Auto Futures

Operating an Electric Vehicle Microfactory

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MODELS • TECHNOLOGY • SUSTAINABILITY

Changing needs

Electrification is the main growth driver of the market and it is re-shaping the industry with New Players, New Businesses and New Service-based Models

MARKET REQUESTS

- Safety first
- Small EVs: Four/three/two wheels
- Affordable prices and low Total Cost of Ownership
- High connectivity level with high security level
- Personalization

MANUFACTURING NEEDS

- Low investments
- Flexibility and multipurpose platforms
- Blockchain certified “Made in Turkey, Italy, Poland…”
- High convergence with renewable energies: V2H, V2G, V2X

Urban Mobility Opportunities

Vehicles

• e-Bikes are the most widespread: **+50 Millions year** with a further CAGR of 5-7% for the next 5 years

• The highest CAGR is registered for small three (**India >800,000 e-rickshaws in 2017**) and small four wheel vehicles (**China 2.1 Million Low Speed EVs produced in 2018). Including ASIAN** a 50% to 70% CAGR in the next 5 years is likely,

• **Japan** has been the first country experiencing urban concentration and that is the reason why today about 50% of vehicles in the roads are Kei-cars

Operators

- GM's $500 million invested in Lyft and owns Cruise Automation
- BMW's ride-sharing service, ReachNow
- VW's $300 million investment in Gett
- Tesla is going to have its own ride-sharing platform
- Toyota Motor Corp. has backed Uber for an undisclosed amount
- Daimler owns Hailo, MyTaxi, Taxibeat, and Ridescout
- Ford acquired shuttle service Chariot and then bought a majority stake in Argo.AI for $1 billion

Mobility-as-a-Service

USERS

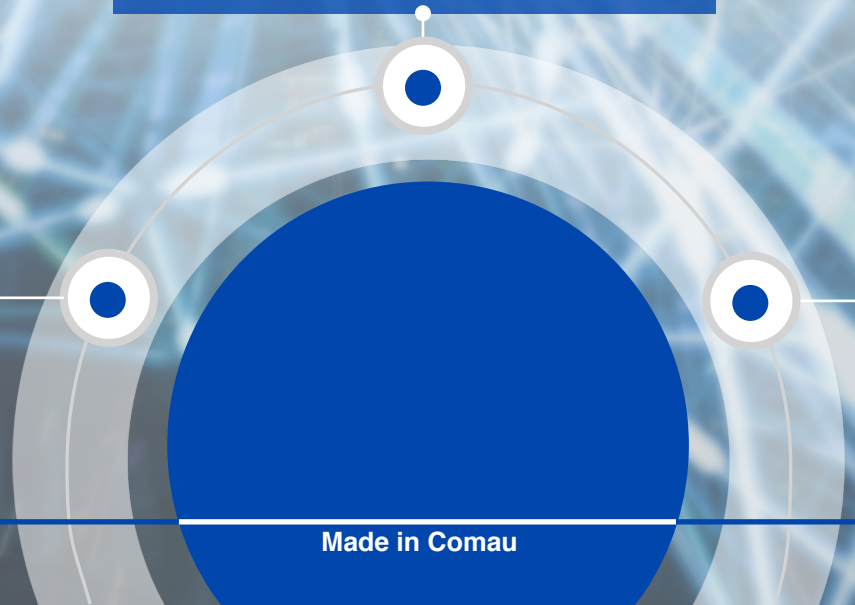
- MaaS dramatically lower costs compared with car ownership
- Successful peer experience will drive more widespread usage of the service
- MaaS requires no investment or lock-in.

PROVIDER

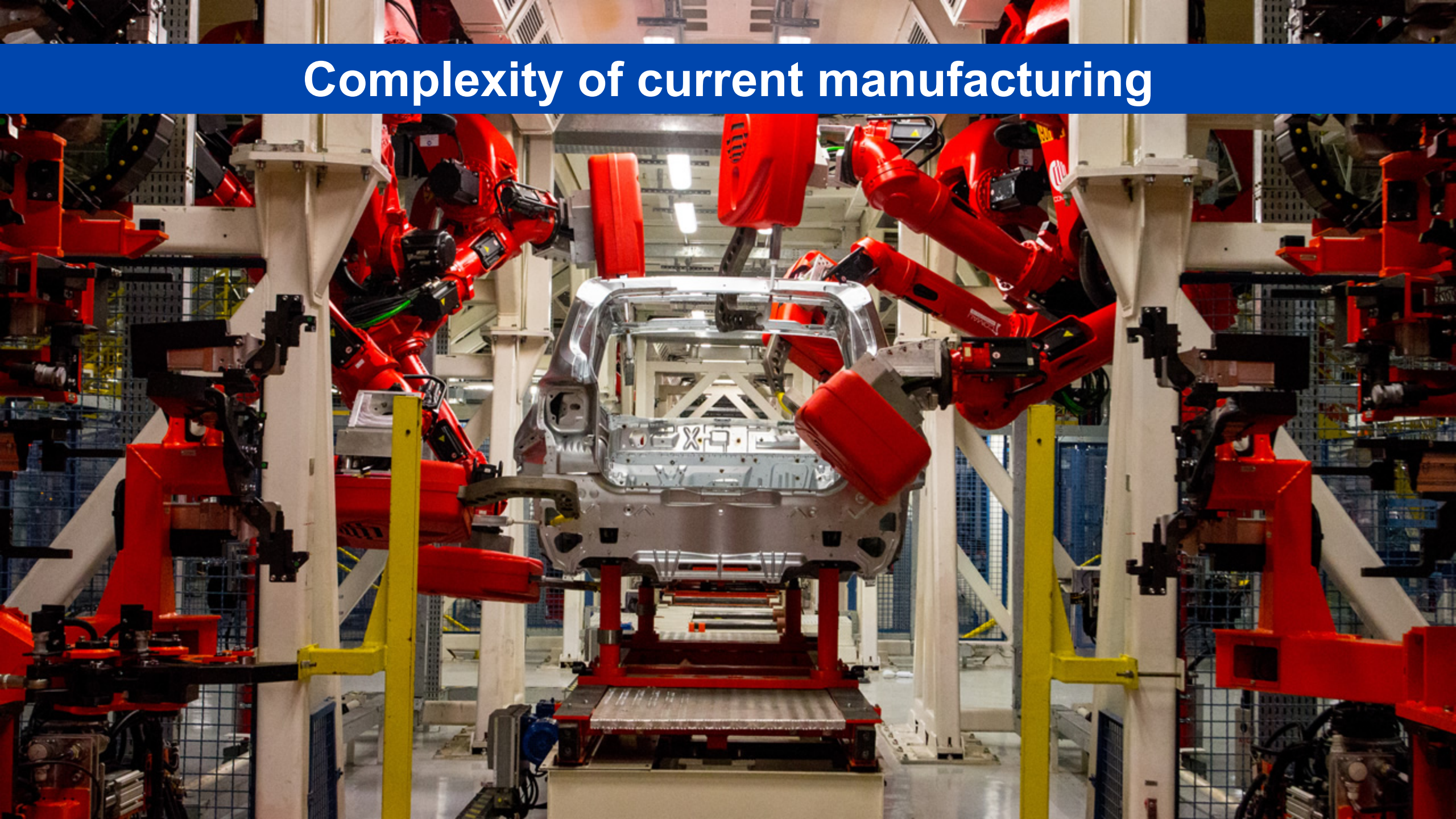
- All technology evolutions are converging toward a dramatic increase of platforms
- No experience to manufacture vehicles and usually purchase from OEMs
- Contribute to save energy and reduce emissions

OEMs

- Higher vehicles utilization impacts manufacturing
- Tend to incorporate MaaS providers
- Make low profits on small EVs and do everything possible to defend their positions.

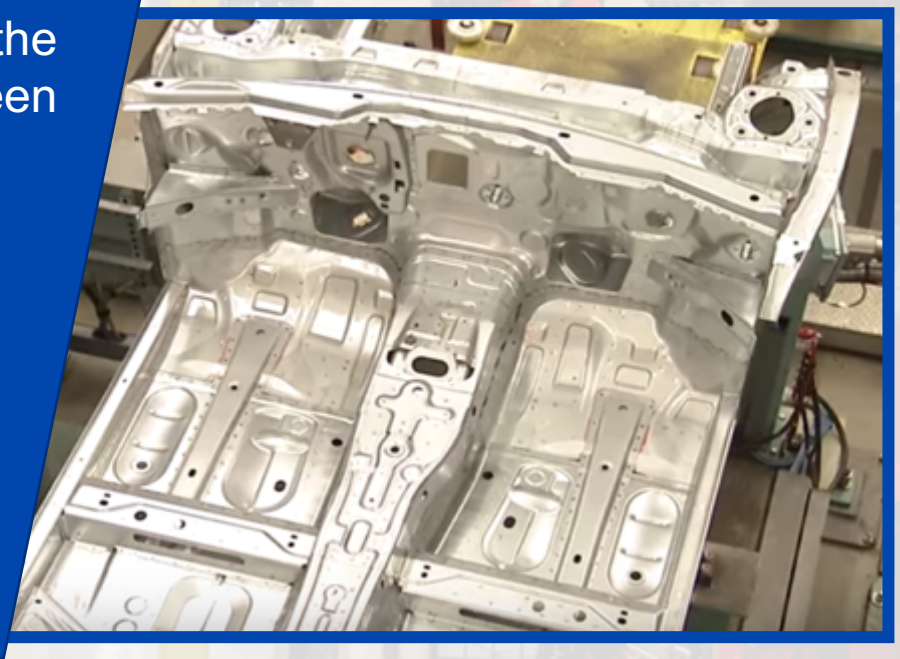


Complexity of current manufacturing



Complexity of current manufacturing

- Complexity of moulds to shape metal sheets in a 3D geometry
- Complexity of tooling to assemble/weld the moulded components
- Lack of flexibility to reconfigure the structure: great difference between chassis with one and two doors
- A large scale mfg line costs >100 M€
- **Large production volumes necessary for acceptable ROIs.**



The Challenge

Develop a production environment capable of:

- Flexible manufacturing implementing Industry 4.0 technologies
- Low cost investment
- Automotive grade suppliers
- Best in class vehicles for safety and performance
- Best in class vehicles and plant for implemented level of security

Microfactory co-developed with Comau

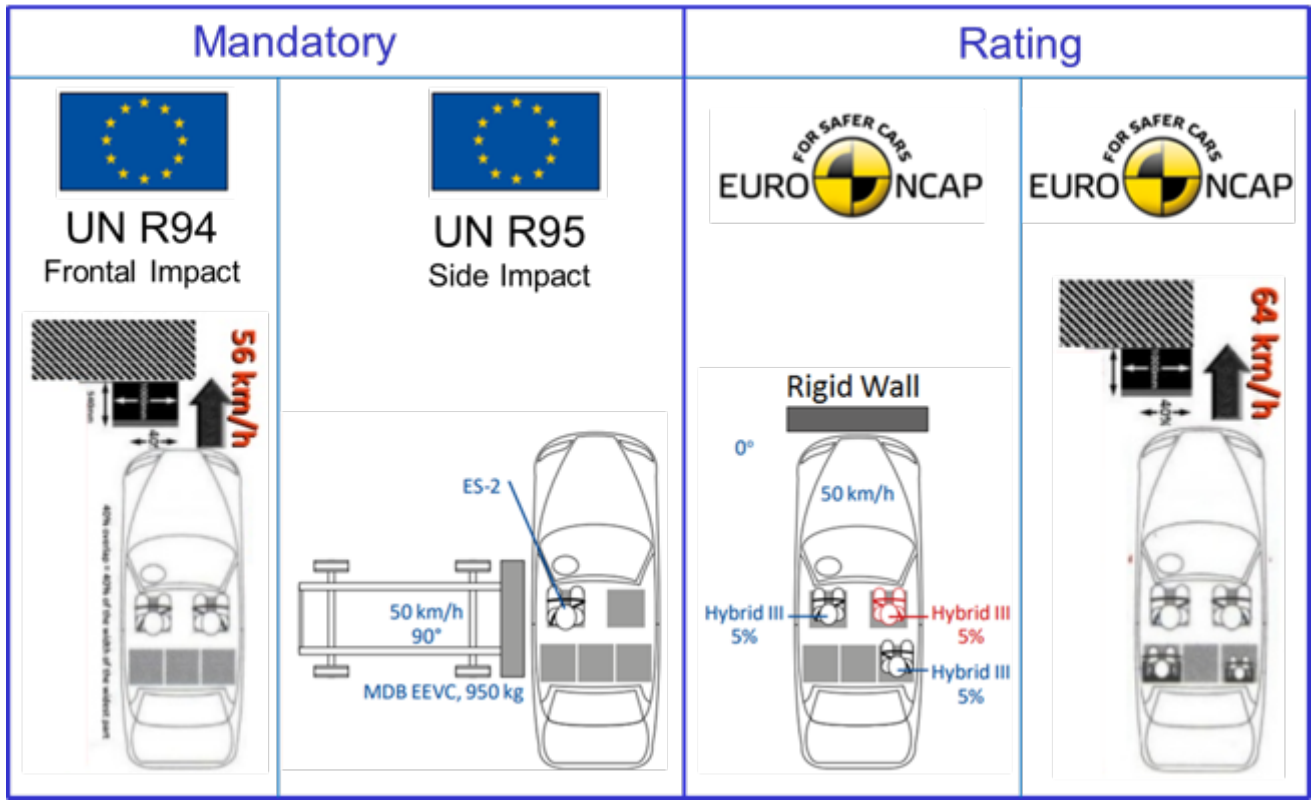
The vehicle architecture

Minimal changes in the chassis to manufacture in a flexible and agile way a variety of vehicles.
Designs worldwide patented.

The vehicle family

Crash Tests

Safety tests performed for all vehicle architectures



cidaut

Código Cliente: E16-1844
Código Interno: E16-1844

2 RESULTADOS DEL ENSAYO TEST RESULTS

Los resultados de este documento únicamente se refieren al objeto sometido a ensayo.
The results shown in this document only concern the sample tested.

2.1 Resultados Biomecánicos Biomechanicals Results

Analysis start time:0.000 s; Analysis end time: 0.160 s

NORMA DE COMPORTAMIENTO DE LA CABEZA *HEAD PERFORMANCE CRITERION*

	CONDUCTOR DRIVER	LÍMITE LIMIT
HPC Head Performance Criterion	543.2	1000 (si hay contacto de cabeza)

NORMAS DE COMPORTAMIENTO DE TÓRAX *THORAX PERFORMANCE CRITERION*

	CONDUCTOR DRIVER	LÍMITE LIMIT
Valor de compresión de costilla superior [mm] Upper Rib Deflection [mm]	2.5 mm	42.0 mm
Valor de compresión de costilla media [mm] Middle Rib Deflection [mm]	9.0 mm	42.0 mm
Valor de compresión de costilla inferior [mm] Lower Rib Deflection [mm]	12.5 mm	42.0 mm
Norma de viscosidadde costilla superior Upper Rib Soft Tissue Criterion (VC)	0.00 m/s	1.0 m/s
Norma de viscosidadde costilla media Middle Rib Soft Tissue Criterion (VC)	0.03 m/s	1.0 m/s
Norma de viscosidadde costilla inferior Lower Rib Soft Tissue Criterion (VC)	0.06 m/s	1.0 m/s

NORMA DE COMPORTAMIENTO DE PELVIS *PELVIC PERFORMANCE CRITERION*

	CONDUCTOR DRIVER	LÍMITE LIMIT
Fuerza Máxima en Sínfisis Púbica (PSPF) [kN] Pubis Symphysis Peak Force (PSPF) [kN]	0.87 kN	6.0 kN

NORMA DE COMPORTAMIENTO DE ABDOMEN *ABDOMINAL PERFORMANCE CRITERION*

	CONDUCTOR DRIVER	LÍMITE LIMIT
Fuerza Máxima Resultante en Abdomen (APF) [kN] Abdominal Peak Force (APF) [kN]	0.53 kN	2.5 kN

PROVISIONAL

Flexible Production Plant for IFEVS

Scope:

- Micro-factory for multi-model portfolio
- Entire plant co-development
- Design for manufacturability
- Standard solution for easy replication

Technologies and Innovations:

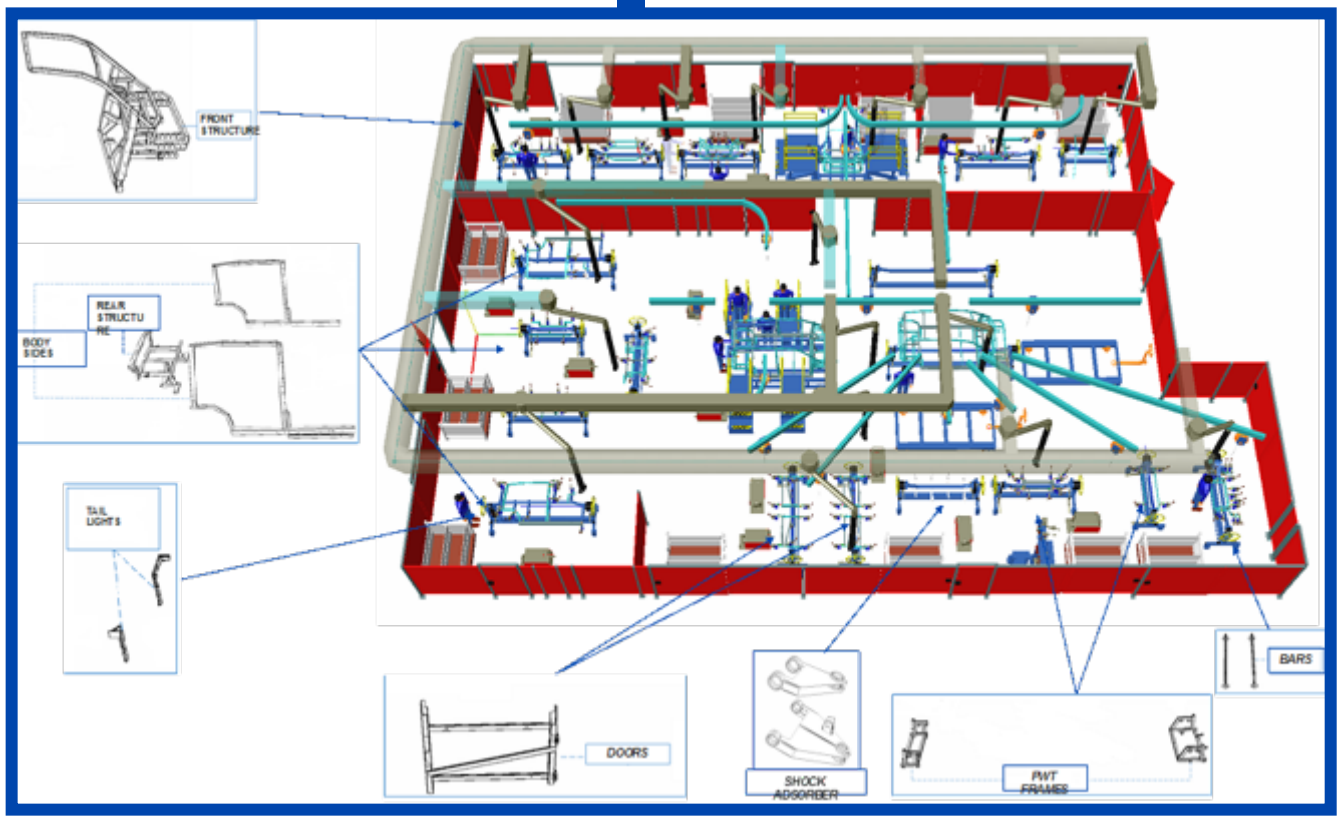
- ✓ Welding, fastening, vision systems
- ✓ In-line testing and quality gates
- ✓ Industry 4.0 architecture

Benefits:

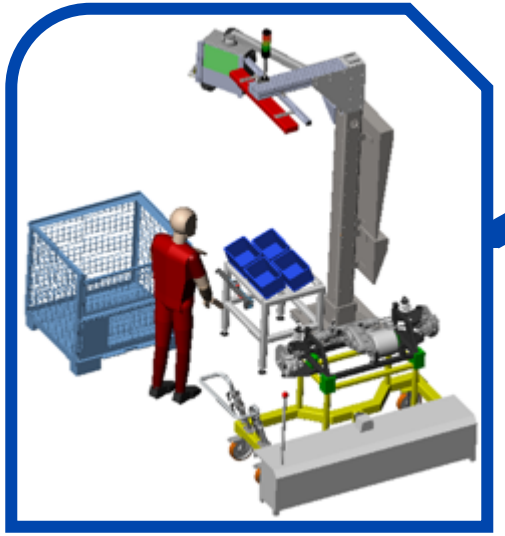
- ✓ Partnering from concept product design to vehicle production launch
- ✓ Scalability: from manual to fully automatized solutions
- ✓ Station Modularity and easy re-configurability

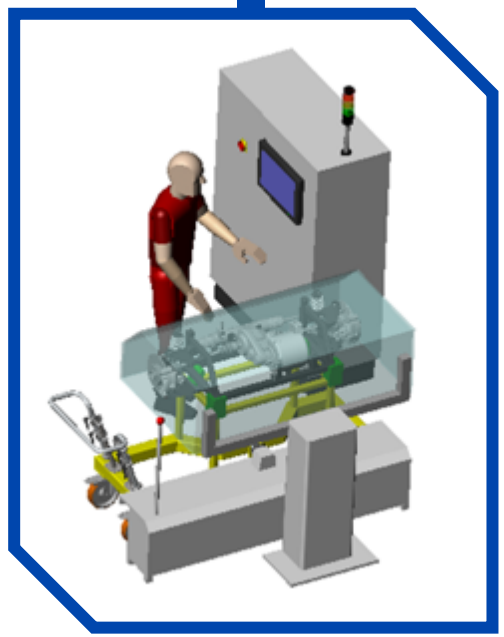
Manufacturing lines

Chassis assembly and welding



Powertrain assembly





Comau Overview

A €1.5 Bn company*

2017 Turnover per area (%)

*Average annual revenue 2015 - 2017

A Brand of FCA FIAT CHRYSLER AUTOMOBILES

31 Locations

15 Countries

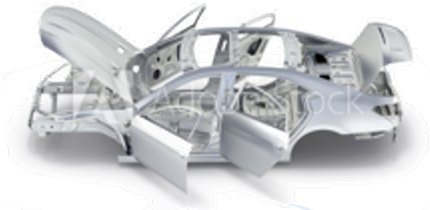
5 Innovation centers

9,000 Employees

14 Manufacturing plants

Comau solutions for E-Mobility from Body to Power Systems

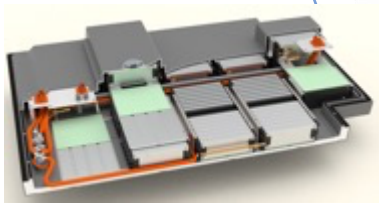
Assembly systems for **Sub-Process** as well as the entire **e-Drive-Line**



Production Systems for **Body Assembly**

Production Systems for **ICE machining** and assembly

Assembly systems for **Battery Modules** and **Battery Pack**



Production Systems for **manual** and **automatic transmissions** machining and assembly

Battery Assembly

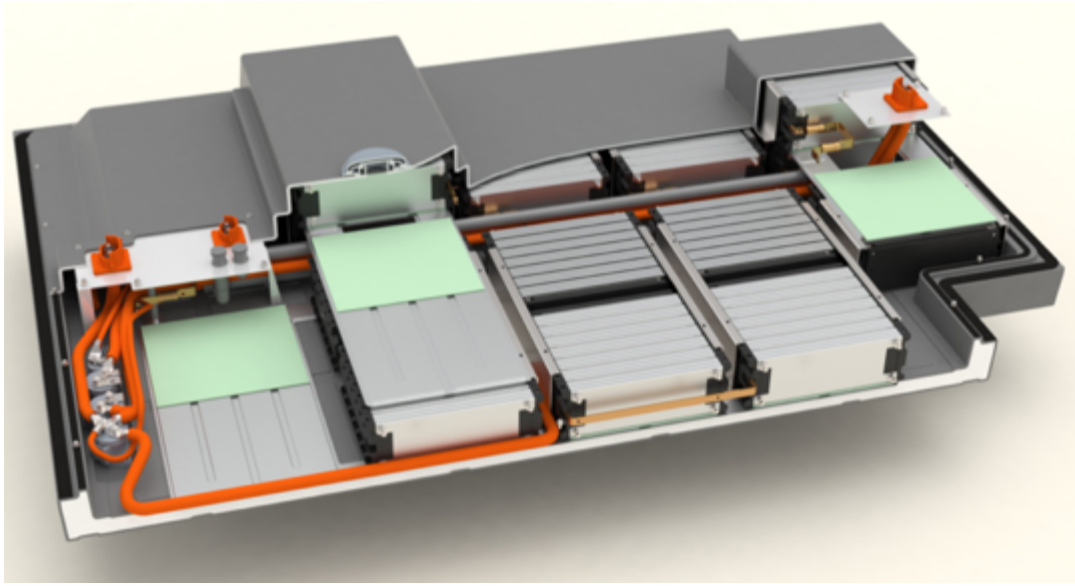
Early manufacturing process validation and prototyping for industrialization

Sector:

Automotive OEM – Luxury Sport Car Brand in Italy

Scope:

Assembly line for Module and Battery Packs for two different models



Technologies and Innovations:

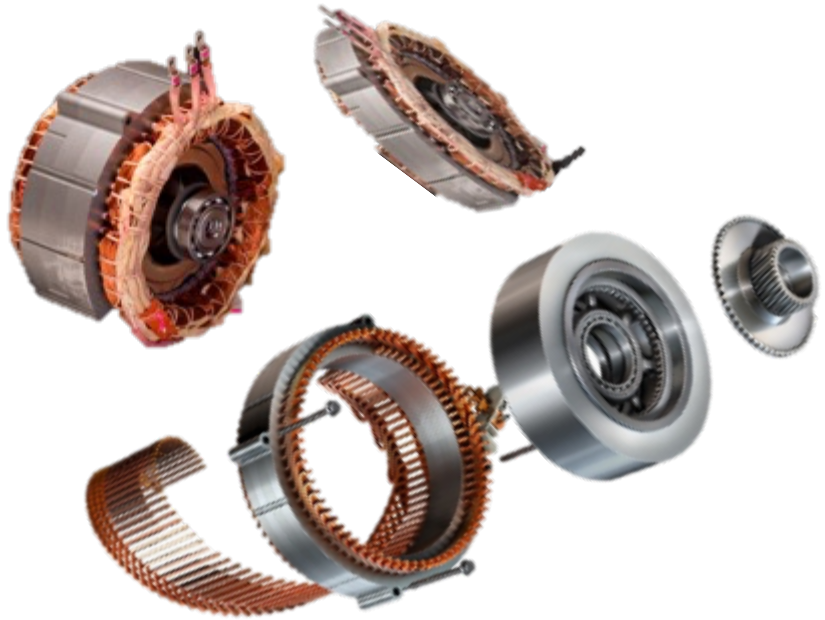
- ✓ Laser Welding **(Comau Lhyte)**
- ✓ Thermography for welding check
- ✓ Thermal paste application
- ✓ Pouch Cell tab cutting and bending
- ✓ Bi-Adhesive film application

Benefits:

- ✓ Short time to market
- ✓ Support Customer in process development of a product still in evolution
- ✓ Comau internal Laser Welding Laboratory for process validation and prototype production
- ✓ Assembly line – Modularity and easy re-configurability

E-Motor Assembly

Fully Readiness for E-motor solutions process development



Sector:
Automotive OEM – Mass Market Brand in Europe

Scope:

- #1 Assembly line for Rotor (120k pcs/year)
- #1 Assembly line for Stator (120k pcs/year)

Technologies and Innovations:

- ✓ Coil winding
- ✓ Impregnation
- ✓ Balancing

Benefits:

- ✓ Integration capability for program involving several technology suppliers
- ✓ Program Management capability
- ✓ Time to market

Body Assembly

Partnered the 1st Customer anticipating the E-Mobility challenge

Sector:

Automotive OEM – Disruptive New Comer Brand for Electrical Vehicle in North America

Scope:

- #1 Complete Body Assembly Production System
- #1 Underbody Assembly Production System

Technologies and Innovations:

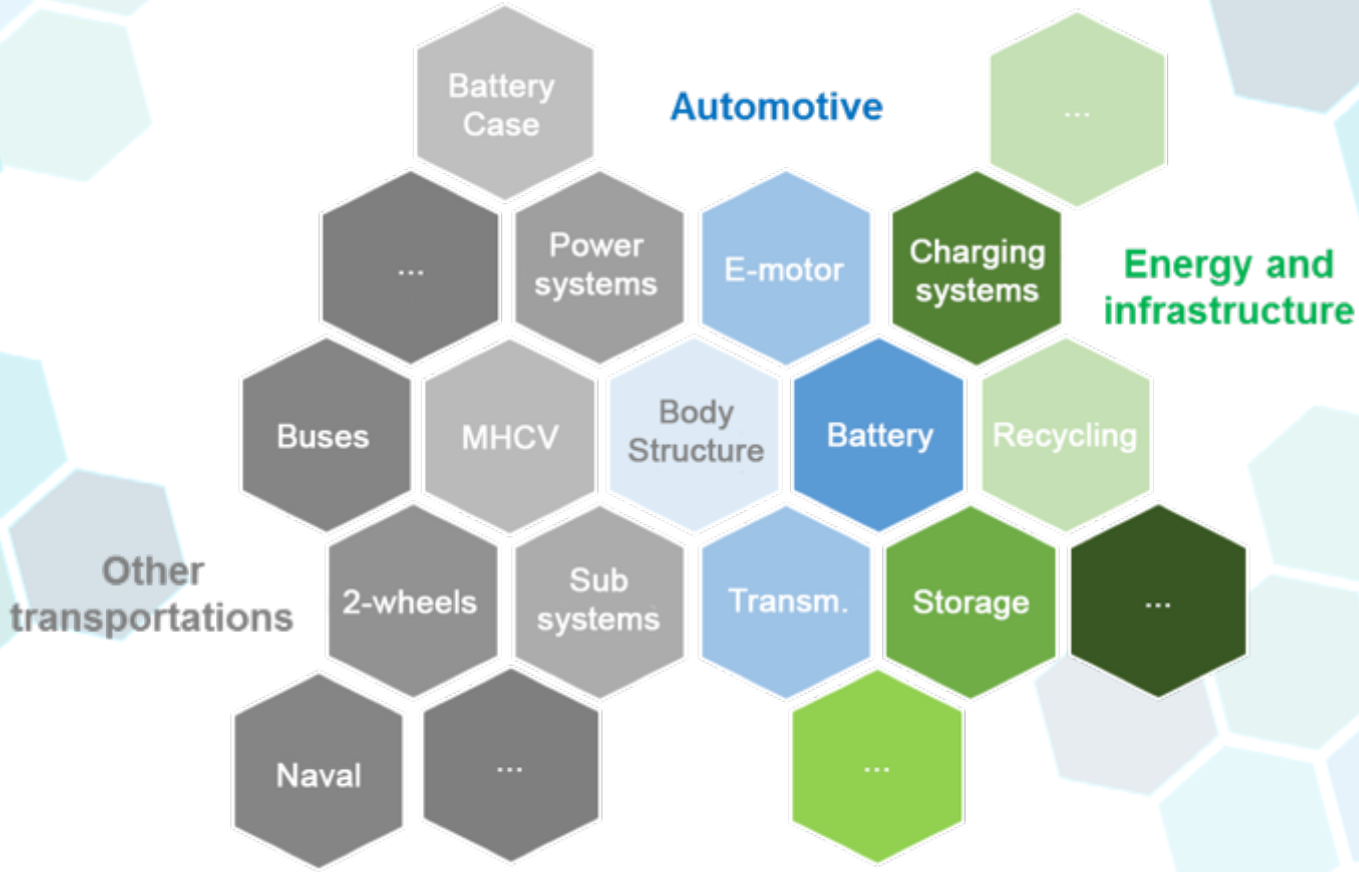
- ✓ Comau Flex
- ✓ Joining technologies for several kind of materials

Benefits:

- ✓ Supporting short time to market vehicle launch for three different models
- ✓ Reduced footprint with high robot density for high automatization
- ✓ Standard Modular e Flexible production systyem

… Comau outlook to a larger E-Mobility Ecosystems

There is a large business ecosystem leveraging on energy and transportation merging driven by electrification



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