



Comau Approach to Industry 4.0

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Made in Comau

A History Rooted in Excellence, a Future Driven by Innovation



Comau specializes in producing **advanced industrial automation solutions that integrate products, technologies and services** to help companies of all sizes increase plant efficiency while lowering operating costs and optimizing returns.

Comau's competency stems from **over 40 years of field-proven experience and a strong presence within every major industrial country**. The comprehensive offering of **modular, flexible and highly configurable products** is based on **open automation principles**, and can be tailored to meet the needs of each individual customer.

9,000
employees

17
countries

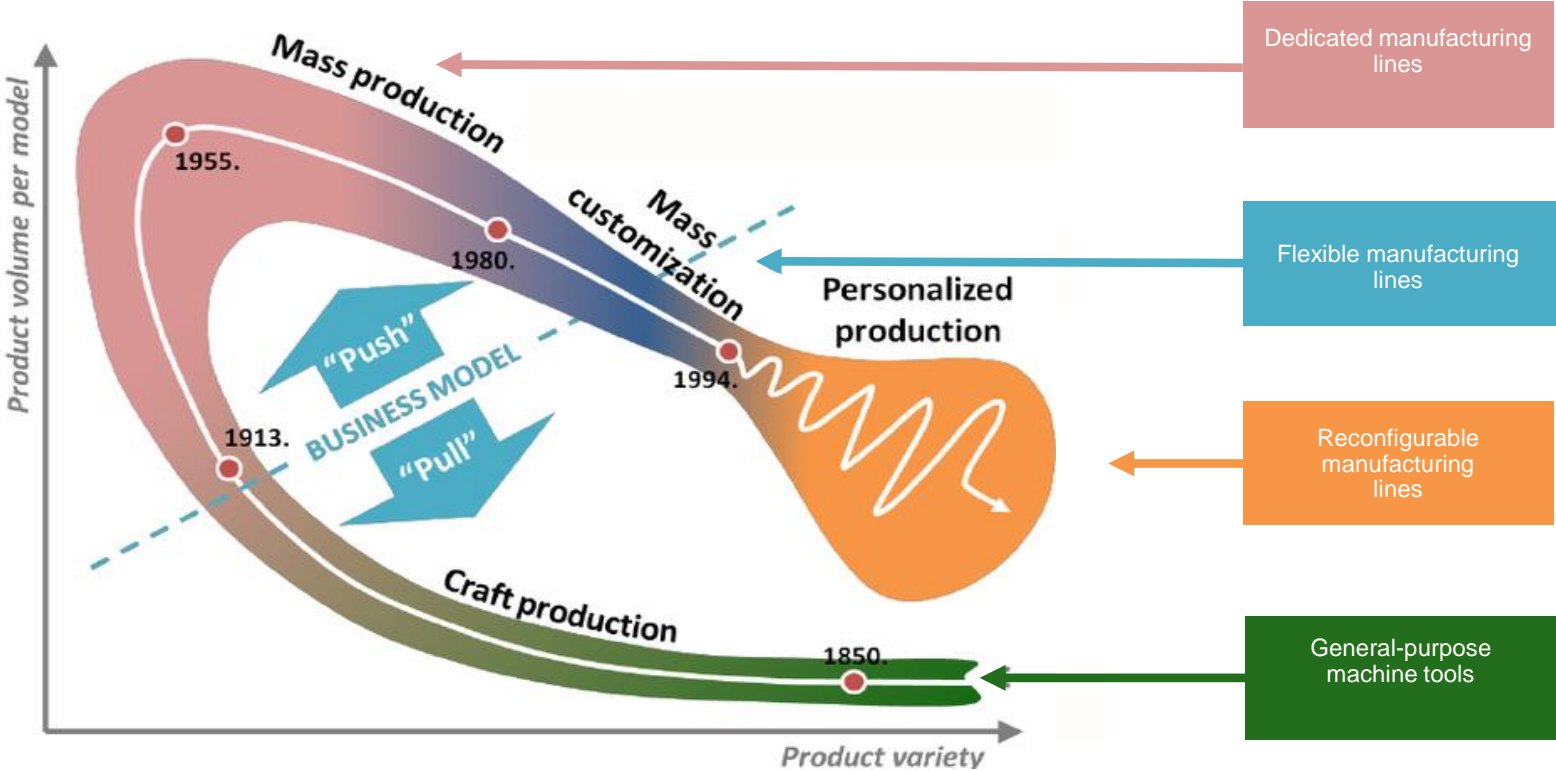
5
innovation
centers

A Brand of

FCA

FIAT CHRYSLER AUTOMOBILES

Personalized Production Demands New Manufacturing Approach



SOURCE: "Design of reconfigurable manufacturing systems", Journal of Manufacturing Systems, 2013 – Prof. Yoram Koren

Customized Production Demands New Manufacturing Approach



SIX CORE PRINCIPLES OF RECONFIGURATION

Customization

Scalability

Convertibility

Integrability

Modularity

Diagnosability

CUSTOMIZED PRODUCTION

- Continuously shortening product life cycles.
- Rapid quantity fluctuation.
- Small batch sizes up to make-to-order production and at the same time a large number of variants.
- High degree of alteration in the part spectrum.
- Raising product quality demand.

Reconfigurable Manufacturing Systems represent the solution with an important contribution from Robotics.

Key Automation Trends

INVESTMENT OPTIMIZATION



- Maximize Overall Equipment Effectiveness
- Enhanced Virtual Commissioning
- Minimize Production Cost

AUTOMATION HIGH DENSITY



- Minimize Floor Space per Vehicle
- Maximize Machine Modules Reuse
- Minimize Plant Facility Construction Costs

MATERIAL MANAGEMENT



- Transportation Cost
- Minimize Path per Kitting
- Minimize man hours/kitting
- Minimize Implementation Time and Cost
- Minimize Non-Value Added Activities

INTEGRATED PRODUCT-PROCESS



- Product-Process standard template
- Non-Model Specific Architecture
- Minimize Startup Time
- Advanced Joining Technologies for Dissimilar Materials

ZERO DEFECTS



- Minimize Scrap and Rework Costs
- Minimize Defect Rates

Digital Factory Elements: The Big Enabler of the Manufacturing Digital Transformation



Virtual industrialization

Virtual plants and products to prepare physical production via simulation, verification and physical mapping

Smart Robots & Machines

Multipurpose «intelligent» robots able to adapt, communicate, and interact with each other and with humans based on remote control

New quality of connectivity

Connection of digital and real worlds with constant exchange of information between machines, work pieces, systems and human beings

Big data and analytics

New methods to handle huge amounts of data and tap into the potential of cloud computing

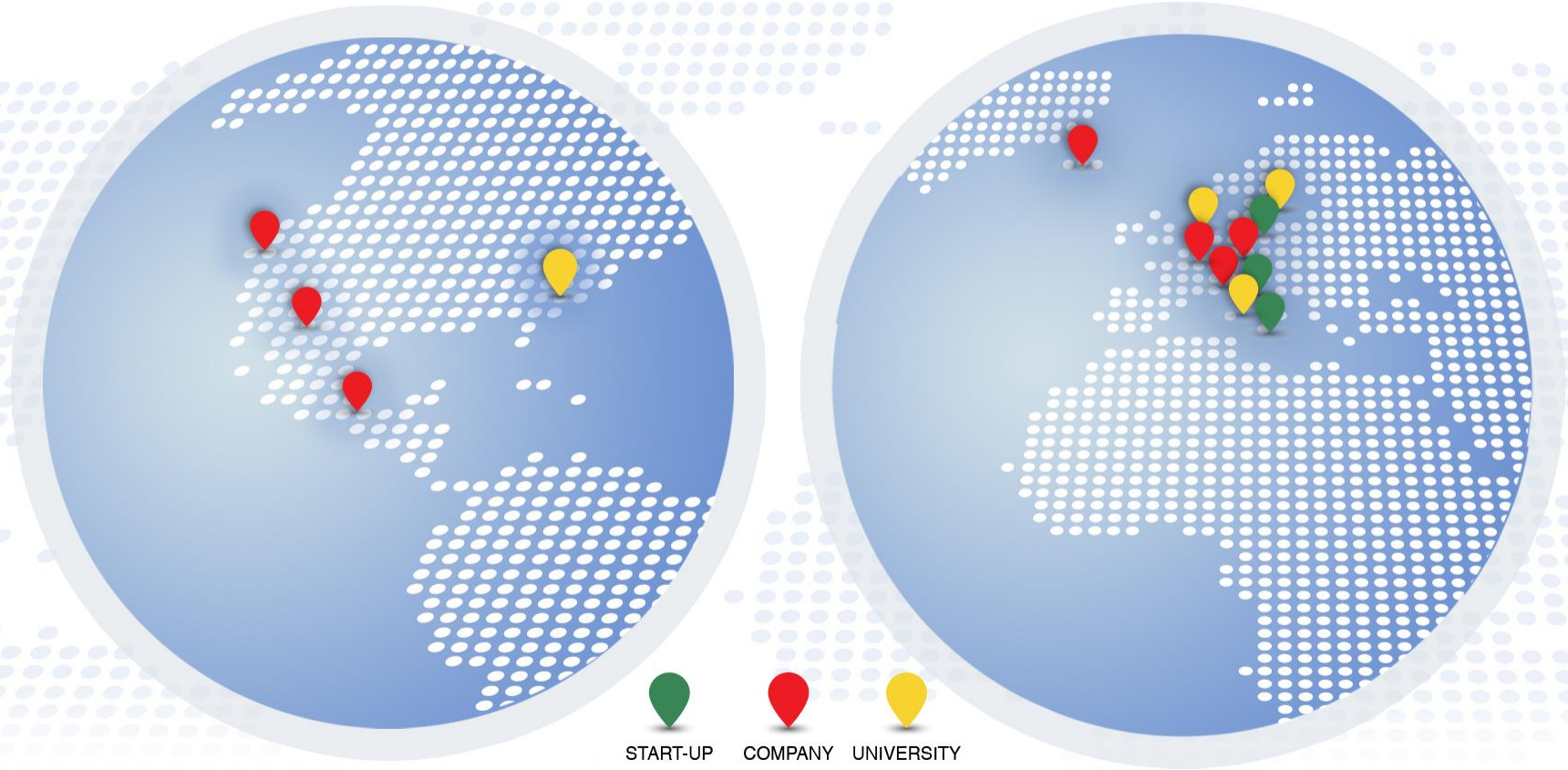
Cyber-physical systems and marketplace

IT systems built around machines, storage systems and supplies linked up as CPS

Factory efficiency

Preventive and predictive maintenance; energy efficiency; decentralization and remotization; process reengineering

Comau Innovation Network



Comau Innovation Pillars

EASY TO USE SOLUTIONS

- Intuitive, easy to understand and easy to use solutions that keep automation simple
- «Plug & Play»: all our new products and solutions inherit an open architecture concept

ADDED VALUE MANUFACTURING SOLUTIONS

- Manufacturing technologies and innovative processes that facilitate flexibility, the use of advanced materials, the achievement of high product performance.

HUMAN ROBOT COLLABORATION

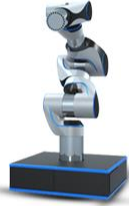
- Symbiotic human-machine relations, which seek a deeper understanding of human behavior and go beyond conventional approaches

Comau Approach to Industry 4.0

EASY TO USE SOLUTIONS



DIWO – Digital Workplace



Advanced Robotics



Wearable and Mobile Technologies



New generation software applications - consistency with capitalization

ADDED VALUE MANUFACTURING SOLUTION



Logistic System
AGILE1500
Autonomous Guided
Intelligent Lean Equipment

HUMAN ROBOT COLLABORATION



Advanced Use
Robotic Arm

Exoskeleton

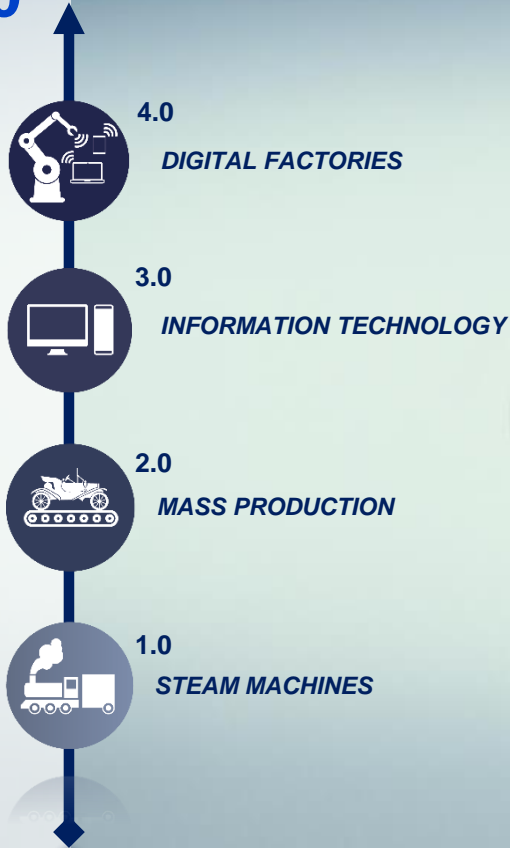


HUMANufacturing: Our Way To Industry 4.0

We believe that digital manufacturing and the technologies that support it represent the next step toward excellence in automation.

This new Smart Factory paradigm is being driven by breakthrough innovations in products, processes and systems.

- ✓ Cloud computing, advanced connectivity networks, mega-processors designed to handle big data
- ✓ Improved computational, analytics and business intelligence capabilities
- ✓ Additive manufacturing and similar technologies able to bridge digital and physical realms
- ✓ **HUMANufacturing** and the full cooperation between man, with the industrial automation solutions, and the new digital technologies that surround him



DIWO: Digital Workplaces



EASY TO USE
SOLUTIONS



Why

- Current practice is based on corrective maintenance, which leads to unpredictable downtime
- Process and product information are not fully correlated
- Process capability and bottleneck analysis are difficult to perform, due to the huge amount of unstructured data



What

- Remote collection of operational and quality data from equipment's, analysis and correlation of data with service operations to predict future malfunctions and process drift.
- Cognitive systems able to improve efficiency and throughput, using the available information



Value proposition

- Improved efficiency of existing and new systems
- Direct saving on impacted maintenance cost
- Reduction of breakdowns of equipment's operations resulting in optimization of Overall Equipment Effectiveness

Wearable and Mobile Technologies



EASY TO USE
SOLUTIONS



Why

- Today factory floor fixed HMI have a low flexibility and mobility



What

- Applications to support assembly and maintenance operators with consumer smartwatch/smartphone/tablet devices and intuitive gesture-voice-based input to perform their daily activities



Value proposition

- Continuous advancements in human machine interface (HMI) technology are driving huge gains in productivity and usability
- Smartwatch gives operators more flexibility when executing and certified assembly task
- Tablet gives maintenance team fast assistance when repairs machines

SMU Sensorized Memory Unit



EASY TO USE
SOLUTIONS



Why

- In many cases the equipment are not able to provide specific information to evaluate their condition avoid failures
- Recognize machine component misalignment, defective bearing, bent need signal analysis (es. vibration, torque,..) properly done
- Control loops on industrial robots are closed through position sensors which are positioned on the motors and there is no feed back from the physical mechanical components



What

- Integrated sensor solutions that combine hardware with data analytics and transmission in an easy to setup and use application for predictive maintenance
- Solid state inertial platform to collect acceleration data from the last joint of the robot



Value proposition

- Easy sensorization of existing equipment
- Reduce sensors setup time and cost
- Reduce bandwidth usage for data transmission
- Robot performance closed loop optimization

Advanced Robot Programming



EASY TO USE
SOLUTIONS



Why

- Nowadays robots are programmed manually using either a teach pendant or by means of an off-line programming tool. This “textual” robot programming languages have proven to be difficult for many people to learn, and to use effectively.
- In addition, the robot programming is based on series of position and signal conditions rather than simple to use real human concept of task.



What

- Software applications to support task-level and object-level instruction of robot and control systems based on visual “Assembly Plan from Observation” approach where users can interact directly with the part to be assembled.



Value proposition

- Reduce programming time of existing and new robot
- No need to learn a robot programming language

AGILE

Autonomous Guided Intelligent Lean Equipment



ADDED VALUE
MANUFACTURING
SOLUTIONS



Why

- Autonomous vehicles are one of the key tools meeting the Factory of the Future's needs, such as growing demand of flexibility, riconfigurability and minimal use of resources in production systems



What

- An autonomous mobile platform providing modular and wide ranging solutions for logistic applications in manufacturing systems through all process stages
- Step 1 will be a 1.5 ton vehicle (AGILE 1500)



Value proposition

- High performance vehicle (best in class payload / size + speed) with best TCO ratio
- Modular, Scalable, fully Customizable - All navigation systems implementable
- Customer investment protection

AURA

Advanced Use Robotic Arm



Why

- To reach the goal of building an adaptable factory, it is necessary:
- to avoid fences or other obstacles to a free floor
- to allow men and robots to work side by side, complementing each other peculiar skills
- to allow men an easy interaction with robots, correcting their behaviour when necessary and easily teaching them new tasks



What

- High speed collaborative robot (110kg payload)
- 6 safety layers for a modular approach
Laser scanner, Foam with Proximity sensor and Piezo-resistive sensor, Force sensor on wrist (manual guidance), Vision system



Value proposition

- Optimization of working process
- Reduction production time
- Reduction of manual processes / working steps

Exoskeleton



HUMAN ROBOT
COLLABORATION



Why

- The proportion of workers that will require support to improve the quality of work in their activities is increasing because of aging or injuries
- Modern robotics assisting and serving human beings will enter into the “surroundings” of workers activities and thus become an integral part of factory



What

- Wearable passive (non servo assisted) devices to improve manual operations quality and to relief fatigue
- Wearable active (servo assisted) devices to improve the operator strength and solve ergonomics issues



Value proposition

- Reduction of musculoskeletal disease/injury
- Support of workers during simple and continuous movements, such as grasping control sticks or lifting heavy building materials, reducing equipment investment

e.DO: People Make Robotics



EASY TO USE
SOLUTIONS

e.Do



Why

- To help students with their coursework
- To execute simple chores
- To simulate and test a variety of business applications



What

- A unique, “build-it-yourself” 6-axis articulated robot project based on a 100% open-source hardware and software platform that allows users to understand how robotics work from the inside-out and the outside-in
- Backed by community-led expansion
- IoT compliant (multisensor board distributed on every joint)



Value proposition

- Multi-faceted project directed at business, educational and consumer markets

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