



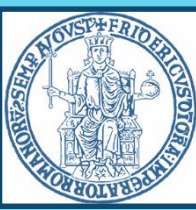
ADLER GROUP

SEMINARIO INTERDISCIPLINARE DI CULTURA AERONAUTICA

Le produzioni di grande serie di parti in Composito

15 Aprile 2016

R. Letizia



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- ❖ Adler and composite

- ❖ Aerospace to Automotive

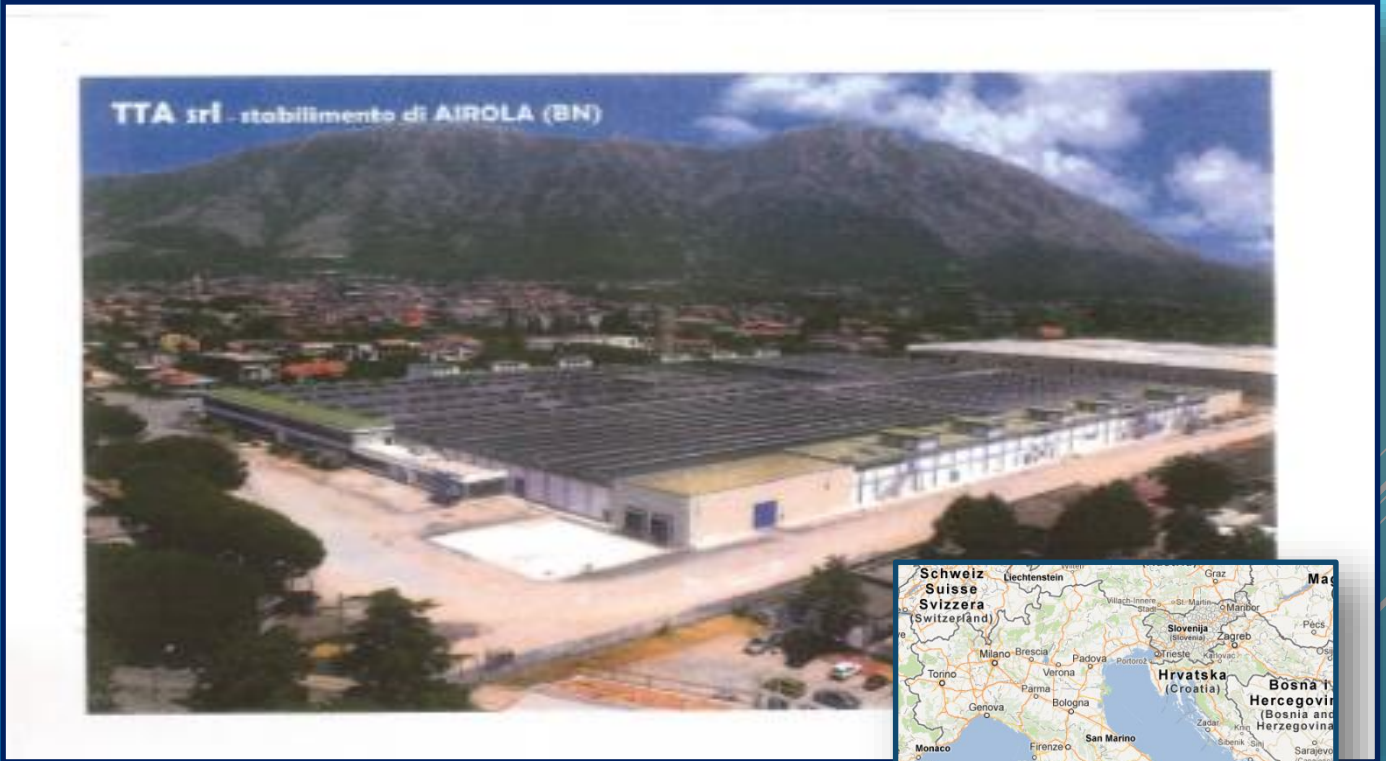
- ❖ Composite materials in automotive (Why and When?)

- ❖ Main Composite technologies vs applications and market fields:
 - ▶ Autoclave and press prepreg hand lay up
 - ▶ PCM (Prepreg Compression Molding)
 - ▶ Thermoplastic Compression Molding
 - ▶ Adler Group experiences

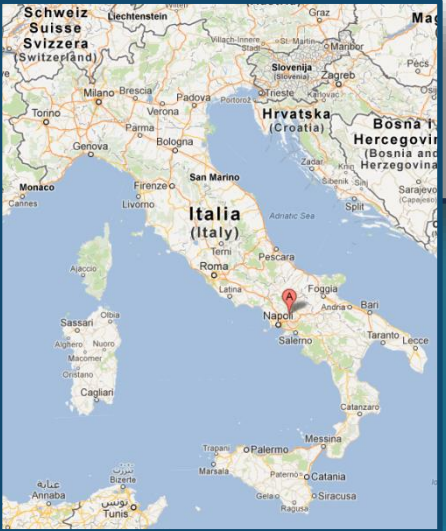




- **TTA** plant was born to create an entity dedicated to innovative components, products and systems in composite material (Automotive/ Aerospace)
- **TTA** has started the production in June 2013
- Composite production:
 - Total of 559 employees
- The site is also engaged in Research and Development



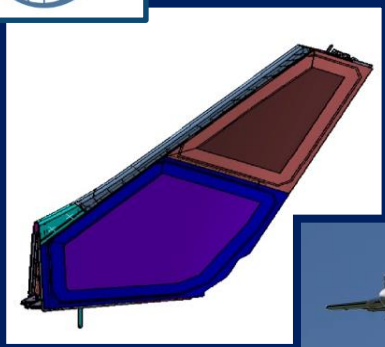
TTA COVERED AREAS
Production area : 37,950 sqm
Offices: 2,100 sqm



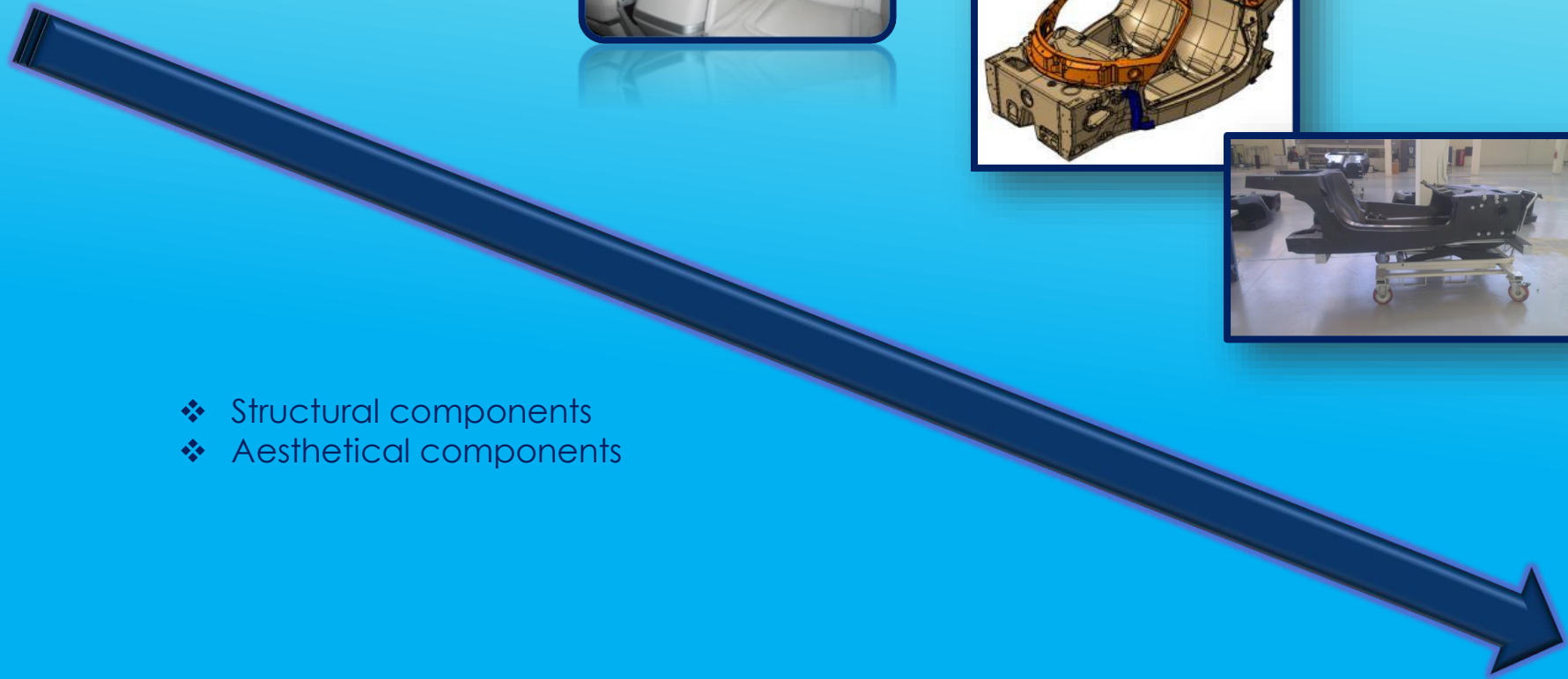


Aerospace and automotive sector

- ❖ Autoclave and press prepreg hand lay up
- ❖ PCM (Prepreg Compression Molding)
- ❖ RTM (Resin transfer Molding)
- ❖ Thermoplastic Compression Molding



- ❖ Structural components
- ❖ Aesthetical components



Why composite materials in automotive?

MAIN DESIGN DRIVERS IN AUTOMOTIVE APPLICATION

WEIGHT REDUCTION

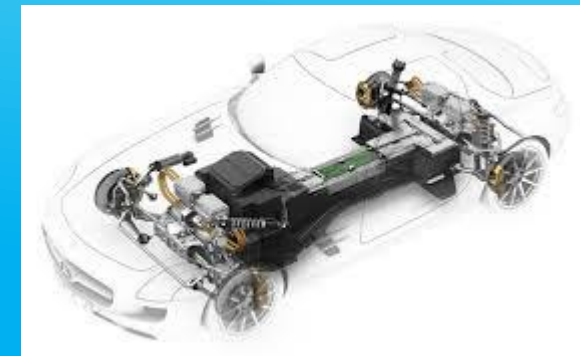
- CO2 emissions
- Fuel consumptions
- Engine performances

For HYBRID/ELECTRIC drive vehicles weight saving is a MUST



STRUCTURAL PERFORMANCES

- Safety (Crash worthiness)
- Drive comfort





Composite Materials in automotive



When do the replacement of traditional materials with Composites make sense?

At the current state of art, when **weight saving** and/or **“emotional feeling”** to give the customer , **and not costs**, are the main drivers:

- Racing / Super cars / Niche programs
- Luxury cars/Hybrid – Electric drive cars
- Special editions of “High volumes” programs



Alfa Romeo 4C

Very first application of composites in automotive



Ferrari F1



La Ferrari



New Audi A8



BMW i3



BMW i3

More recent applications



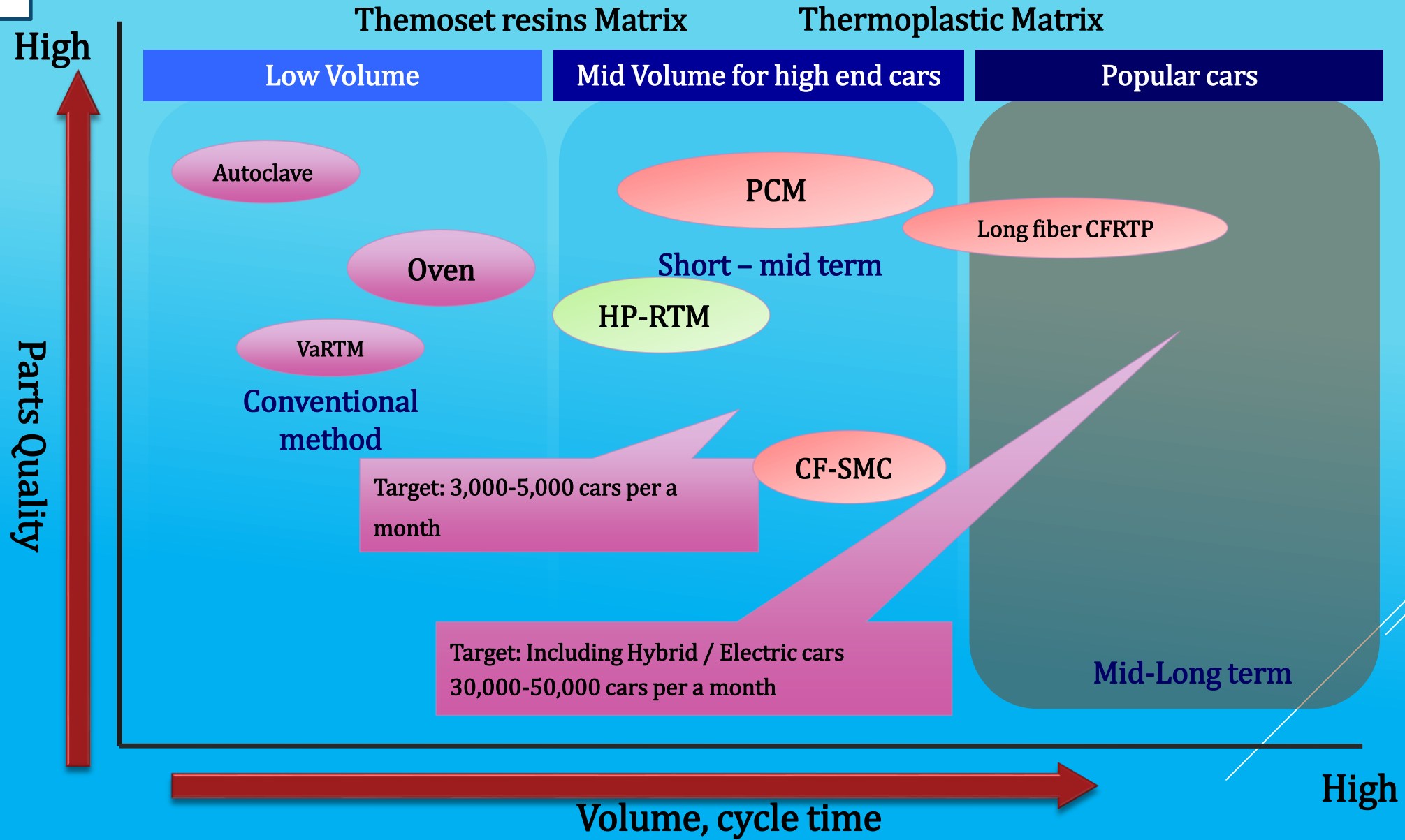
Alfa Romeo Giulia Quadrifoglio



Fiat 500 Tributo Ferrari



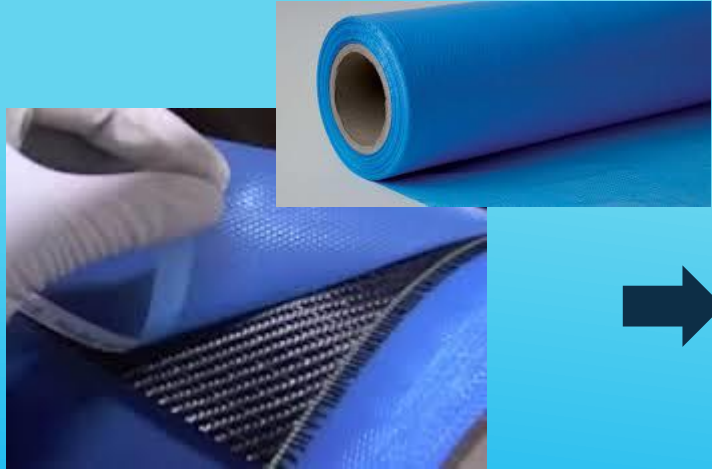
Main Composite Technologies vs applications and market fields





Main Composite Technologies vs applications and market fields

PREPREG HAND LAY UP- AUTOCLAVE



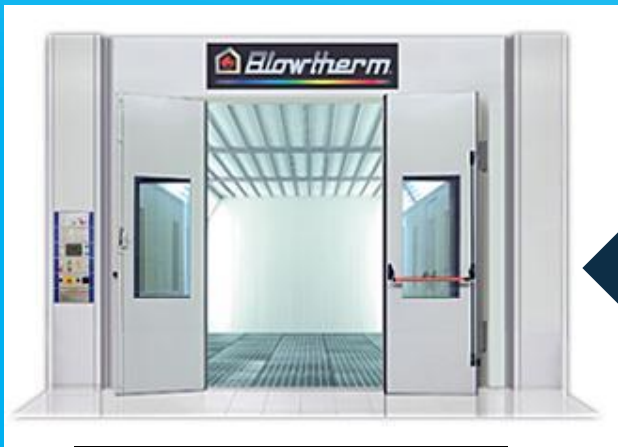
PREPREG



CUTTING



HAND LAY UP



FINISHING



CNC MACHINING

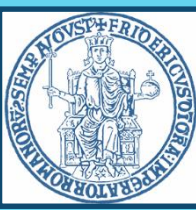


AUTOCLAVE CYCLE

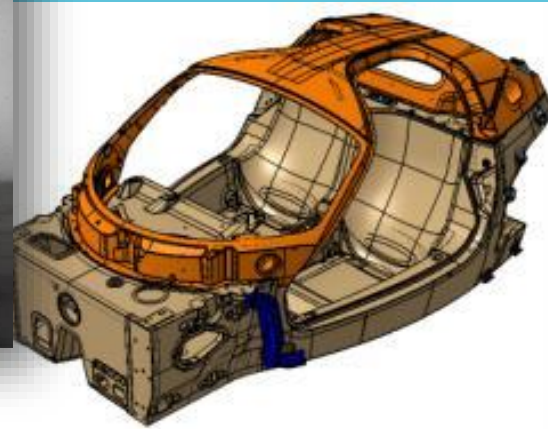




Adler Group experiences



PREPREG HAND LAY UP AUTOCLAVE TECHNOLOGY – STRUCTURAL COMPONENTS



ALFA ROMEO AR 4C CHASSIS
(Up to 20 parts/Day)



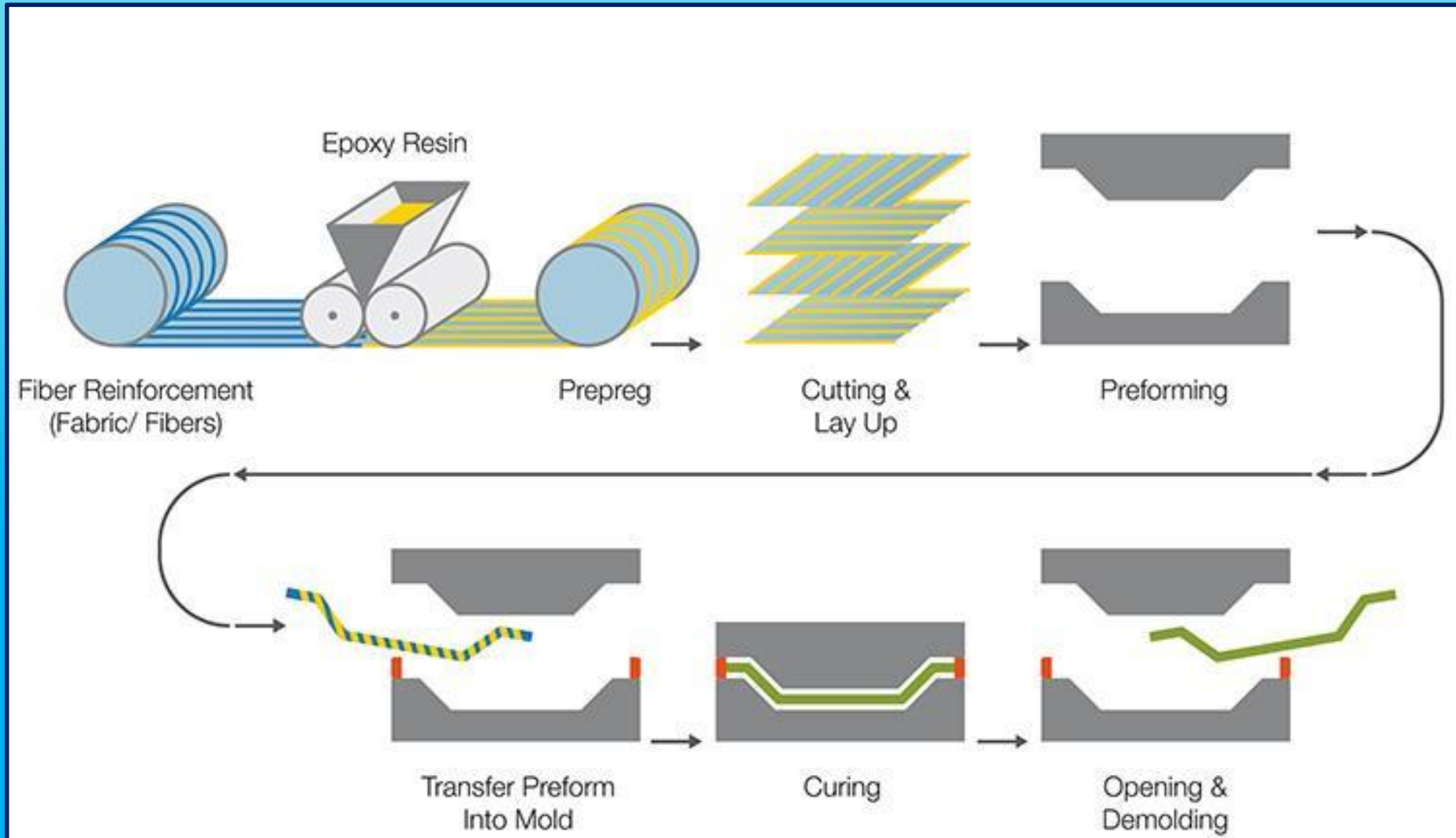
"LA FERRARI" F150 CHASSIS
(Up to 2 parts/Day)



Main Composite Technologies vs applications and market fields



PCM (PREPREG COMPRESSION MOLDING)





Main Composite Technologies vs applications and market fields

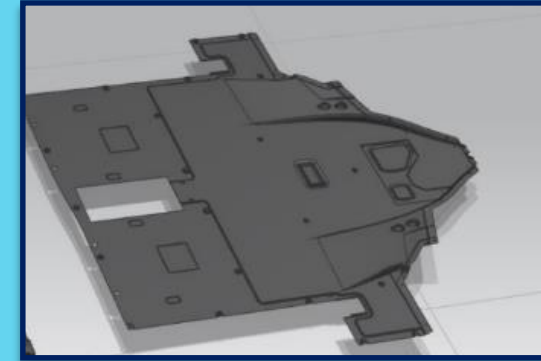
PCM (PREPREG COMPRESSION MOLDING)

► Strengths:

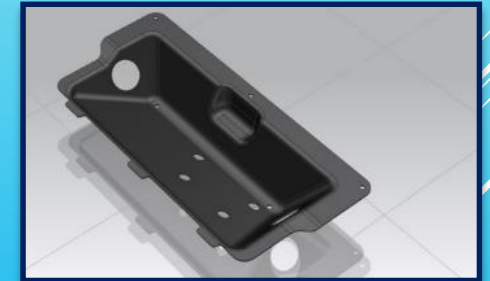
- ❑ Rapid Cure UD/Fabric prepreg (3-5 min curing time!)
- ▼ Medium production volume/ High-end cars (up to 200-300 parts/day)
- ❑ Very good structural performances/weight ratio, close to prepreg hand lay up technology
- ❑ Medium - High level of automation, process repeatability

► Weaknesses:

- ▼ Very complex geometries not achievable
- ❑ Carbon look surfaces (interiors or outer panels) , lower quality than prepreg technology achievable (at the current state of art)
- ▼ High tools and equipment costs (even if lower than HP-RTM)



Under floor protection



Hydraulic cover



Engine hood

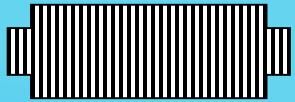




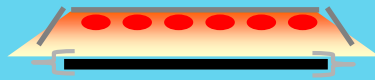
Main Composite Technologies vs applications and market fields



THERMOFORMING OF CFRTP (THERMOPLASTIC MATRIX)



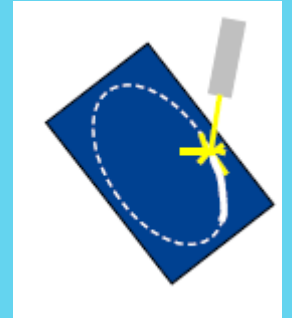
Pre-consolidate Laminates



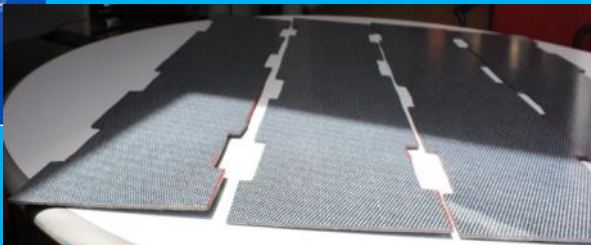
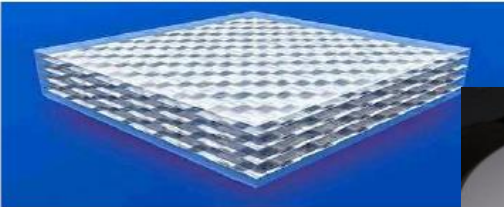
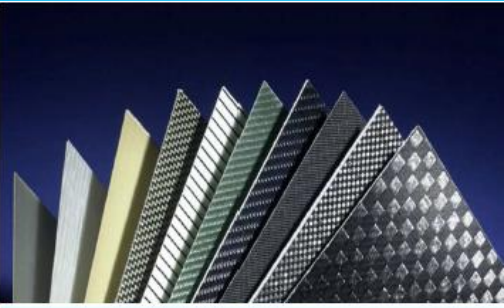
Heating (IR)



Thermo forming (pre-heated molds)



Trimming



THERMOFORMING OF CFRTP (THERMOPLASTIC MATRIX)

Strengths:

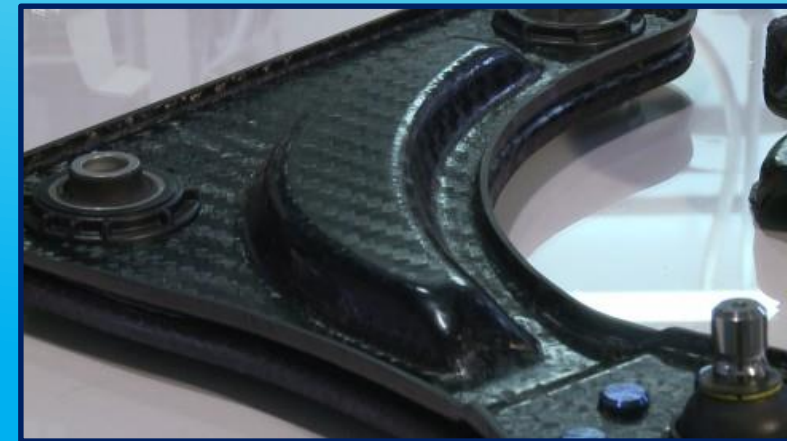
- ❑ Extremely rapid time cycle ($\geq 1,5-2$ minutes, depending on the matrix polymer)
- ▼ Medium-high production volume/ High-end cars (up to 400-500 parts/day)
- ▼ Structural performances (toughness, crash behavior)
- ❑ Induction welding technique for joining parts (only carbon fiber)
- ❑ Raw material storage (no need of refrigerator)
- ❑ Recyclability
- ❑ High level of automation, process repeatability

Weaknesses:

- ▼ No carbon look surfaces (at the current state of art)
- ▼ Only simple geometries and constant thickness
- ❑ High raw material costs (at the current state of art)
- ▼ High tools and equipment costs (but lower than HP-RTM)



Brake Pedal

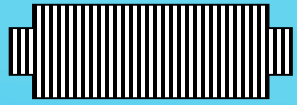


Triangle suspension

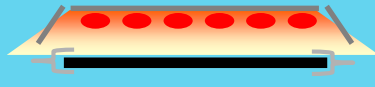


Main Composite Technologies vs applications and market fields

HYBRID PROCESS : THERMOFORMING OF CFRTP + BACK INJECTION



Pre-consolidate Laminates



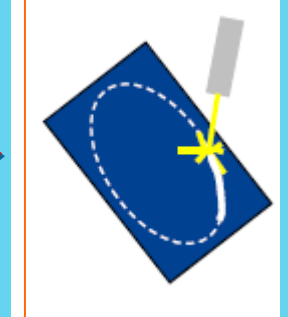
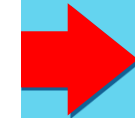
Heating (IR)



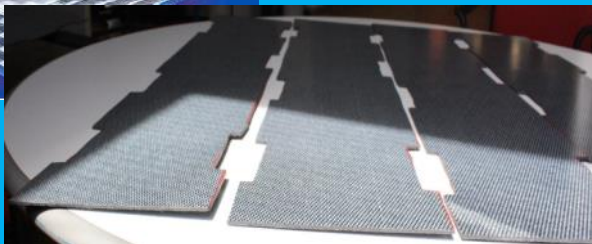
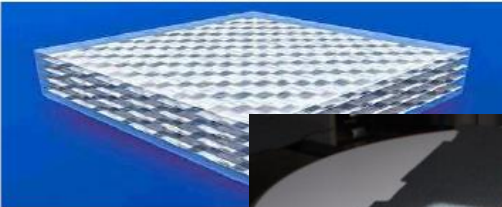
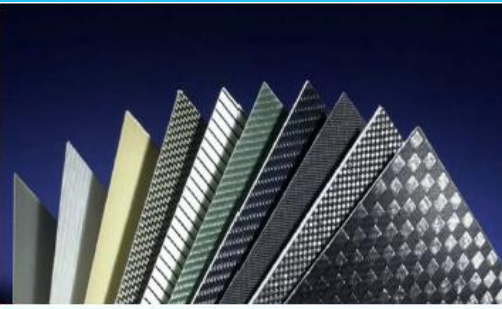
Thermo forming (pre-heated molds)



Back injection



Trimming



HYBRID PROCESS : THERMOFORMING OF CFRTP + BACK INJECTION

► AS Thermoforming , but:

- ❑ More complex geometries achievable
- ❑ Higher stiffness by ribs added as back injected parts
- ❑ Co-molded metal inserts
- ❑ Integration of different functions → global time cycle/costs reduction



Seat structure

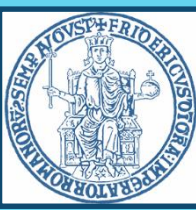


Side Impact door beam





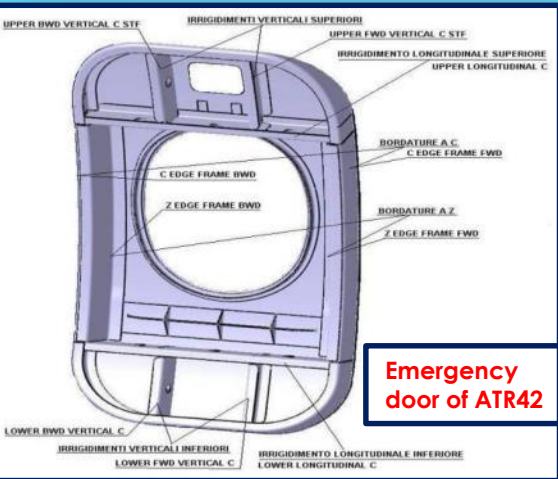
Adler Group experiences



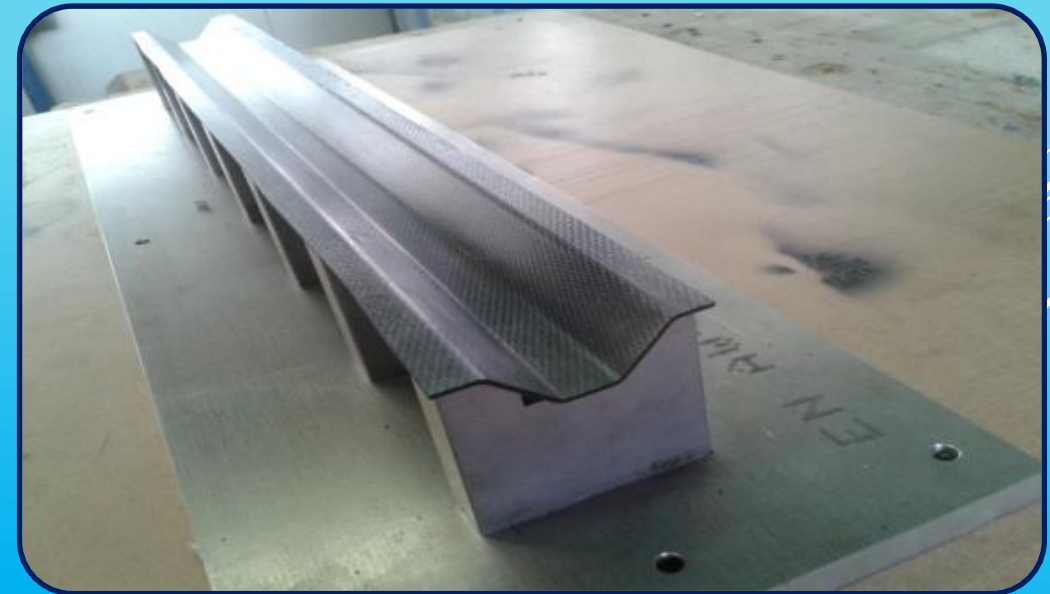
CFRTP : THERMOFORMING OF THERMOPLASTIC MATERIAL

AERONAUTIC - PPS MATRIX

AERONAUTIC - PEEK MATRIX



Emergency door of ATR42



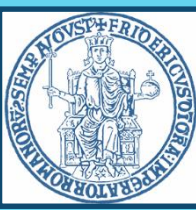
"Omega" stringer



Emergency doors parts

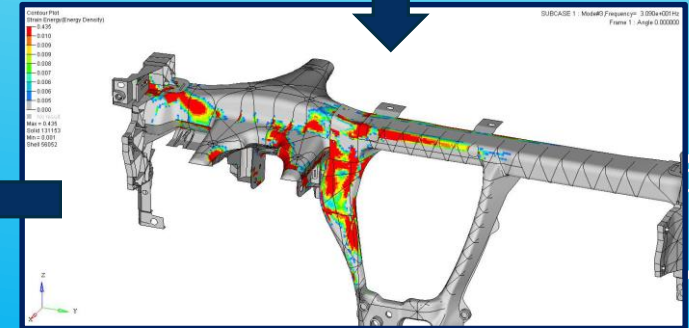
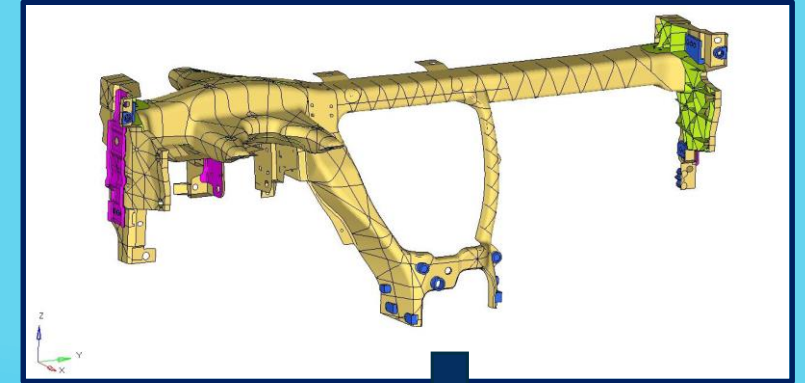


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CFRTP : THERMOFORMING OF THERMOPLASTIC MATERIAL

AUTOMOTIVE – PA6 MATRIX

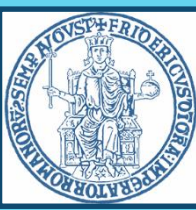


CROSS CAR BEAM

- PA6 Matrix
- Carbon fiber
- Uniform thickness = 3mm

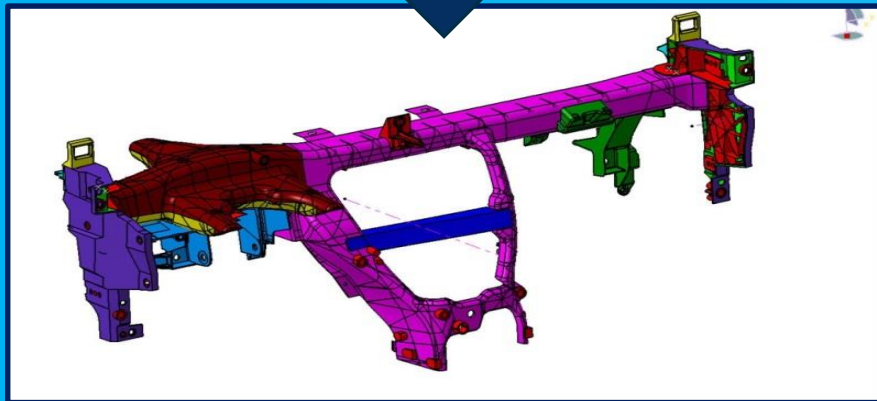
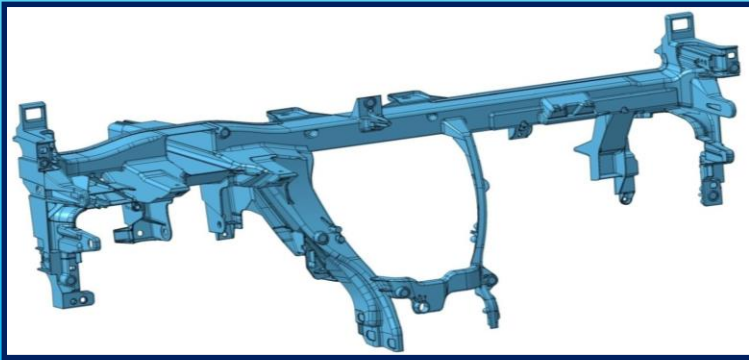


Adler Group experiences



THERMOFORMING PROCESS – TECOP CROSS CAR BEAM PROJECT – PA6 MATRIX

This is a research program in which Adler Group is involved together with FCA, about the thermoforming process development for the production of a cross car beam made of thermoplastic composites



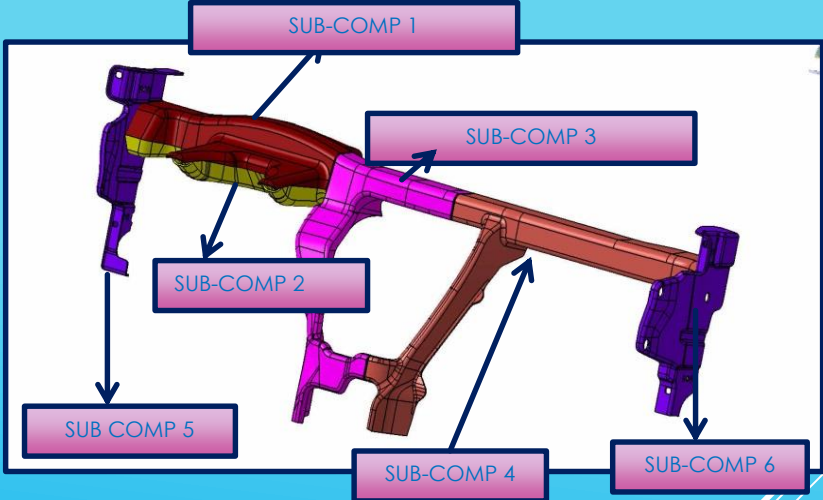
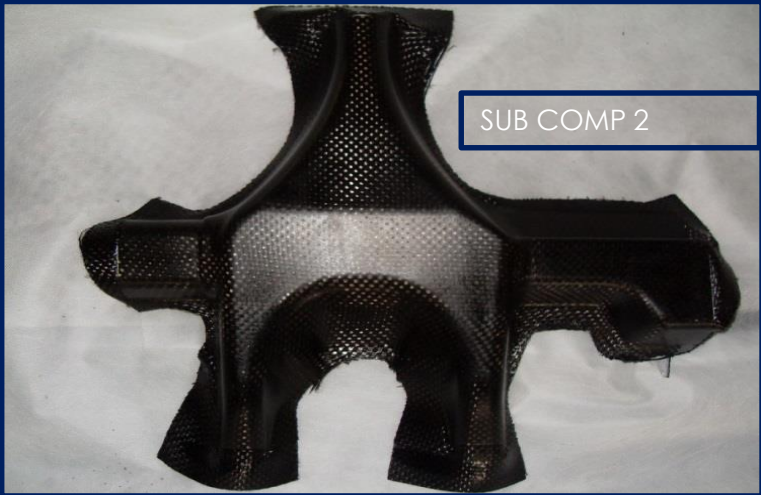
- ❖ Project targets : reduction of 15% in weight and same structural performances respect to the reference cross car beam made by “traditional “technology (casted magnesium, 520 FCA model)
- ❖ **PA6** matrix for cost reduction → compatible with automotive components for high volumes vehicle segment market
- ❖ Fiber glass or carbon fiber reinforcements (results by FEA analysis)
- ❖ Thermoforming process for each single part
- ❖ Possibility to add ribs-reinforcements by over-injection → hybrid solution
- ❖ Glass fiber and carbon fiber both evaluated
- ❖ Main thermoforming process parameters: heating cycle of laminates up to 255°C, pre-heating of molds @ 145°C



Adler Group experiences

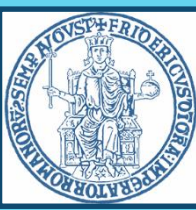


THERMOFORMING PROCESS – TECOP CROSS CAR BEAM PROJECT – PA6 MATRIX



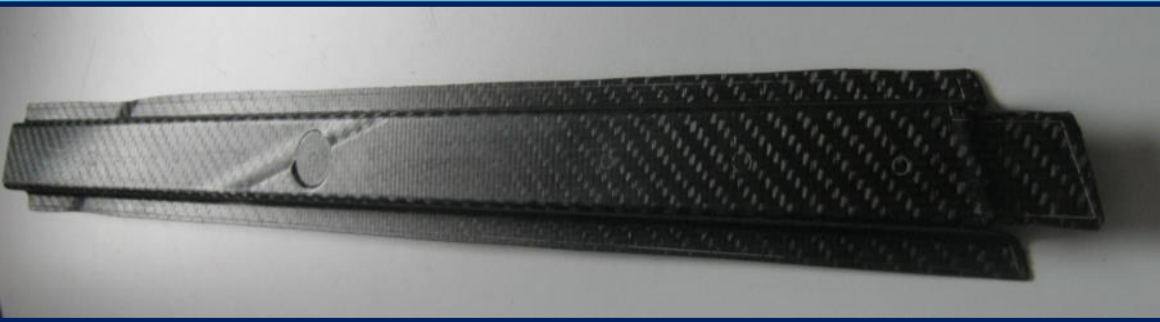


Adler Group experiences



CFRTP : THERMOFORMING OF THERMOPLASTIC MATERIAL

AUTOMOTIVE – PA6 MATRIX

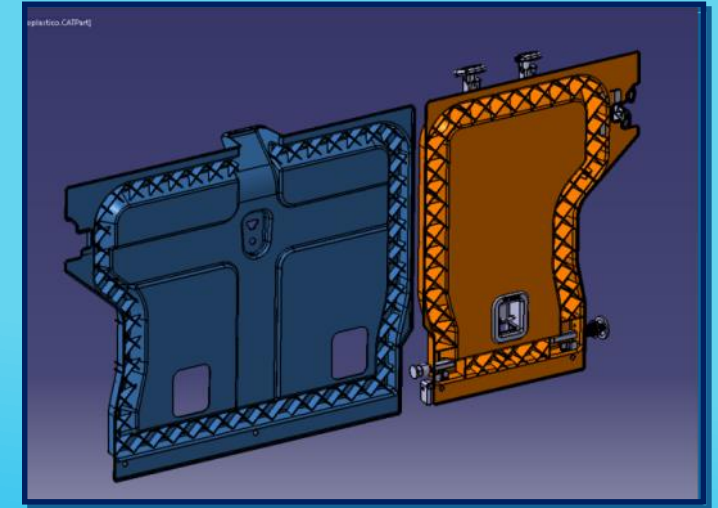
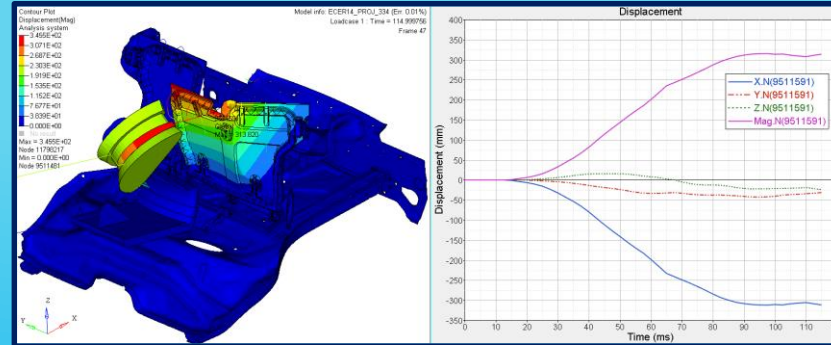
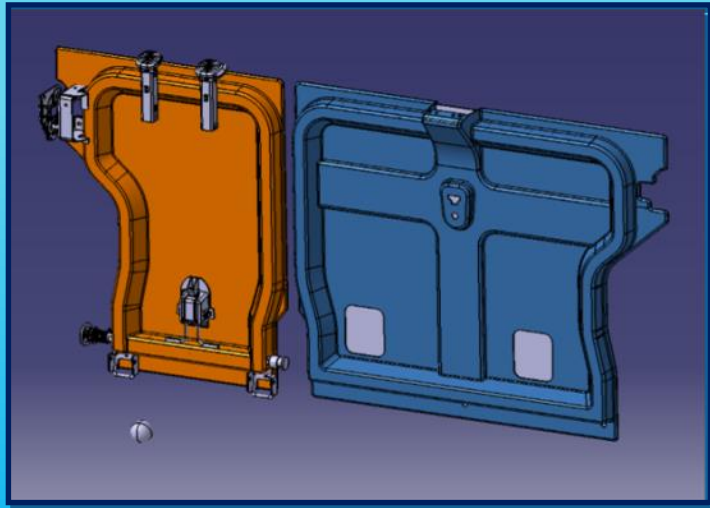


SIDE IMPACT DOOR BEAM

- PA6 Matrix
- Glass fiber and carbon fiber (both solutions tested)
- Uniform thickness = 2mm
- Over injection of internal ribs made of PA6 matrix reinforced with 30% short glass fiber



CFRTP : THERMOFORMING OF THERMOPLASTIC MATERIAL

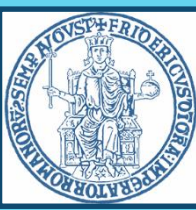


REAR SEAT STRUCTURE (development in WIP)

- PA6 Matrix
- Glass fiber and carbon fiber (both solutions to be tested)
- Uniform thickness = 3mm carbon, 4 mm glass
- Over injection of internal ribs made of PA6 matrix reinforced with 30% short glass fiber



Le produzioni di grande serie di parti in Composito



THANK YOU

