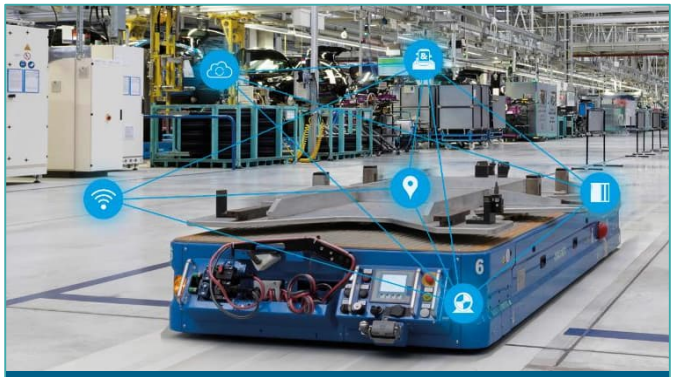
Benefit
- **Presence of sensors and IoT equipment must not interfere with the harsh EM environment**

Unrestricted © Siemens AG 2020

Siemens SIMOVE AGV system platform

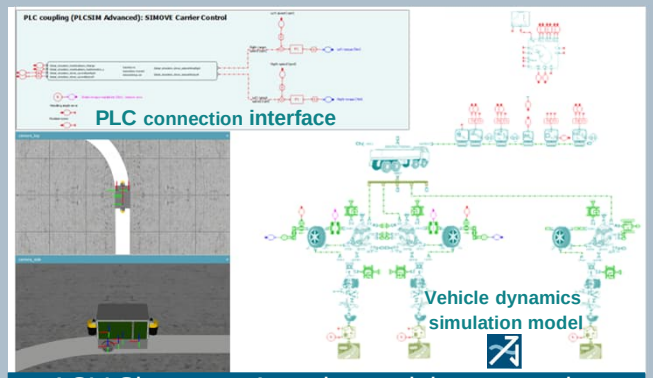
Concurrent engineering & virtual commissioning

SIEMENS
Ingenuity for life

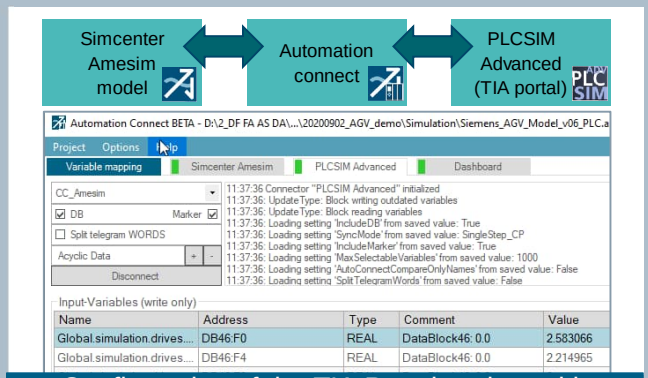


- **Achieve higher quality: AGVs design and multiphasic system integration with different scenarios as trajectory shape, vehicle loads and height**
- **Speed-up engineering with automation standards and virtual validation**
- **Increase the know-how in a risk-free environment**
- **AGVs monitoring to reduce down-times and issues**

Virtual commissioning environment – Software-in-the-Loop



AGV Simcenter Amesim model connected to PLCSIM Advanced



Configuration of the TIA Portal project with SIMOVE Carrier Control

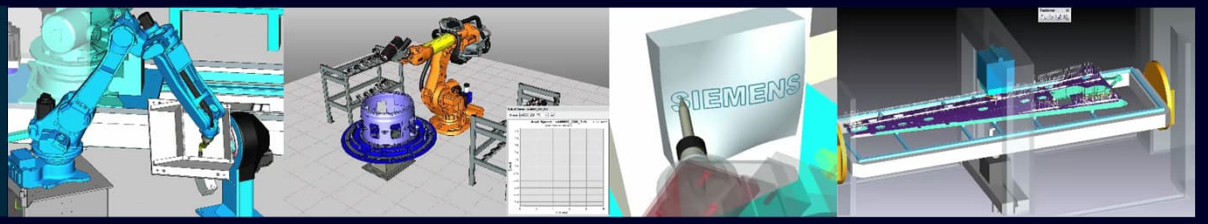
- Simcenter Amesim simulation model of the full vehicle (chassis, electric and trajectory definition) with the interface to Automation Connect
- TIA Portal with PLCSIM Advanced with the logic of the SIMOVE Carrier Control (PLC)
- Configuration of Virtual Commissioning project in Automation Connect (interface to map and exchange variables)

Unrestricted © Siemens 2020

Process Simulate

General

- Kinematics & Geometry
- Layout / Reachability / Collision analysis
- Sequence of Operation Simulation
- Documentation, e.g. Images / Movies / Reports

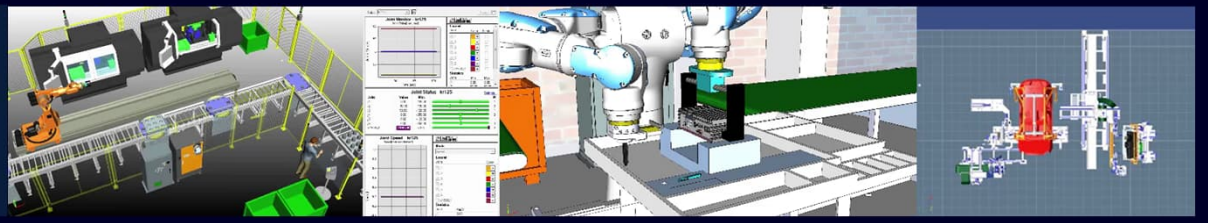


Robotics

- Joining, coating, treating or handling processes
- Manual & automatic Trajectory planning
- Offline programming & path optimization
- Exact cycle-time calculation - RCS & VRC

VC

- Coupling to PLC (HiL&SiL) / SIMIT / WinMOD
- Supports complex device behavior, like AGVs
- Behavior modelling using LB / SCL / FMU / API
- Material-lifecycle / Grip & Release / Sensors



Human

- Semi-automatic wizard-based task modelling
- Motion Capturing - Extensive device support
- Ergonomic analysis & Timing & Reporting
- Integrating Virtual Reality & Physics

SIEMENS

464
Line 1
488
Line 2
560
Line 3
KUKA

Address insights to your plant with Insight Hub

IIoT as a service:

Insight Hub

Centralized compute and storage,
with solutions, apps and services

SIEMENS

Address insights to your plant with Insight Hub

Insights Hub는 Siemens의 Low-code platform, Edge computing, Field/control 기능과 연계하여 더욱 포괄적인 IIoT를 제공합니다.

Low-code platform

Build apps faster for cloud,
on-premise or hybrid infrastructure

IIoT as a service

Centralized compute and storage,
with solutions, apps and services

Edge computing

Decentral compute and storage with
device runtime, apps and management

Field/control

Automation runtime and
engineering connectivity

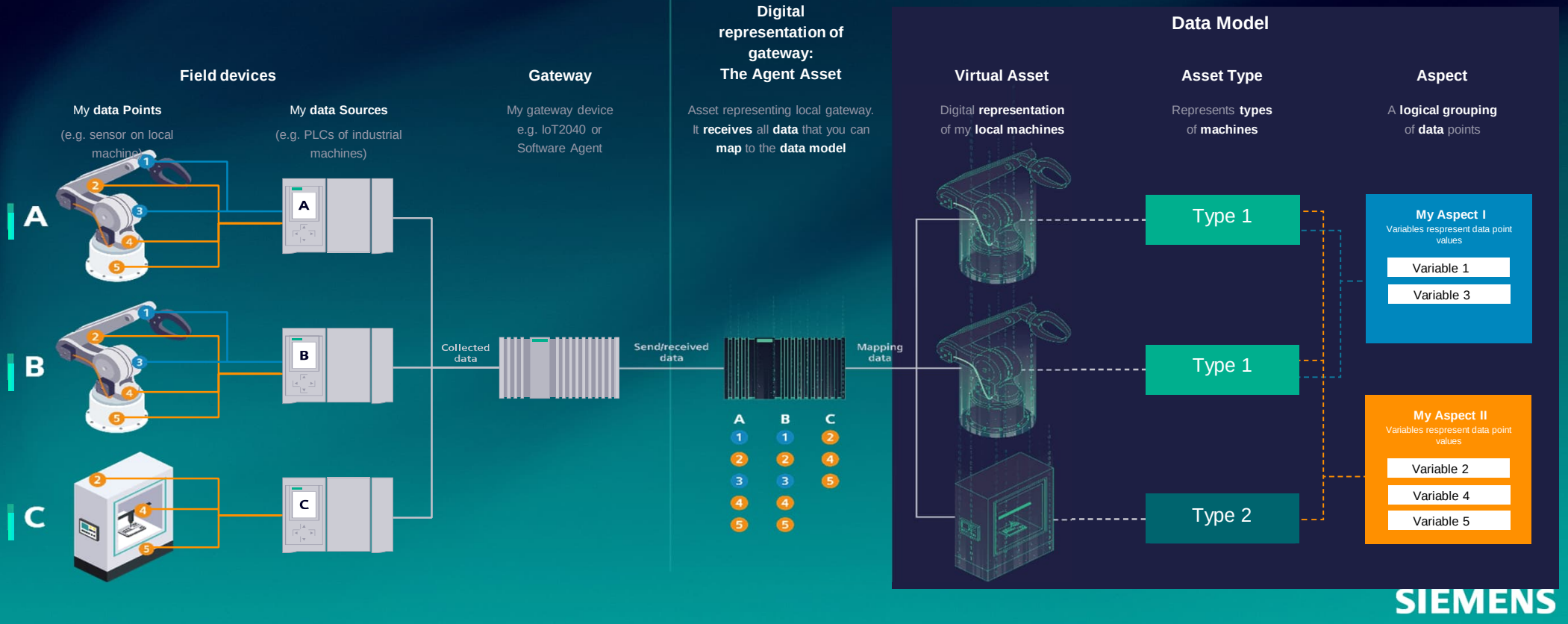
SIEMENS

Address insights to your plant with Insight Hub

Insights Hub Connectivity

My site and my things

Insights Hub



SIEMENS

Address insights to your plant with Insight Hub

Siemens가 제공하는 주요 Application들을 통해 설비 가시성 확보, 설비 효율 극대화, 예측 유지보수, 제품 품질 개선, 자재 물류 최적화, 지속가능성 개선 등을 달성할 수 있습니다.

1 Insights Hub Monitor

설비 가시성 확보

실시간으로 설비 및 라인의 성능을 모니터링하여 상황에 맞는 데이터를 활용 및 분석하여 통찰력 확보

2 Insights Hub OEE

설비 효율 극대화

설비 및 라인의 효율성을 산출 및 분석하여 생산 가시성 개선 및 생산성 손실 방지

3 Insights Hub Asset Health & Maintenance

예측 유지보수

유지보수 프로세스의 효율성을 개선하여 유지보수 비용을 절감하고 이상 징후를 신속하게 감지 및 대응

4 Insights Hub Quality Prediction

제품 품질 개선

기계 및 프로세스 데이터를 수집한 후 AI 모델에 입력하여 품질을 예측하고 결함 가능성 원인 파악

5 Intralogistics

자재 물류 최적화

내부 물류 프로세스를 최적화하고, 자재 채널 상태를 모니터링하며, 자재 관련 다운타임 감소

6 SIMATIC Energy Management & Optimization

지속가능성 개선

에너지 사용량을 절감하여 지속 가능성에 대한 요구를 달성

SIEMENS

Address insights to your plant with Insight Hub

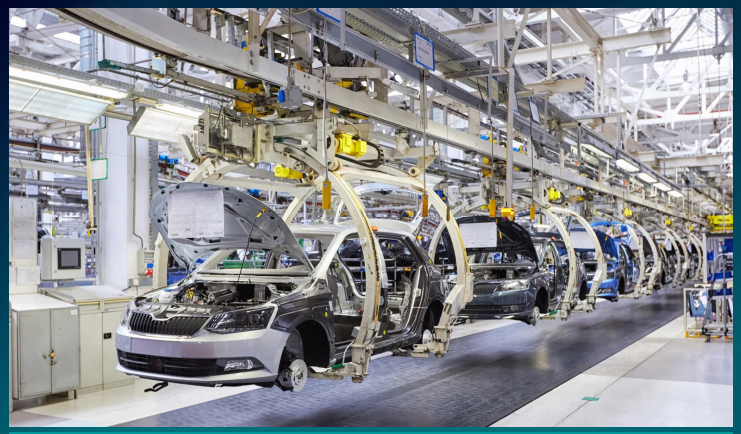
Insights Hub

Shopfloor Data

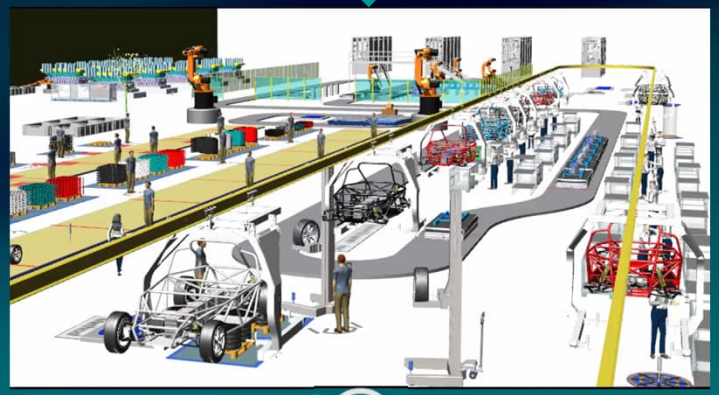
SIEMENS

Factory Twin

Simulations



Connected Factory



Analyzing the past

- ✓ Production Replay
- ✓ Bottleneck Analysis

Insights into the future

- ✓ What-If Analysis
- ✓ Model Calibration
- ✓ Resource Optimization

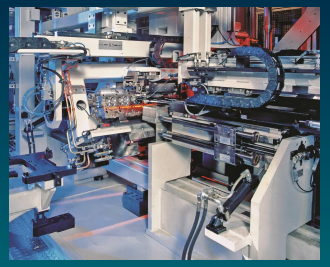
Derive Actionable Production Insights

SIEMENS

Start accelerating your digital journey today

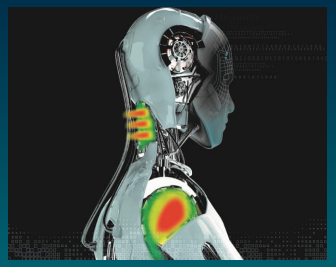
Through solutions designed for you!

Advanced Machine Engineering



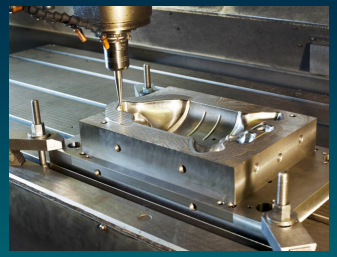
OPTIMIZE DESIGN AND VALIDATE FIRST

Intelligent Performance Engineering



MULTI-DISCIPLINE SIMULATION & TEST

Digital Part Production



BUILD QUALITY FIRST

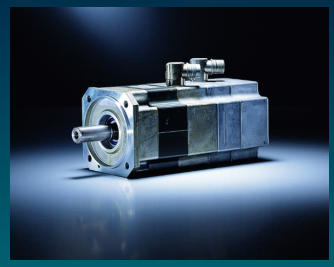
Smart Manufacturing

MASTER COST & TIME STREAMLINE OPERATIONS

Service and Asset Lifecycle Management

CUSTOMER LOYALTY THROUGH SERVICE

Accelerated Product Introduction



SUPPORT MASS-CUSTOMIZATION

SIEMENS

IM Trends

Disruptive Influences

- Energy Costs
- Supply Chain
- Staffing

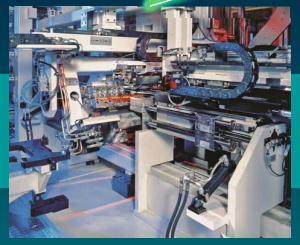
Smarter Factories

- Connected m/c
- Automation
- Home Working

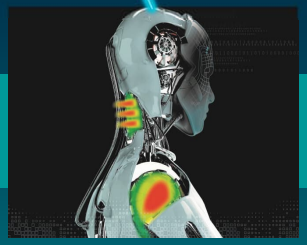
Business Model

- Carbon Pricing
- Re-shoring
- Servitization

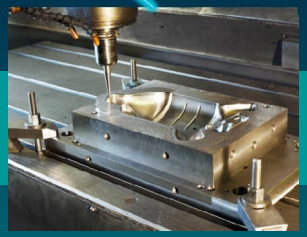
IM Digital Threads



Advanced Machine Engineering



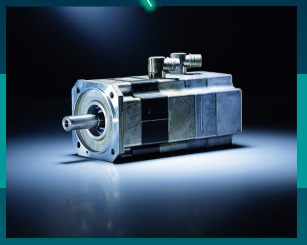
Intelligent Performance Engineering



Digital Part Production

Smart Manufacturing

Service and Asset Lifecycle Management



Accelerated Product Introduction

SIEMENS

Thank you

Seunghyon.choi@siemens.com
010-5252-5962
최승현 팀장

SIEMENS
Digital Industry SW
Simulation Portfolio Sales

SIEMENS