

Industrial digital transformation



CONNECTED DEVICES

Connected devices, smart equipment and sensors to enable the transformation "spark"

INDUSTRIAL INTERNET OF THINGS - IIOT

Convergence of IT and OT to enable the "knowledge"

BIG DATA AND ARTIFICIAL INTELLIGENCE

Together with cloud computing and cybersecurity enable the creation

Property of Comau - Duplication prohibited

Automation

Made in Comau

Why digital transformation?

•	The world of manufacturing
•	is changing and so
•	are its market drivers.
•	

- Evolution requires
- transforming the status quo
- into different production
- paradigms, and overall
- personalized production.

- Processes must become
- increasingly reconfigurable,
- flexible, scalable and
- promptly reactive.

Digitalization is the fundamental enabler of these new manufacturing paradigms.

PRODUCTION RELATED

PRODUCT RELATED

✓ 3-5%
Productivity increase

15-20% Inventory reduction

20-35%

Reduction in machine downtime

• 15-25% Reduction in time to market

40 15-25%

Reduction in plant maintenance costs

se 5-15%

Cost of poor quality reduction

Key data challenges for manufacturing



Data Silos

- Multiple data silos;
- Multiple business units and no single views of customer;
- Store redundant information for same manufacturing process.



Data Volumes

- Data Growing exponentially, 1.7MB of data generated every second per person;
- Unconventional sources IIoT, 5G.



New/Streaming Data Sources

- Semi/unstructured data sources:
- Real-time data leveraged from edge, to quality control, through supply chain to your computer.



Driving Actionable Insights

- Extract intelligence and drive personalized actions based on data in real-time / right time:
- Use Machine learning and AI to drive predictive maintenance, anomaly detection, quality and predict potential outcomes.

Digitalization levels

03 DESCRIPTIVE ANALYTICS

What Did It Happen? Interpretation of historical data to better understand changes that have occurred.

02 DATA COLLECTION

How Can We Collect the Data? Proces of gathering and storing information on targeted variables in a defined system

01 DATA SELECTION

What Data? Which Machine? Identify the most relevant data form a machine (available and not).

04 DIAGNOSTIC ANALYTCS

Why Did It Happen?

Ability to drill down to root cause, setup threesholds and perfom cause/effect and cluster analysis

PREDICTIVE ANALYTICS 05

What Will Happen?

Ability to predict the probability of future occurences and provide insights.

PRESCRIPTIVE ANALYTICS 06

How Can We Make It Happen?

Finding the best course of action in a scenario given the available data (optimization). Utilize modelling and experiments to identify possible outcomes.

COGNITIVE ANALYTICS 07

What To Do, Why and How? Simulate human brain intelligence, self learning feedback loop.

Why Comau?



MANUFACTURING BACKGROUND: 45 YEARS OF EXPERIENCE Expertise in the challenges of automation: flexibility, production maximization and reconfiguration.



PROCESS ASSESSMENT CAPABILITIES Application of user-centered design principles as a result of understanding clients' needs.

ENGINEERING & PRODUCT MANAGEMENT Long-term competencies in systems engineering, automation processes and products.

SOFTWARE & MACHINE EXPERIENCE With a proven track record in user-centered design, and agile

project management for software and machinery design

Made in Comau

5

Comau value proposition



Value Proposition

- **Analytics** to elaborate the acquired data in order to work on predictive maintenance, more accurate production planning forecast, quality improvement and other insights.
- Performance & KPIs Detailed and real-time view of automation performances & KPI monitoring;
- Predictive analytics: advanced analytics and simulation for automation equipment and lines;
- Operations management: process orchestration, sequencing, planning, logistics.



Advantages & Benefits

- Modular platform;
- Scalability from shop-floor to IT network;
- Equipment health check time and costs optimization;
- Automatic production orders status;
- Product and process traceability;
- Full-connectivity for Comau and non-Comau equipments and devices.



Digital and product automation benefits



Property of Comau - Duplication prohibited

Made in Comau

What is in.Grid?

in.Grid is the Comau platform that allows you to shape Industry 4.0 in line with the **Smart Factory Concept**.

By interconnecting **Comau and non-Comau equipment**, n.Grid enables you to plan, manage and monitor both the production flow and machinery performance. The platform uses **Artificial Intelligence techniques** to elaborate the acquired data in order to work on predictive maintenance, more accurate production planning forecast, quality improvement and other insights. Information will be available and displayed through a **simple and interactive interface**.

Workers play a central role when faced with a completely digitized production process. It calls them to evaluate the information received from the system and make strategic and operational decisions based on it.



What is in.Grid?



Comau: your partner for OT and IT integration

The Comau in.Grid solution allows field devices that are already present in your installations to **communicate with system management superiors in order to analyze and archive your data**. It can also be used to interface with enterprise resource planning (ERP) systems such as SAP. In addition, **in.Grid can integrate various existing third-party solutions** that clients may already be using for their specific needs.



Use cases: - Automotive Body Shop

Description

- Where? 13% of model Body Shop
- What? Health monitoring and quality control of spot welding application, sealing application, open gate station and backlash analysis of 4 axis of COMAU robots
- *How*? Collecting information from robot controller, sealing box controller, Lenze drive and Siemens PLC. No external sensors were required

Features

- Data collection from equipment
- Failure data analysis to define algorithms in order to predict and enhance the line efficiency
- Spot app: monitor/predict electrode consumption, monitor of welding mechanical clearance
- Sealing app: hardening prediction, leaking prediction, anomaly detection
- Open gate app: cycle time anomaly detection, maintenance parameter monitoring (CBM)
- Robot backlash app (for maintenance): to detect potential mechanical anomalies on robots
- User interface. Functionalities available on web/mobile interface

- Spot: Saved 20% of consumable material and re-gained 2hrs of production/month
- Sealing: Reduction of stoppages (leakage, hardening), avoided 5 stops/month
- Open gate: Reduced maintenance intervention time
- Backlash analysis: Avoided robot breakage regaining 6hrs/4 months
- Maintenance costs reduction
- ROI < 6 months





Use cases: Automotive Final Assembly Application

Description

IoT solution for real time monitoring of COMAU assembly cells. The solution aims to reduce the main customer pain points: Overcycle, Minor stoppages, Speed loss and Breakdowns. The implementation is developed on Microsoft Azure. The technical solution is designed in order to be flexible and able to be expanded to different lines / stations, also outside the specific perimeter (e.g. Body or Machining).

Features

- Data collection from FANUC robots and ROCKWELL PLCs
- Analytics on PLC for Condition Monitoring of Servo motors
- Edge device for data collection, filtering and data sharing.
- Microservices on the Cloud for data analytics and management MS Azure used as PaaS.
- Online Discrete Events Simulation (DES)
- Web based UI for statistical data evaluations and actionable insights visualization ANGULAR technology)

- Reduces risks of downtime by correlating automation equipment performances with equipment status
- Reduction in System Commissioning and Ramp-up time
- Improvement insights for Production Throughput & Cycle Time by using DES (Descrete Event Simulation) software in real time for accurate model execution and simulation.
- Support Process Engineering Improvement and optimization for future Installation or retooling.



Use cases: Automotive Engine Machining Application

Description

- Where? Cylinder Head line
- What? Health monitoring and quality control
- How? in.Grid IoT Platform application to nr. 5 URANE 25 machines plus nr. 1 Cartesian Gantry

Features

- Commercial data collector for CNCs / PLCs
- Health and quality monitoring of equipment
- Spindle vibration sensors
- Spindle monitoring module
- Data correlation between spindle vibration, tool type, machining step and cutting parameters to detect machining anomalies on spindle and tools

- Improve line reliability and efficiency
- Improve quality performance in the sense of steadiness of quality produced
- Reduction of production stoppages for main losses
- Equipment remote monitoring
- Clear customer investment ROI based on customer pain points (quality and maintenance losses)



Use cases: Automotive Engine Machining Application

Description	Components	Features monitored
- Where? Cylinder Head Machining Line	Kessler HSK 63 Electrospindle	Motor temperature, Absorbed power
 What? Implementation of health monitoring and quality control for machining CNC (nr. 5 SD700L machines, equipped with Siemens Sinumerik CNC 840D Solution Line) How? Collecting information from CNC and PLC, adding vibration sensors for spindle, days leaves to a modified energy line. 		Clamping position, Clamping time, Unclamping time
		Spindle unbalance, Global vibration, Impact, Impact machining.
Data collectors for CNC and IFM sensors		Bearing front, bearing rear, bearing cage , bearing pollution
 Failure data analysis to define algorithms in order to predict and enhance the CNC efficiency CNC component sub-group app: key critical functioning parameter analysis to detect deviation 	X Axis	Temperature
and predict anomalies (see right hand list) - CNC remote monitoring	Y Axis	Balance pressure, Temperature, Axis Current
	Z Axis	Temperature
Benefits	Hydraulic group	Oil temperature, Oil level, Oil pressure
mprove machine reliability and efficiency Reduce machine critical stoppages by avoiding anomalies of components sub-groups Reduction of maintenance costs (rt-TBM, CBM)	Tool Magazine (Q1 & Q2 Axis)	Temperature
 Reduction of quality defects (spindle monitoring) Remote monitoring 	Coolant	Pressure
- Enabling of remote assistance	Cooling	Pressure, Filter pressure

Use cases: **General Industry Application**

Description

- Where? Brown-field line for maintenance of wagon wheels and locomotives
- What? Health monitoring, process control and quality control of non-Comau equipment
- How? Collecting information from ABB robot, sand supply system, Gas Washer System, Ventilation System





- Line monitoring (performance, process)
- Advanced analytics for equipment health check/Maintenance parameters monitoring (CBM) of Portal Lathe, Fake Table, Robot Cell, Sand supply system, Ventilation system, Gas Washer system and Underground Lathe (Siemens PLC, Allen Bradley PLC, Schneider PLC, CNC Sinumeric. ABB robot)
- Ad-hoc user interface customized for customer (custom look & feel)

- Reduction of equipment health check time and costs
- Reduction of equipment maintenance costs (rt-TBM, CBM)
- Enabling of production/maintenance remote assistance
- Increase of line overall efficiency by remote monitoring and prompt maintenance
- Predict issues avoiding line stoppages, increase overall efficiency



Use cases: General Industry Application

Description

- Where? Production plant
- What? Line monitoring and integration of wearables (smartwatch)
- How? Collecting information from shop floor equipment, management of operator user interface and connection to a central server with output on user interfaces such as web, andon and smart watches

Features

- PLC data collection
- Line orchestrating
- Line monitoring/Andon
- Integration of wearables (smartwatch)
- HMI/Operator panel for SOP, action calls (tool, material, technical, quality)

- Machines saturation increase by 30%
- Operator assistance time reduced by 25%
- Logistics operator saturation optimized by 20%
- Indirect losses reduced by 30%



Use cases: Automotive MES Application

Description

- Where? Greenfield line for electrification, battery module assembly line
- What? Process monitoring, line orchestration, product/process traceabilitty
- How? Collecting information from robot controller, sealing box controller, Lenze drive and Siemens PLC. No external sensors were required

Features

- Line monitoring/Andon
- Line orchestrating/Process management
- Product orders management
- Product/Process traceability
- HMI/Operator panel for production recipes/paperless system
- Connection to customer ERP

- Simplified line management and monitoring
- Line resources optimization and line efficiency increase through the line orchestrating module
- Reduction of intervention time (andon/paperless)
- Automatic production orders status
- Product and process traceability
- Management integrated with customer ERP avoiding any logic misalignment





Property of **Comau** - Duplication prohibited

Classification Level: GENERAL BUSINESS