Corbetta Plant presentation

Politecnico di Milano, Milan
November 2020, 03th

Ferdinando Lupinacci - Plant Continuous Improvement Manager

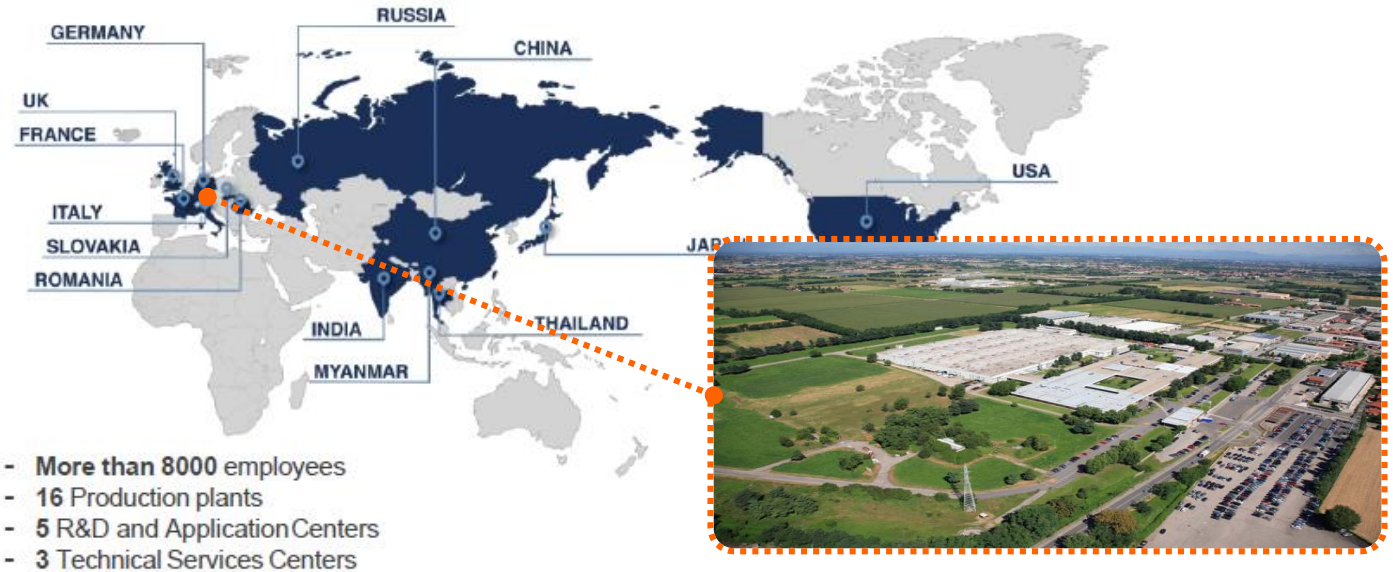
Marelli organisation

Marelli is an international company result of the fusion of two really great global companies Magneti Marelli & Calsonic Kansei, committed to the design and production of hi-tech systems and components for the automotive market.

Marelli organisation

Cockpit Interior	Thermal Systems	Climate Systems	Electric Powertrain	Exhaust Systems

Electronics	Powertrain	Ride Dynamics	Automotive Lighting	Motorsport	After Market



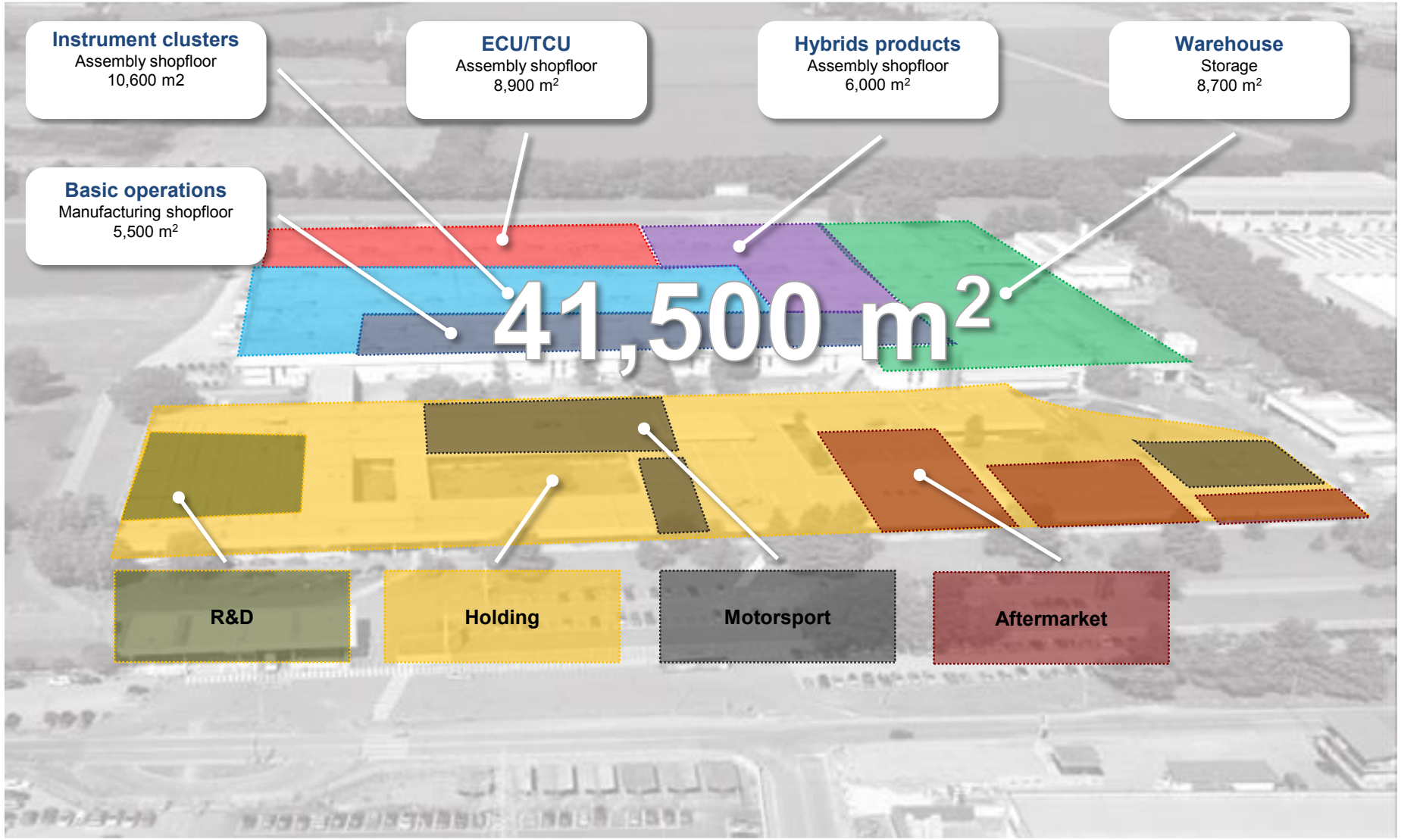
- **More than 8000** employees
- **16** Production plants
- **5** R&D and Application Centers
- **3** Technical Services Centers
- **4** Technical Offices
- **15** Countries

Corbetta (Italy)

Marelli Electronics – MM plants and products

	ECU/TCU/ Smart actuators	Instrument cluster	Body electronics	Infotainment & telematics	Electronics modules	E-products for hybrid applications	Other
Corbetta Italy							
Chatellerault France							
Manesar India							
Hortolandia Brasil							
Tepotzotlan Mexico							
Guanghzou China							
Kechnek Slovakia							

Corbetta district



Plant Certifications

- 2002 ISO/TS 16949:09
- 2004 ISO 14001:04
- 2004 PWT BS OHSAS 18001:07
- 2010 Plant BS OHSAS 18001:07
- 2014 Plant ISO 50001:11
- 2016 Plant ISO 14001:15
- 2017 Plant ISO/TS 16949:09
- 2018 Plant IATF 16949:16
- 2019 Plant ISO 45001:18

1st plant MM worldwide to be certified

Quality management system

Energy management system

Environment management system

Safety management system

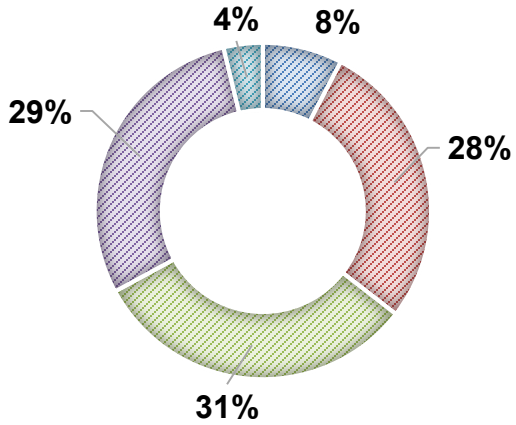
Corbetta Headcount figures

EMPLOYEES DISTRIBUTION

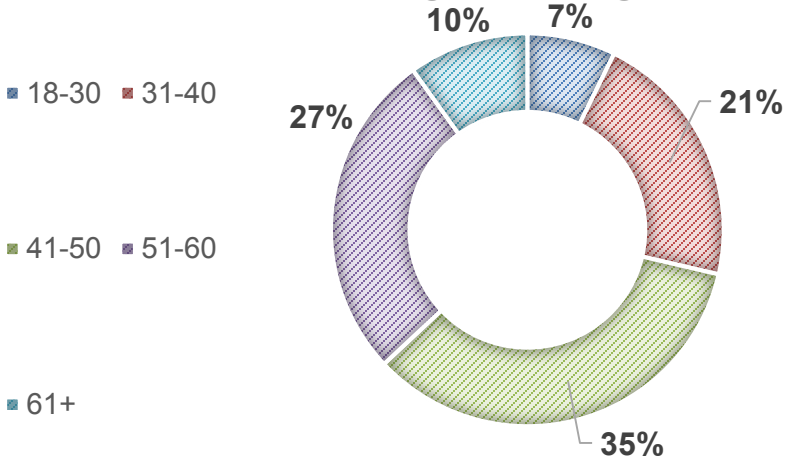
1
172
121
506

800

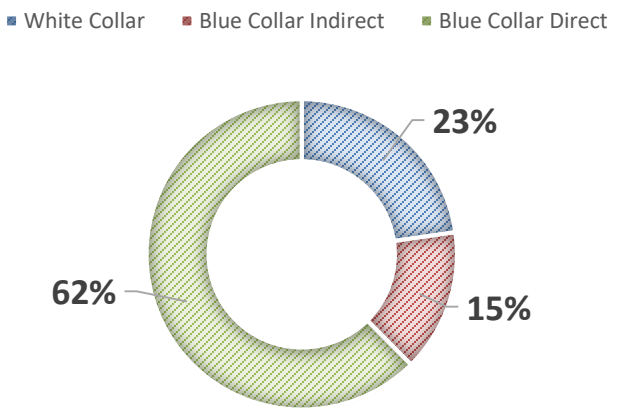
BLUE COLLAR AGE



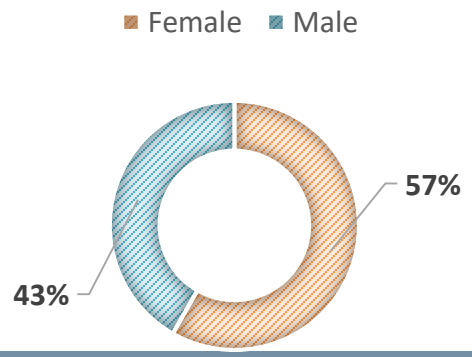
WHITE COLLAR AGE



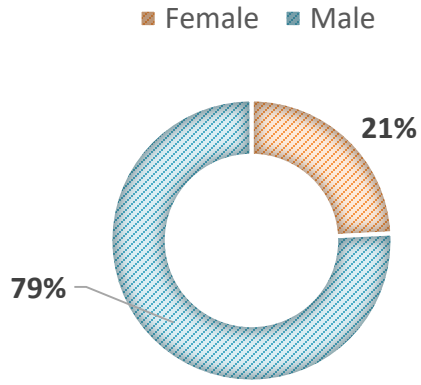
WC/BC RATIO



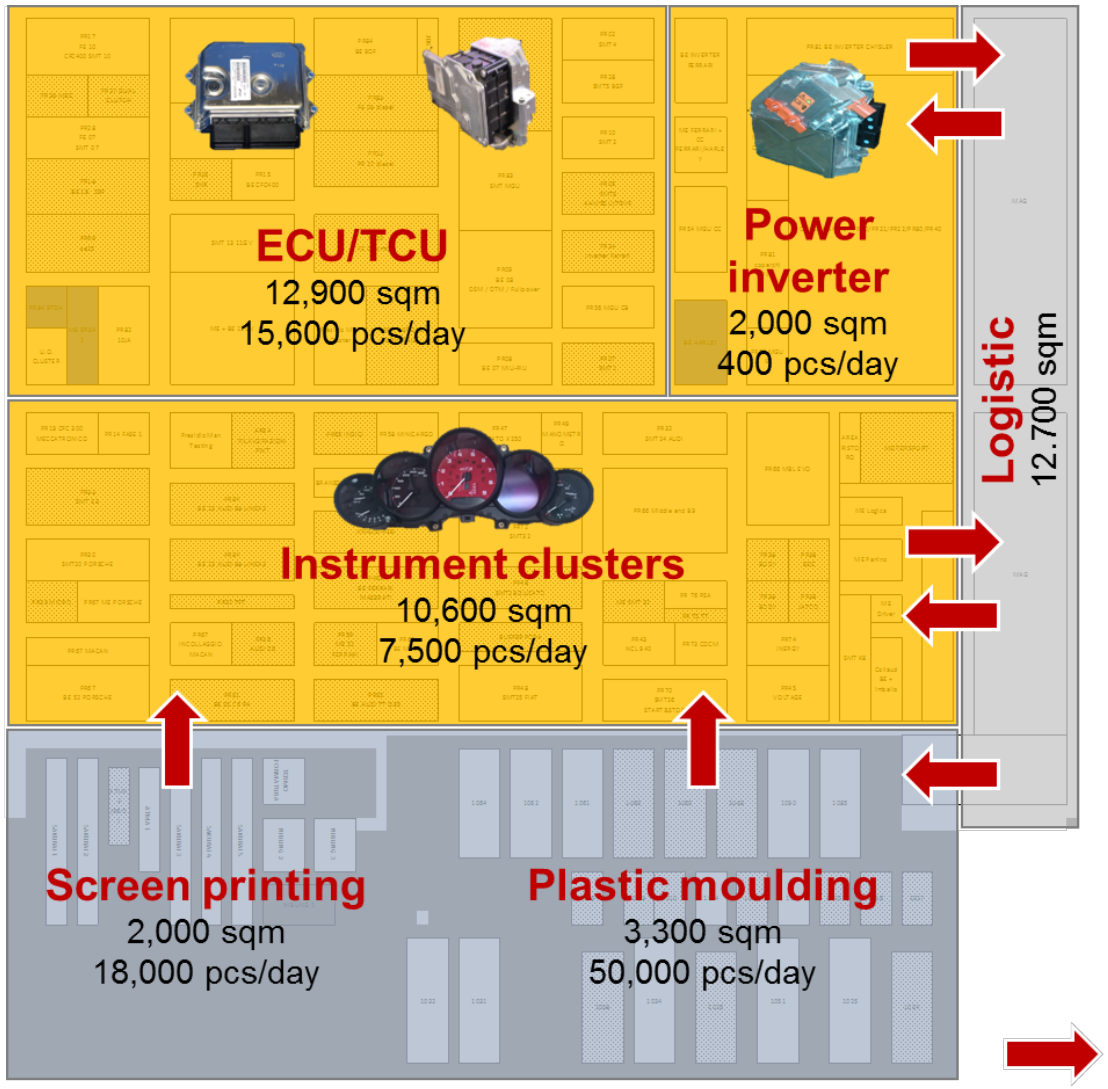
BLUE COLLAR GENDER



WHITE COLLAR GENDER



Corbetta key figures



Total plant area:
41,500 sqm

Total production:
23,500 pcs/day

Revenues (2018 figures):
950 k€/day

Average shifts/wk:
15

Technologies overview: basic operations

- Dials screen printing
- Dials 3D thermoforming
- Thermoplastic injection moulding

Thermoplastic injection moulding

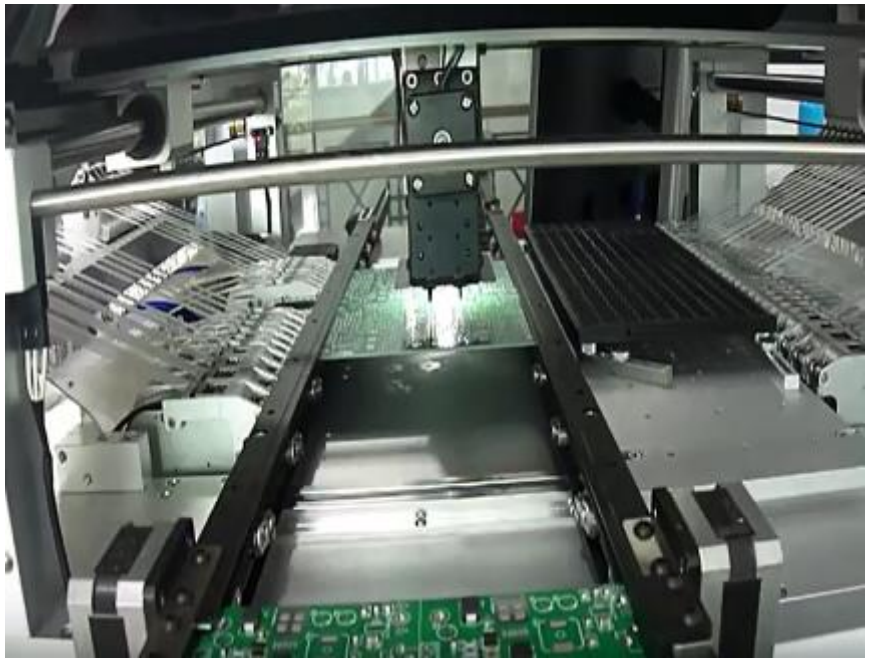
Linear and rotative screen printing lines

3D Thermoforming lines

Daily output

68,000 pieces produced

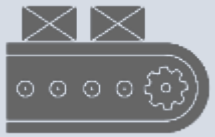
Technologies overview: Front end operations



Surface mounting technology

PCB A for clusters

PCB A for ECUs/TCUs



Daily output

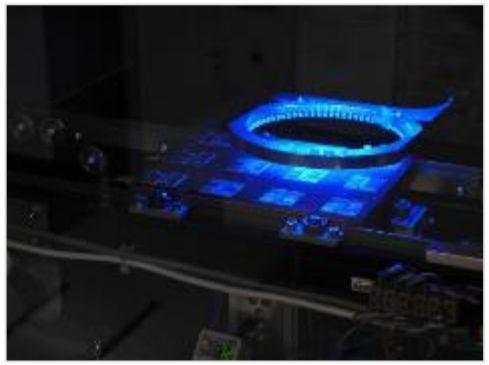
8,500,000 electronic components placed

Technologies overview: Front end operations

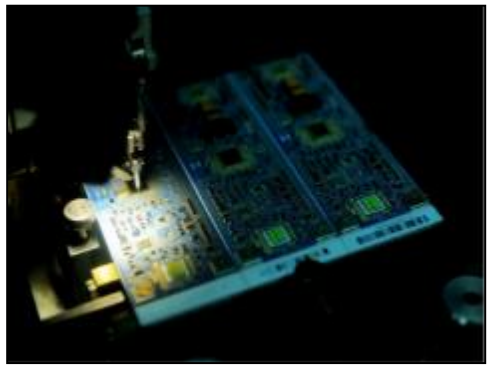
Clean room hybrid technologies:

- Active metal brazing (AMB)
- Screen printing
- Bare die attach
- Substrate attach
- Ribbon and wire bonding

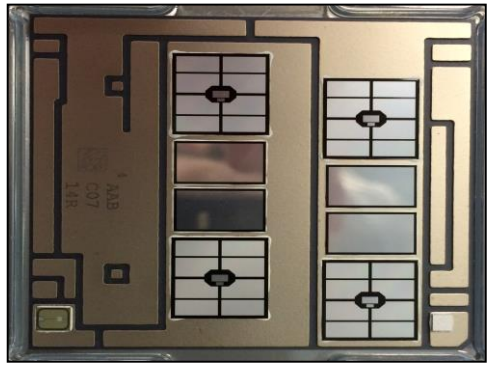
Class 5 clean room according ISO 14644-1



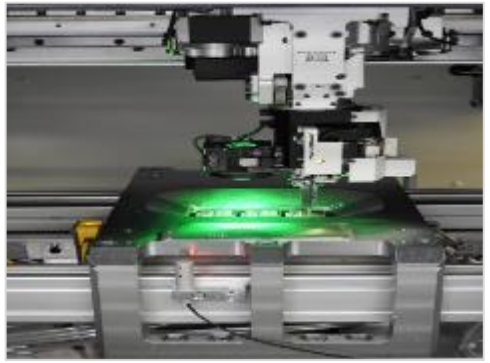
Screen printing



Thick film



Active metal brazing and bare die attach



Wire bonding

Daily output

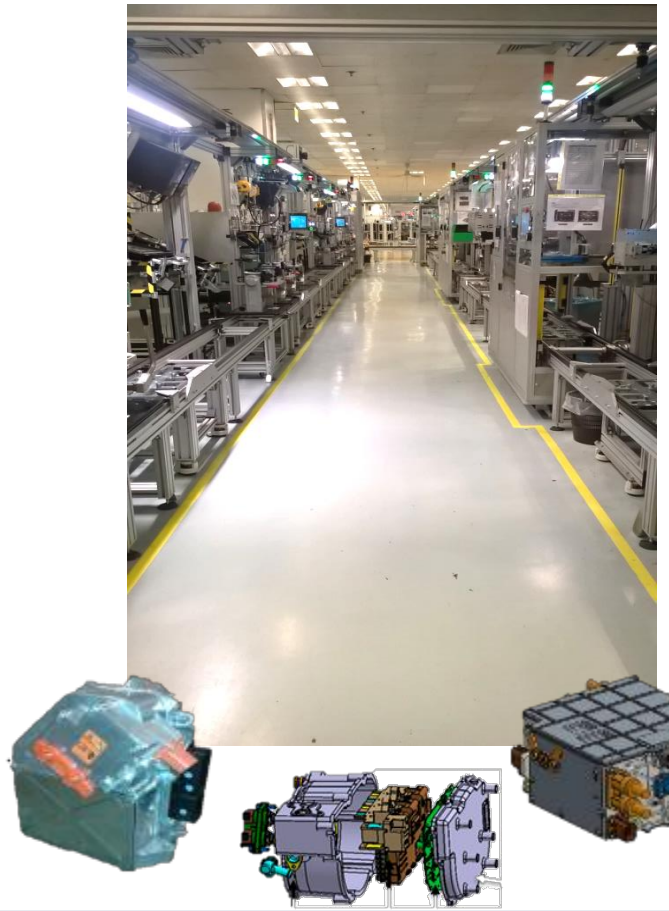
8,500,000 electronic components placed

Technologies overview: Final assembly

Instrument cluster assembly

ECU/TCU assembly

E-products assembly



Daily output

7,500

15,600
pcs. produced

800

Laboratories

Equipments

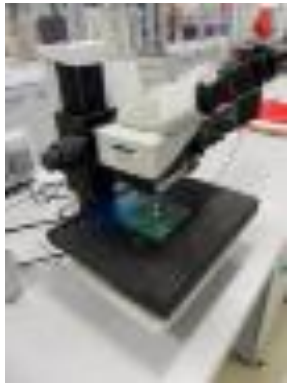
- 2D & 3D automatic optical inspection systems
- X-Ray & tomographic analysis
- High speed camera
- SEM and EDX probe
- FTIR
- DSC
- Optical 3D Metrology
- Acustic emission (Sonoscan®)
- Climatic Chambers
- Others

SEM/EDX analysis

2d/3d X-ray

FTIR

3D dimensional scanner



Metallographic microscope

Differential scanning calorimetry

Project presentation

"*Application of Lean methodology to optimize* Dial Screen Printing Scheduling"

Politecnico di Milano, Milan
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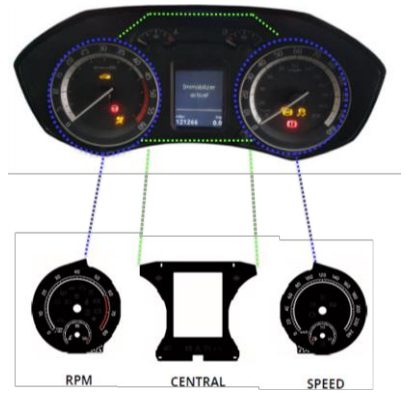
Ferdinando Lupinacci - Plant Continuous Improvement Manager

Case Presentation - Intro

PRODUCT: The case concerns the production of *Screen Printed Dials*: speedometer/accelerometer scales, filters and other aesthetical components inside automobile clusters.
In particular, production follow several steps reported next slide.

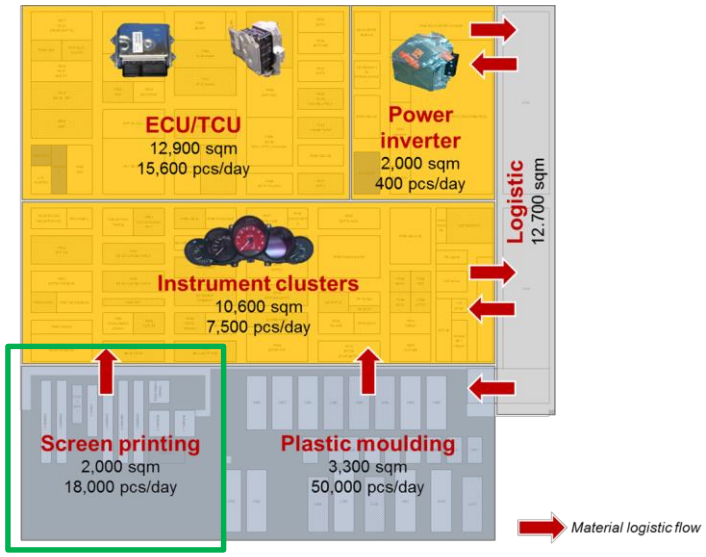


2D and 3D dials example in a cluster

PRODUCTION AREA: The production area inside Corbetta plant related to the case is the *Dial Screen Printing Area*

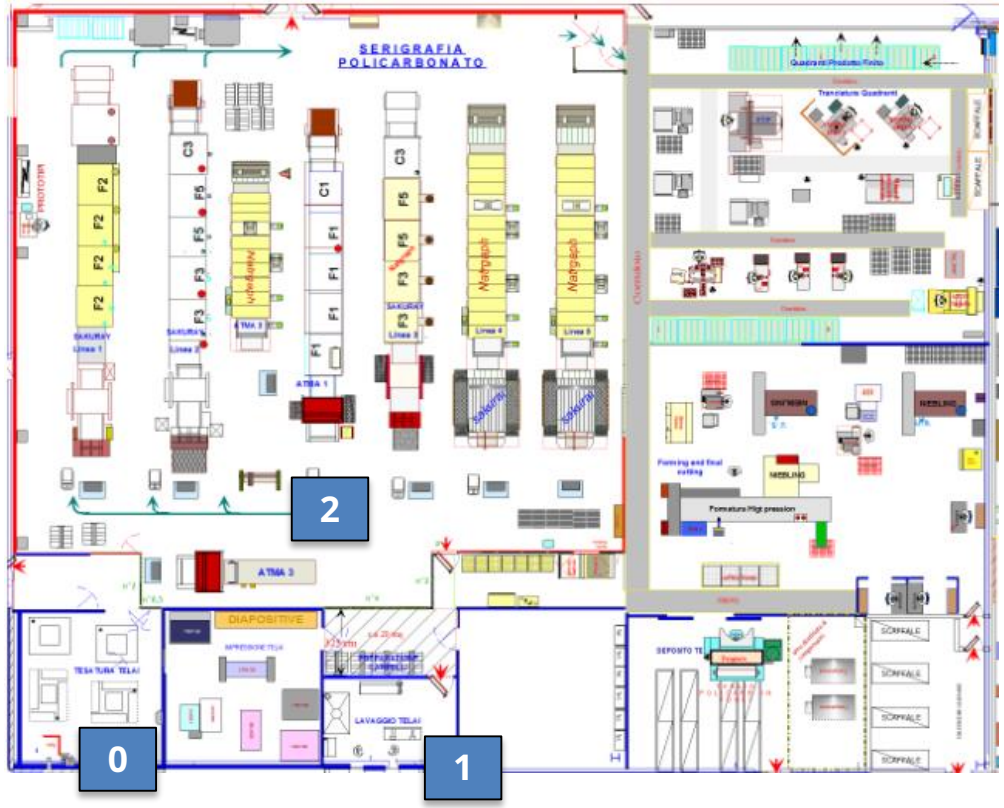
- Some figures:
  - # of produced dials per day: 18.000
  - # of layers per dial: 3 to 17
  - # of production codes: 2.000

- Monitored KPIs :
  - DLL (Direct Labour Losses) [%]
  - OEE (Overall line Effectiveness) [%]
  - Scrap rate [%]



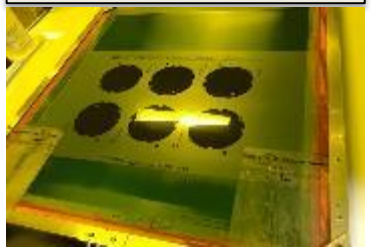
Corbetta Plant

Case Presentation – Process overview



#n time as the number of printing layers

0- Frame preparation

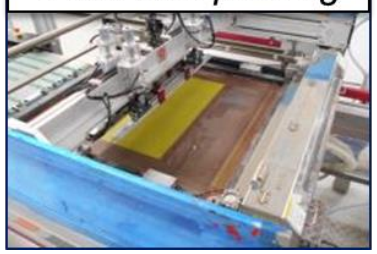


The single specific dial has several layers, for each of these layers must be used a frame produced by UV photo curing.

1-Foil cutting

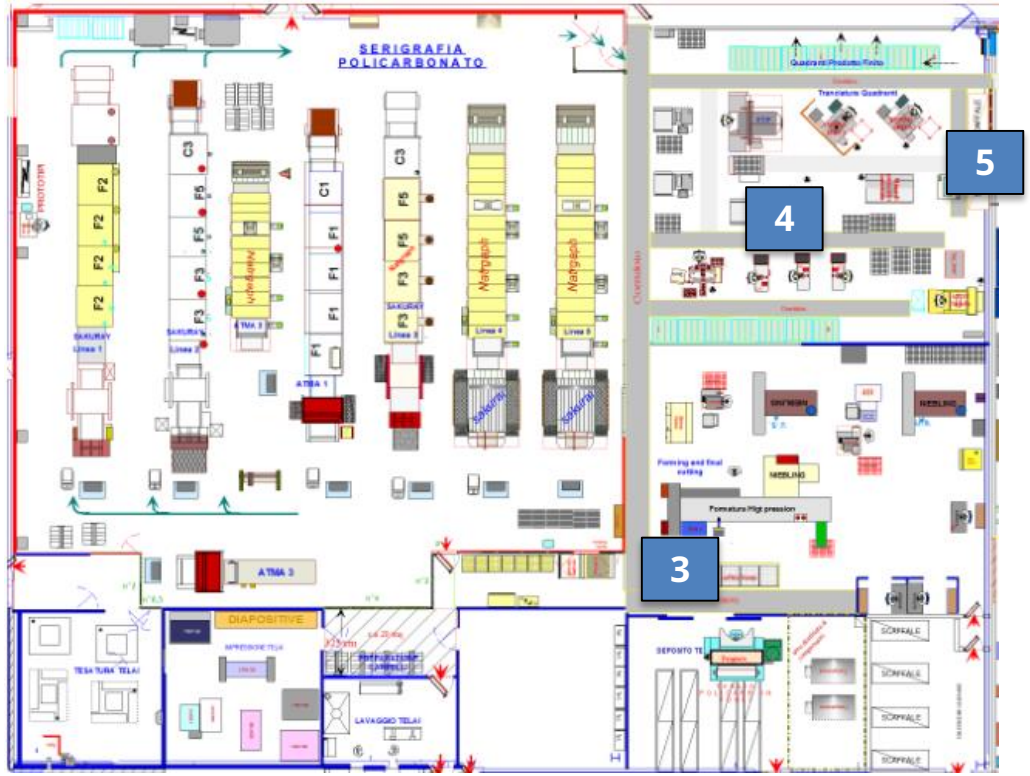
Cutting of polycarbonate coils into foils with specific dimensions.

2-Screen printing



By screen printing process all the layers (colours/shape) of a dial are printed.
5 machines are used for screen printing process.
A code could be not producible on all machines.

Case Presentation – Production Steps



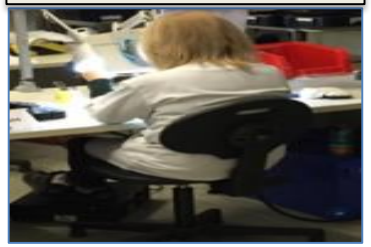
3 - Forming

For the 3D dials before cutting is performed High Pressure Forming.

4-Cutting

Foil from screen printing machines with multiple dials, are cut to obtain single dial.

5- Visual Check



Each dial is visually checked.

Case Presentation - Dial Screen Printing Scheduling

The focus of the work will be on the manufacturing phase devoted to the screen printing and forming of parts of the clusters. This phase requires a batch of products to be produced together.

Due to the wide range of products, the production planning of the components to be produced has a significant impact on the stock levels as well as on the utilization of the production resources.

Specifically, the aim is at investigating managing policies (sequencing) to optimize the overall efficiency of the screen printing phase in terms of:

1. Formalizing and modelling the screen printing area.
2. Collect and structure data related to products, processing times, demand.
3. Develop a scheduling approach to improve the overall equipment efficiency (OEE) of the screen printing area by addressing the reduction of non-productive times (e.g., setup, idle, etc.).

Marelli – Powertrain Systems - Corbetta (MI)
Dial Screen Printing Scheduling

OBJECTIVES:

1. Model the requirements in terms of products and their characteristics, processes and production volumes.
2. Model the production system in terms of layout, routings, capabilities, etc.
3. Analyze current production planning approaches and investigate possible directions for improvement.
4. Investigate optimized scheduling approaches considering the data and the constraints coming from the shop floor.

METHODOLOGIES:

A. Manufacturing systems modelling

B. Managing policies (scheduling, batching)

C. Optimization approaches (mixed integer programming, dedicated algorithms)

D. Data analysis