



The future of manufacturing for the automotive industry

Julien Mascolo

FIAT Research Center , WCM Process Research and Innovation

Factory Innovation - Ecofactory

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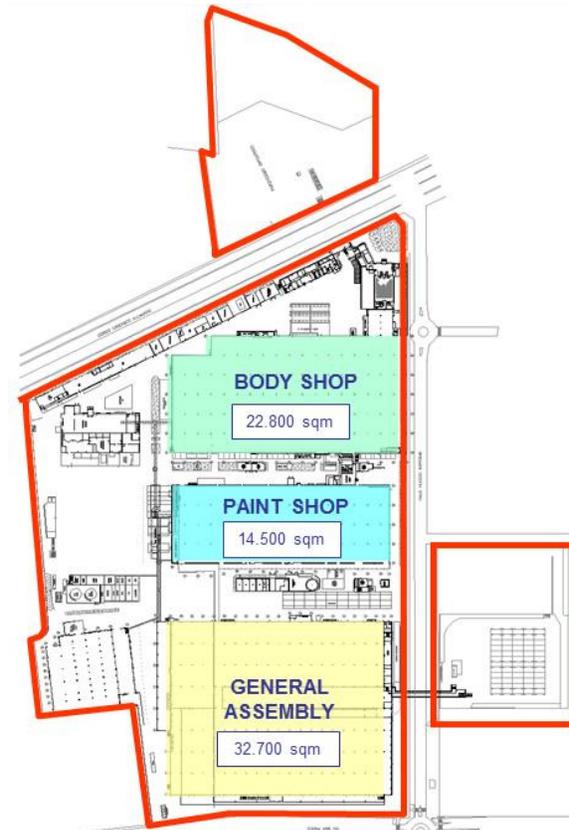
- An overview of Automotive Manufacturing
- Why CPS?
- Examples of current processes and research projects: the future?
- Who we are
- [Intro...](#)

An overview of Automotive Manufacturing



■ Main processes:

- Stamping
- Welding
- Painting
- Assembly



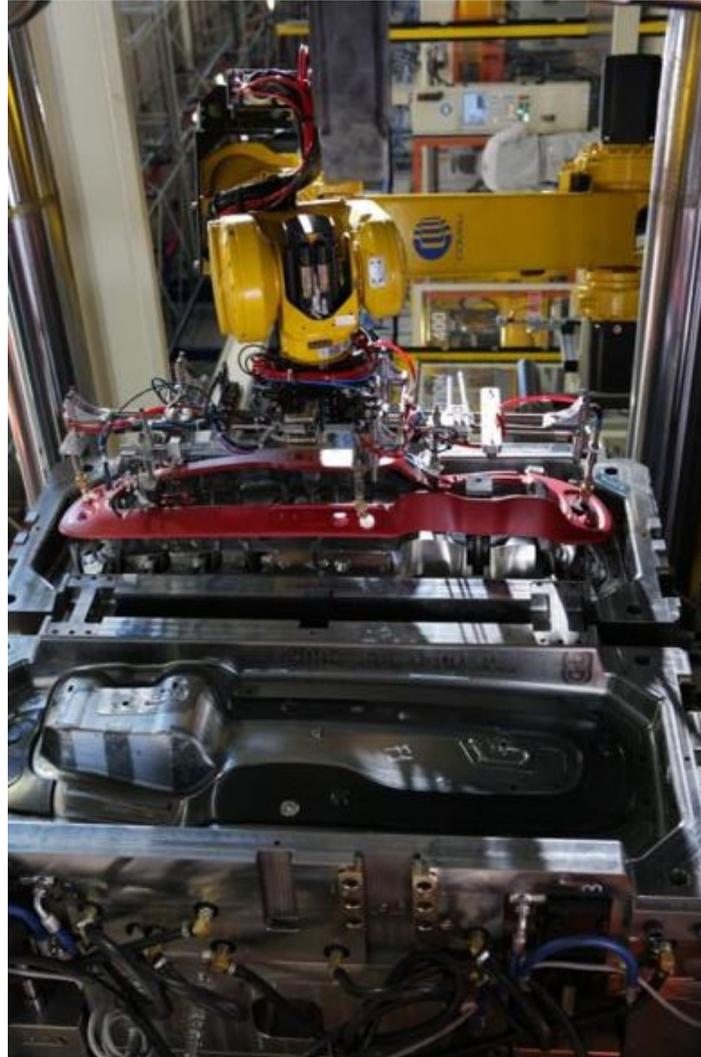
AGAP (Maserati, Torino)

An overview of Automotive Manufacturing



- Main processes:

- Stamping
- Welding
- Painting
- Assembly



An overview of Automotive Manufacturing



■ Main processes:

- Stamping
- **Welding**
- Painting
- Assembly



An overview of Automotive Manufacturing



■ Main processes:

- Stamping
- Welding
- **Painting**
- Assembly



Why CPS?



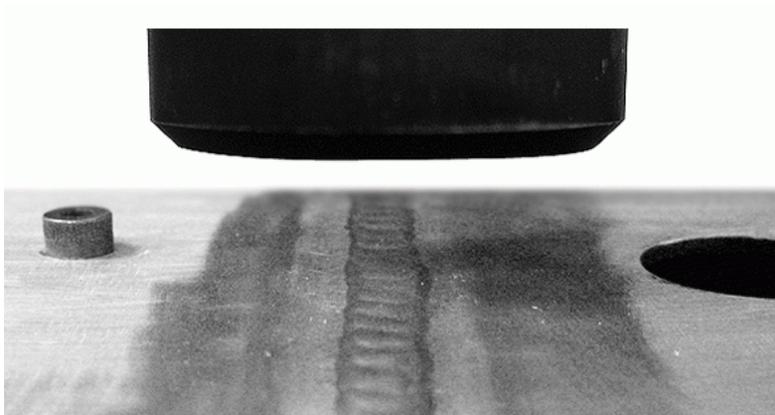
- Integration of computing and networking
- Increased complexity of processes and objects
- Connected objects in shopfloor
- Need for real-time data enabling retroaction and propagation of information

Examples of current processes and research projects: the future?

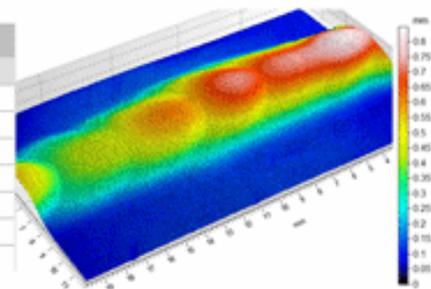


Welding

- Enable advanced process control
- From RSW, closed-loop (no feedback) to:
 - Welding guns adjust the current during welding (e.g. Harms and Wende)
- Remote Laser Welding (optic+scanning mirror) using profilometers & guns
- Increasing the complexity means being able to for example recognise the borders of the sheet and adapt the functioning of the welding guns to the geometry of the component.
- Enabling the data transmission over the line enables to use it for successive operations/ correlate it for quality control



ISO 25178		
Height Parameters		
Sa	2.219	µm
Sq	3.025	µm
Sz	68.48	µm
Sp	34.17	µm
Sv	34.31	µm
Sku	7.680	
Ssk	0.1002	



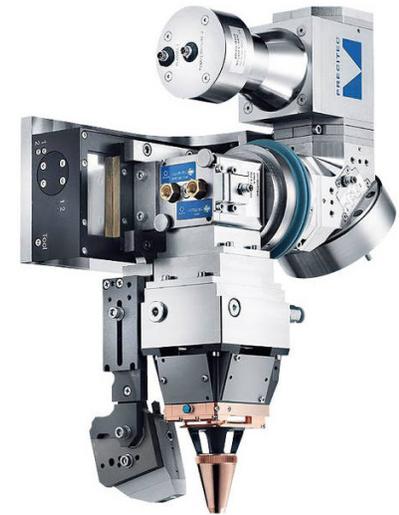
Nanovea

Examples of current processes and research projects: the future?



Quality control

- Ultrasonic systems for quality control in RSW
- For each welding point (x000s on a vehicle)
- Laser welding Monitor
 - ▲ PRECITEC, used in VW and BMW



POWER-TRAC™ SYSTEM



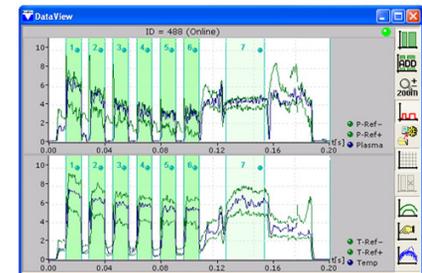
POWER-BOX™ CONTROL UNIT

- ▲ Servot-robot, VW, MB

DIGITAL LINK



POWER-CAM™ LASER-CAMERA



Examples of current processes and research projects: the future?

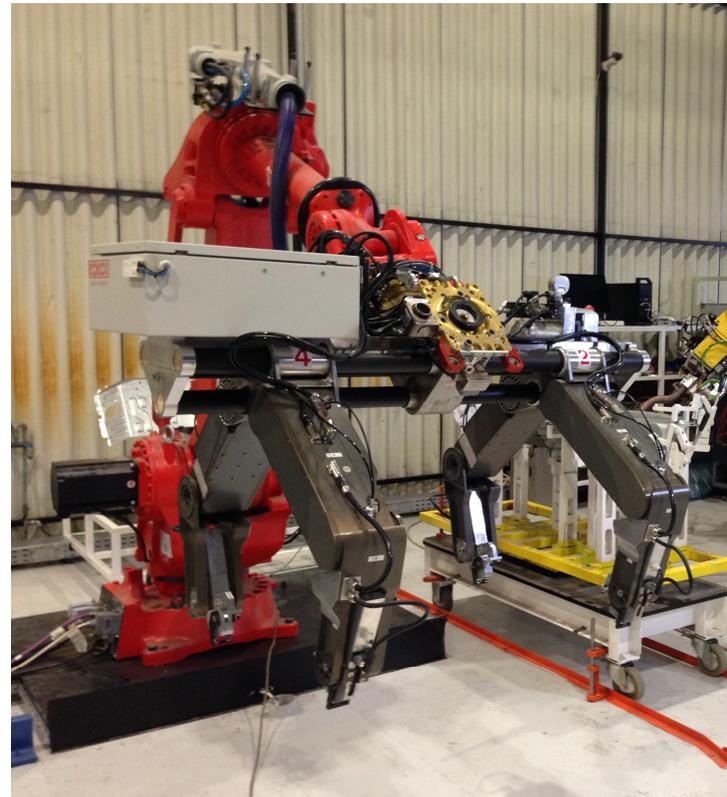


Gripping systems

- Adapted for different components
- Commands can become more complex
- 3D printing enables a virtual
 - warehouse for spare parts



Fanuc



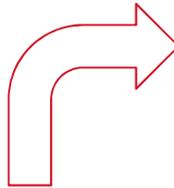
Autorecon prototype

Examples of current processes and research projects: the future?



Painting

- Quality control of gaps and flashes
- HRC for final tests and quality refinishing



Examples of current processes and research projects: the future?



Intralogistics

- Object-centric approach
 - AGV used in alternative to conveyor for the body itself
 - RFID embedded on skid to collect quality-related data



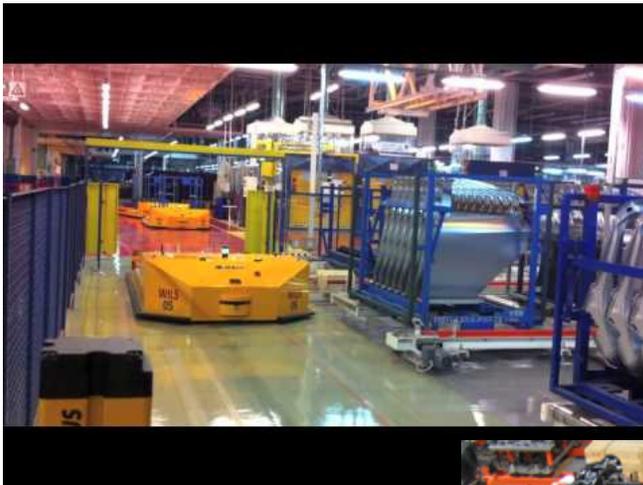
skoda

Examples of current processes and research projects: the future?



Intralogistics

- Fleets of autonomous vehicles for added flexibility



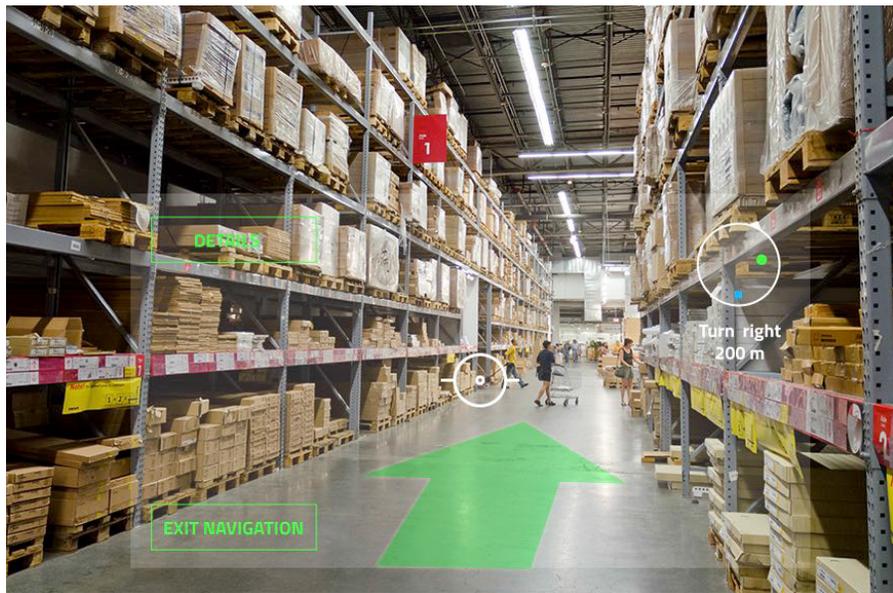
BMW

Examples of current processes and research projects: the future?



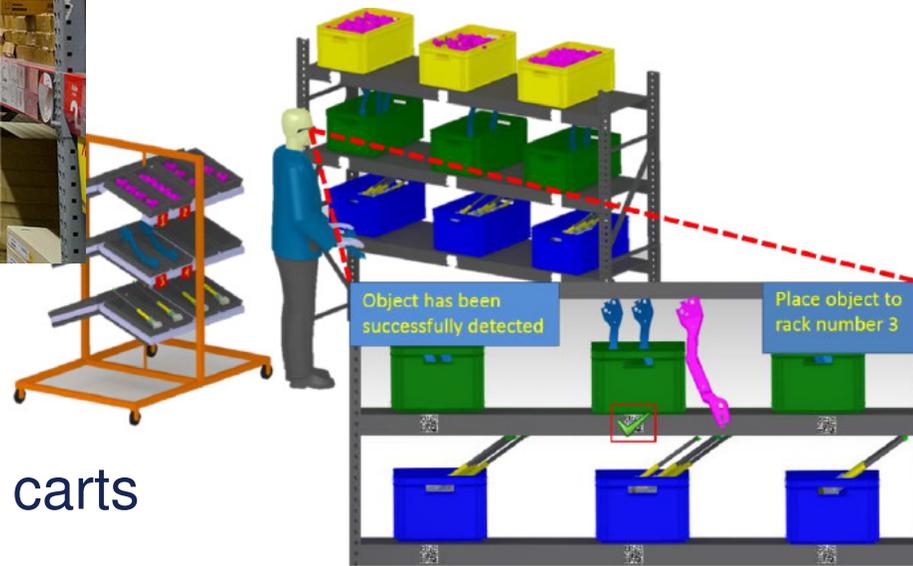
Intralogistics

- Augmented reality for kitting and picking



Joinpad

Navigation



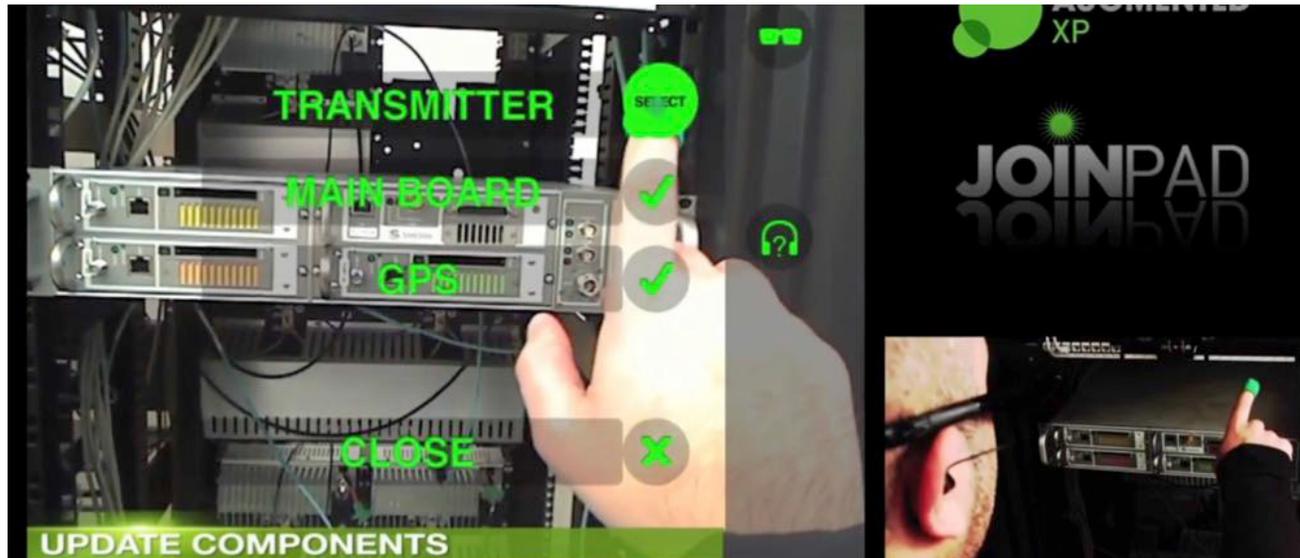
Preparation of carts

Examples of current processes and research projects: the future?



Maintenance of production systems

- Augmented reality
 - Visualisation
 - Advanced HMI



Examples of current processes and research projects: the future?



Assembly

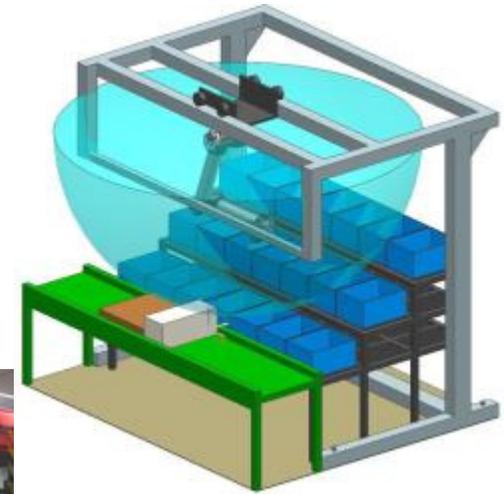
- Human-Robot collaboration
 - HRC for assembly
 - Some examples

Examples of current processes and research projects: the future?



Assembly

- Human-Robot collaboration, with focus on safety



Result of the HII Industrie 4.0 project, EIT-Digital

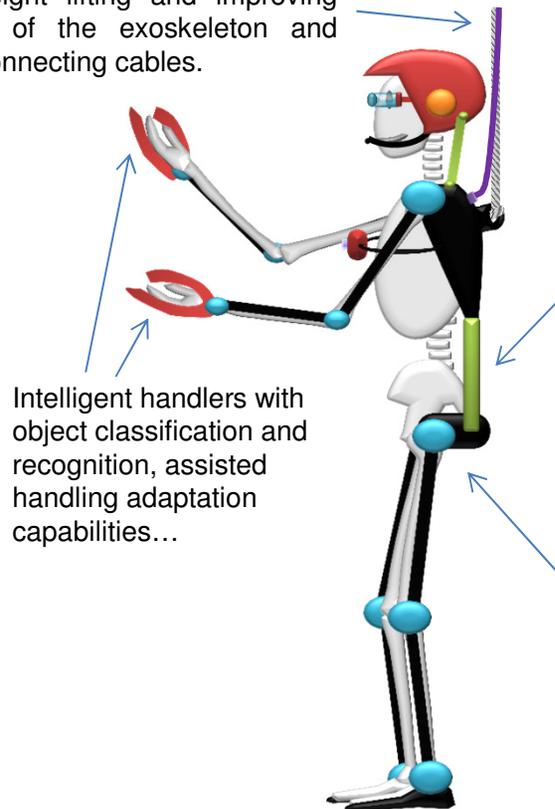
Examples of current processes and research projects: the future?



Assembly

The exo-skeleton

Steel cable hanging from the ceiling to help in weight lifting and improving equilibrium of the exoskeleton and electrical connecting cables.



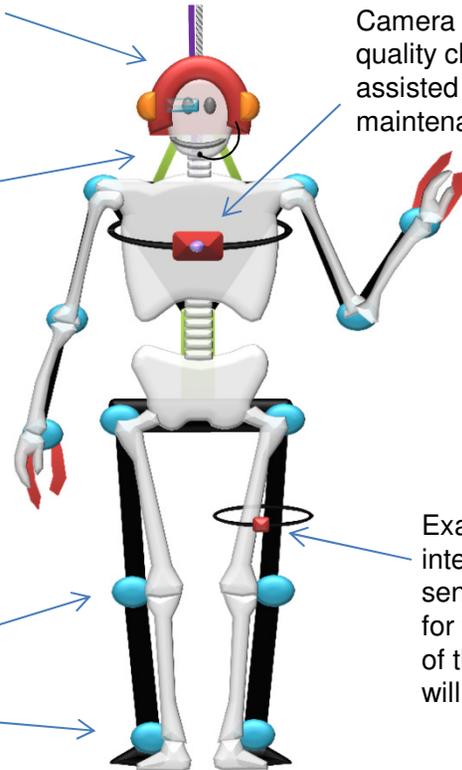
Intelligent handlers with object classification and recognition, assisted handling adaptation capabilities...

Helmet with see through screen, headsets for selective noise reduction, vocal HMI...

Passive protection for unassisted degrees of freedom and fatigue reduction systems

Active systems for assisted actuation

Camera for quality check, assisted maintenance...



Example of intelligent sensory nodes for the detection of the operator's will

-  Intelligent devices and actuators
-  Structural parts
-  Assisted actuation
-  Passive or semi-passive assisted movement for protected degrees of freedom

Examples of current processes and research projects: the future?



The exo-skeleton

Assembly



Factory → exoskeleton:

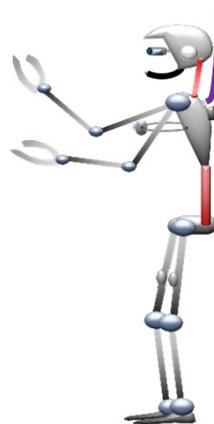
- Mission data
- DB data
- Goods' location
- Diagnostic data query (exoskeleton/operator)
- Other instructions

Exoskeleton → factory :

- Location (GPS/inertial platform)
- RFID Goods recognition/classification
- Work Report (black box data)
- DB update or query
- Quality statistics
- Diagnostic report (exoskeleton/operator)
- ...

Goods ↔ exoskeleton :

- RFID identification of handled goods
- Weight
- Image recognition for quality check, handling assistance...



Operator → exoskeleton :

- DB query on goods, object, operations (microphone with voice recognition)
- Force feedback – movement request
- Clinical/environmental data (temperature, fatigue, heartbeat)

Exoskeleton → operator:

- Enhanced vision (Goods location and data from DB, operating instruction...)
- Enhanced perception haptic feedback for movement refinement
- Headsets with active noise control, dialog with other operators, warnings...)
- Comfort actuations (ventilation...)
- Sensors' Data fusion for Ergonomic/warning evaluation of operator
- ...



Examples of current processes and research projects: the future?



The flexible cell and intralogistics

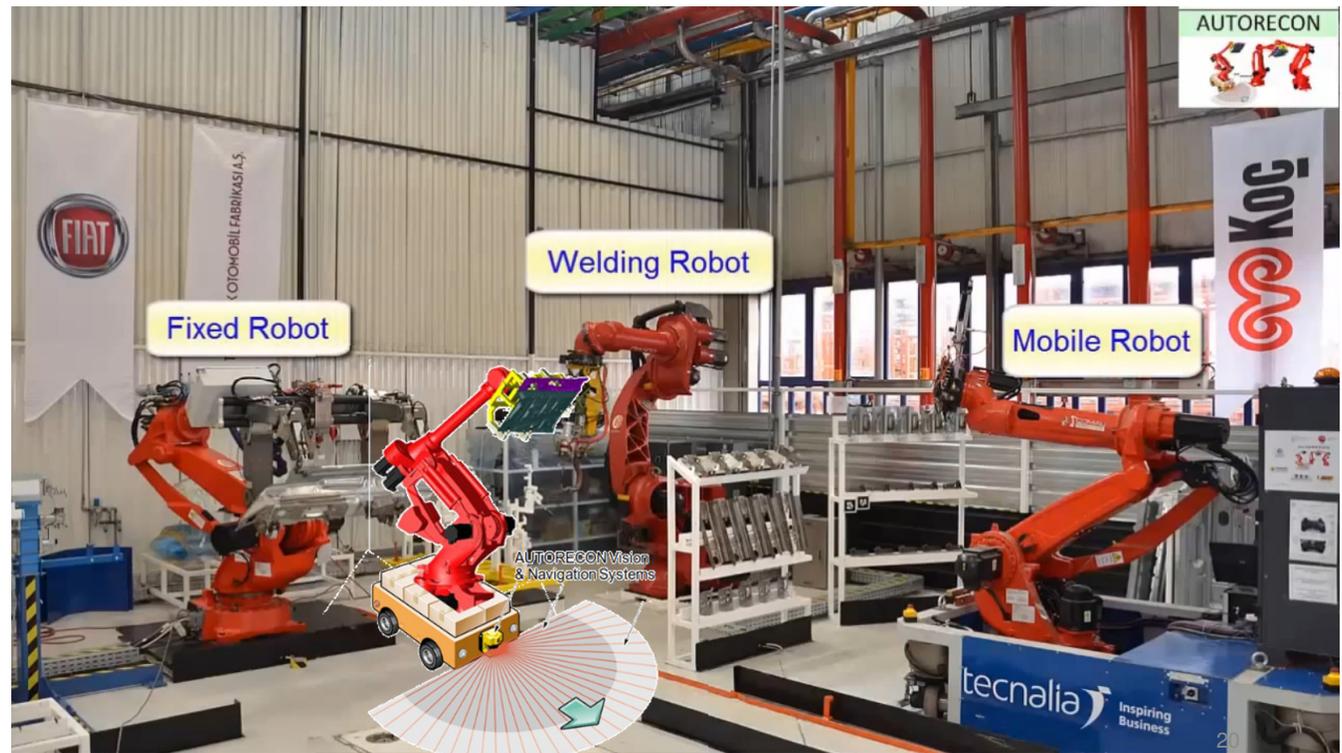
- Flexible reconfiguration of the gripper to handle different parts
- Dexterous manipulation of parts
- Cooperative robots/ robots capable to exchange tools on the run
- Mobile robots to assist other robots in cooperative operations

+

- Robotics for Handling and material call on demand



**Proposal for
EIT 2016**



Examples of current processes and research projects: the future?



- CPS everywhere in the plant
 - Robots
 - Automated vehicles
 - Wearable devices...

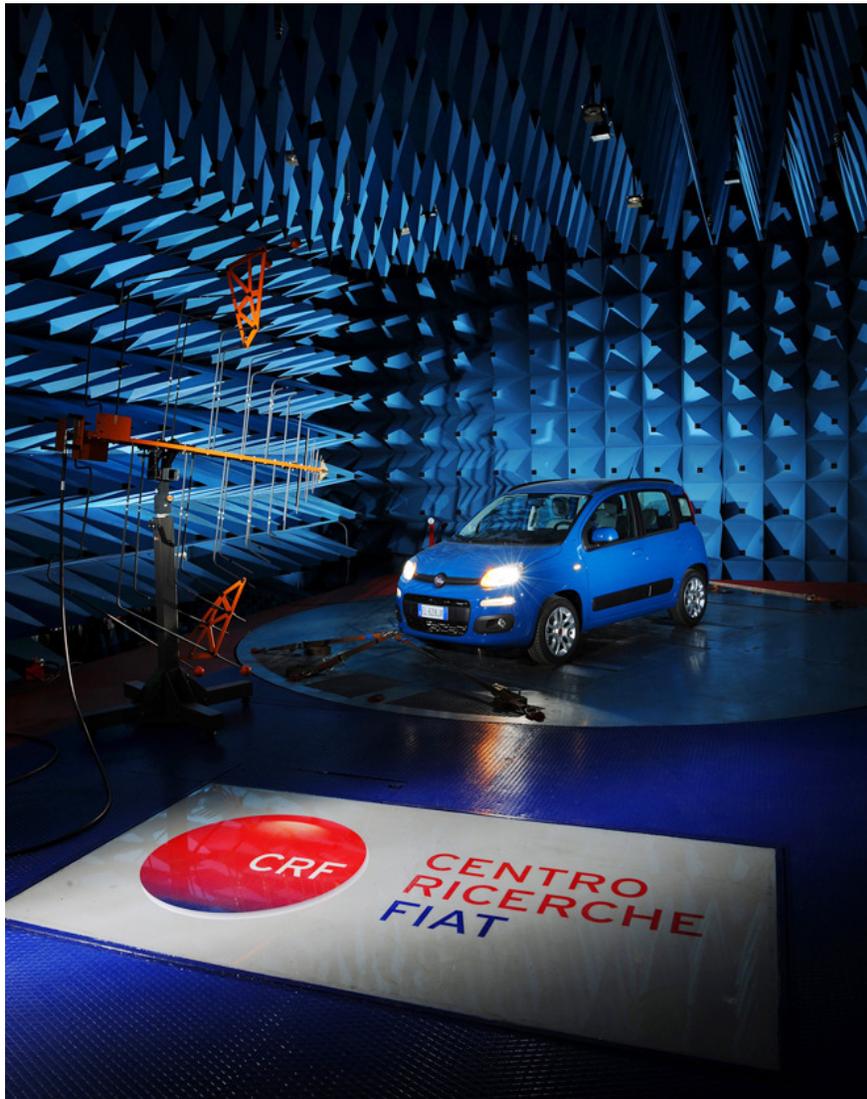
- Networking capabilities

- Interaction capabilities

- Realtime feedback and process improvement

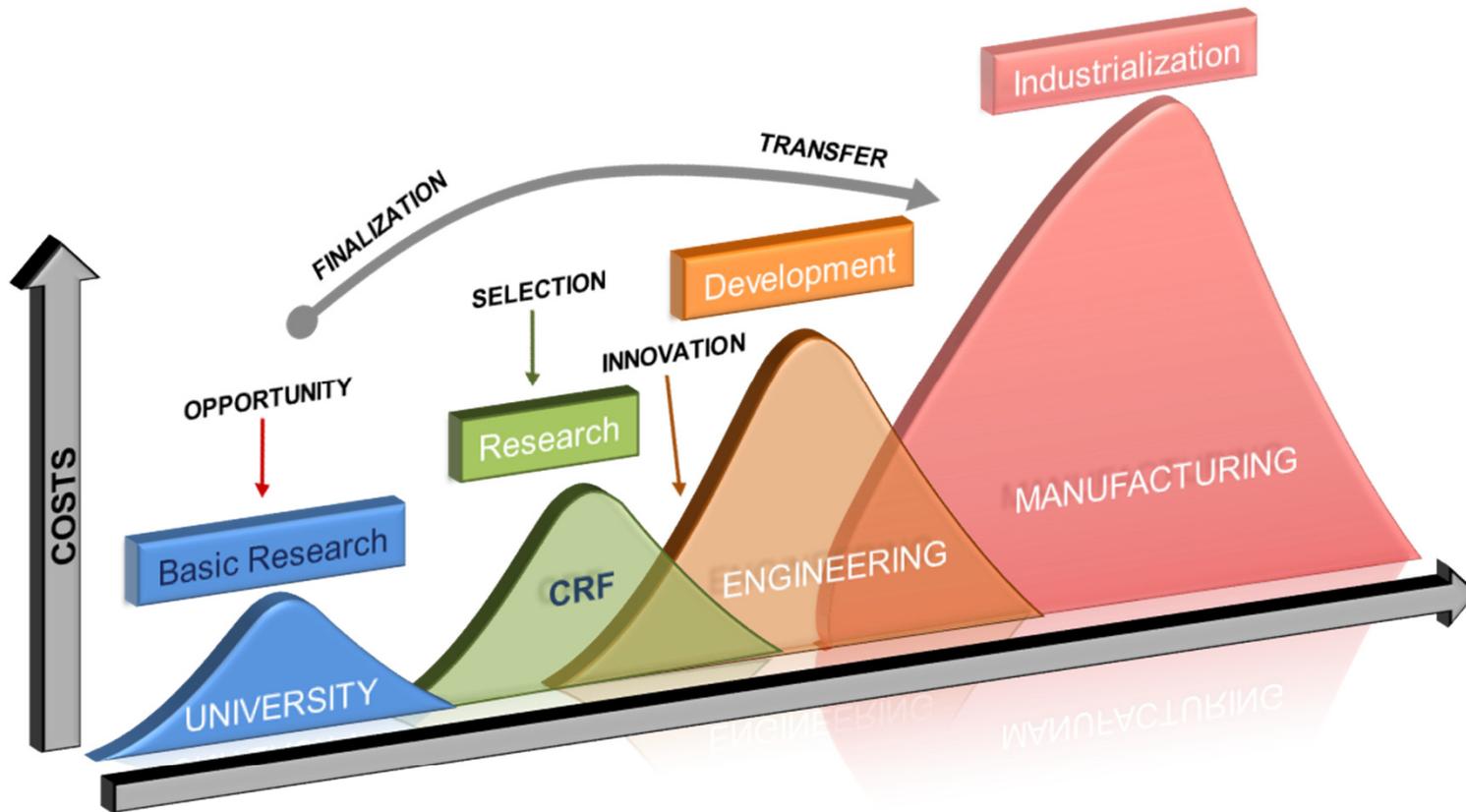


- **Centro Ricerche Fiat was founded in 1978**
- **CRF is the Fiat SpA reference hub for innovation and research**
- **CRF has approximately 1000 employees**
- **CRF has a global network with over 400 Universities and Research Centers**
- **In 2012 CRF owned a patent portfolio of 2726 patent rights, protecting 628 inventions.**



- **CRF has the mission to develop “Strategic Innovation”**
- **This one calls for clearly-defined, agenda-driven Research, formalized into a structured and repeatable process**
- **The aim is creating a tangible difference in the value delivered to customers with respect to both previous generations of Company products and competitors’ ones.**

CRF: technological transfer



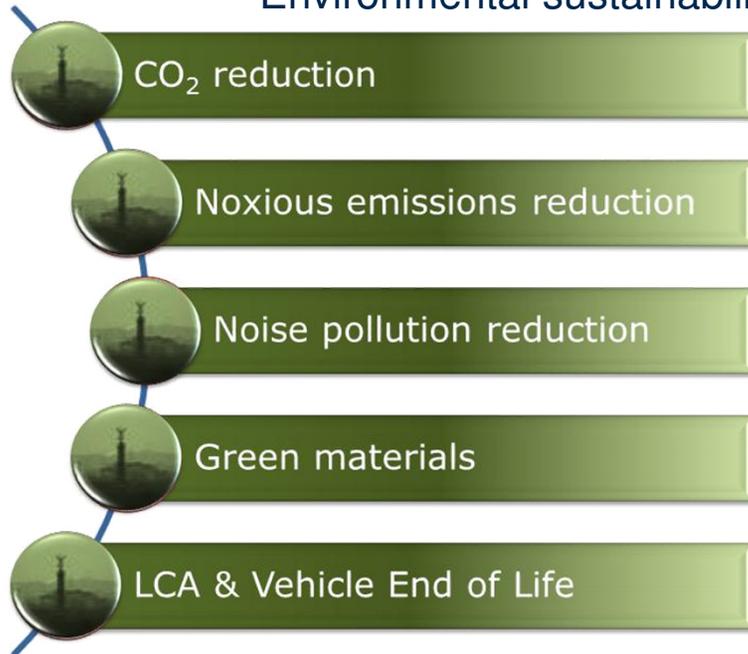
Within Research to Industrialization process CRF is:

- The responsible for FCA medium-to-long term competitiveness
- The main contributor for FCA short-to-medium term competitiveness

The Fiat Strategic Research Agenda Organization



Environmental sustainability



Social sustainability



Competitiveness



The "Strategic Collaborative Research"



Focus on North America (NAFTA)

- USCAR
- USDrive
- Canada

Focus on Europe (EMEA)

- From FP7 to Horizon 2020.
- **Public Private Partnerships (PPP):**
 - Green Cars,
 - Factories of the Future.
- **European Technology Platforms:**
 - ERTRAC: the European Road Transport Research Advisory Council,
 - EPOSS: Smart Systems,
 - MANUFUTURE: Manufacturing,
 - EUMAT: Materials.
- **Joint Undertakings:** Artemis, ENIAC.
- **National and Regional Programs (Italy).**



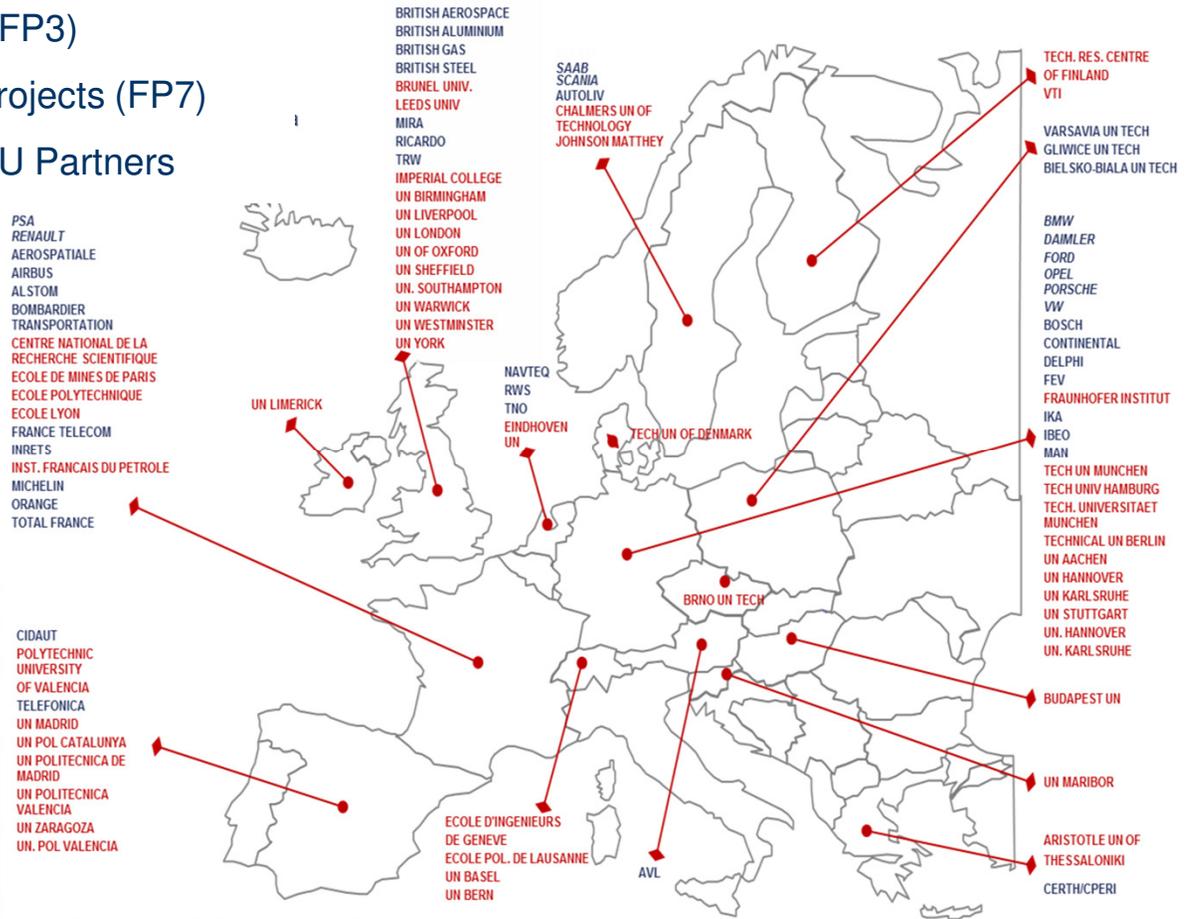
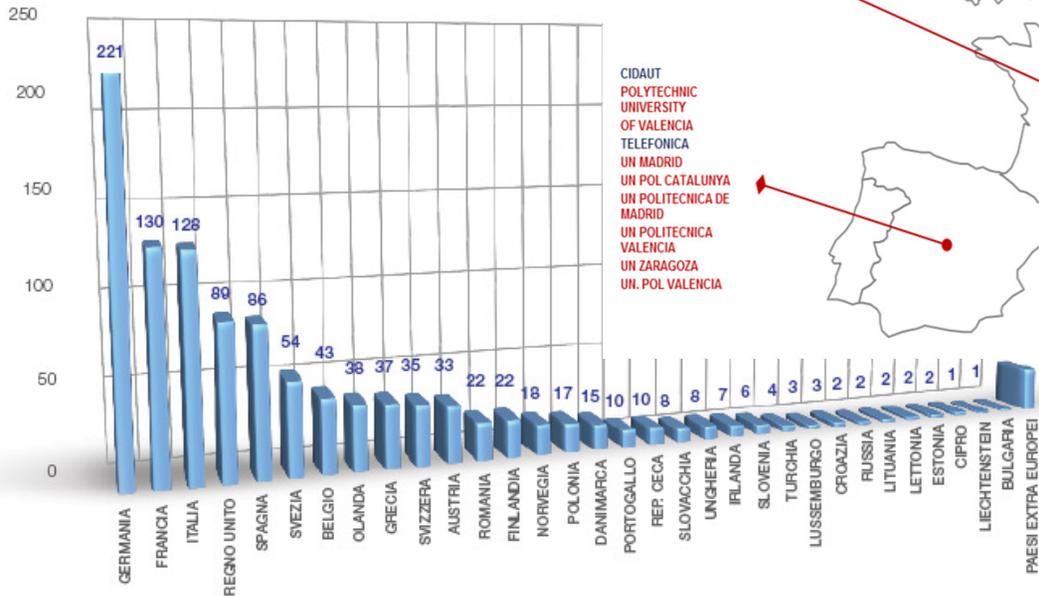
Perspective on other regions (LATAM, APAC)



CRF's commitment to pre-competitive Research & Innovation activities



- Active participation since 1989 (FP3)
- Currently involved in over 100 projects (FP7)
- Collaborations with over 1500 EU Partners
- All projects involve other EU car manufacturers and/or major suppliers



Some research fields



- Real time process monitoring for joining process (laser, MAG, etc.)
- Predictive maintenance
- Design methodologies for flexible production systems
- Methodologies and technologies of energy optimization
- Methodologies and tools for Supply Chain and internal Logistics optimisation
- Real-time production management

Questions?



- Thank you!

- Useful links:
 - Slide 2: www.engineering.com/Videos/ProductDesignChannel/Videoid/3271/The-Future-Of-Factory-Automation.aspx
 - Slide 11: <http://www.micro-epsilon.com/measurement-systems/Paint-Inspection/karosserie/index.html>
 - Slide 16: <https://www.youtube.com/watch?v=3SjLOp155J8>
 - Slide 16: <https://www.youtube.com/watch?v=cCR0Bmw5Txl>