

# **KraussMaffei Technologies GmbH**

## **Economical Composite Technologies**

Wolfgang Hinz, Sao Paulo, 12th November 2014

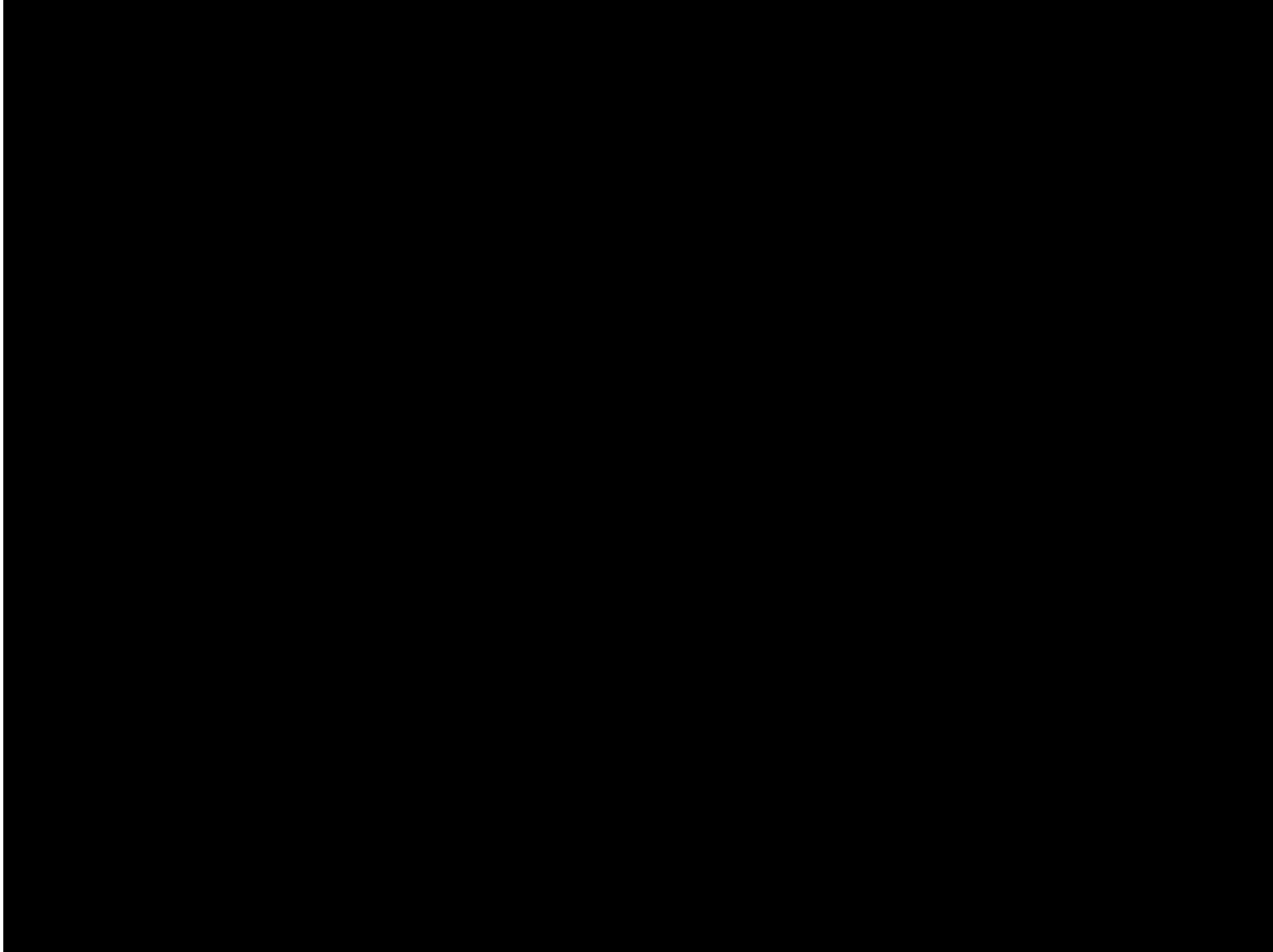
## KraussMaffei process technologies for composites

A single source supplier

- LFI – Long Fiber Injection
- DCPD – Dicyclopentadien
- S-RIM or RIM – Structural Reaktion Injection Moulding
- SCS – Structural Composite Spraying
- FCS – Fiber Composite Spraying
- RRIM – Reinforced Reaction Injection Moulding
- HP-RTM – High Pressure Resin Transfer Moulding



**LFI Technology with different Surfaces**  
Realized Application Samples

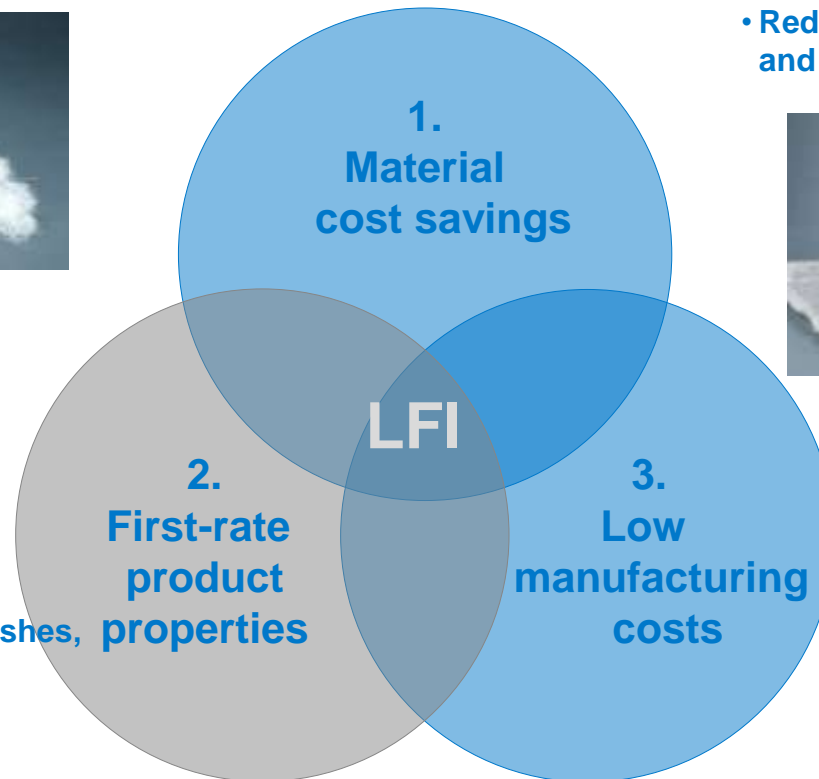


## LFI for benefits at all levels

LFI (Long Fiber Injection) – core benefits



- High strength
- Lighter than SMC
- Lightweight in combination with honeycomb
- Premium Class A surface finishes, selectable by combining processes
  - InMould Painting,
  - Thermomormed Skin,
  - Flexible Skin,
  - Fillers, to reduce material costs



- Lower cost materials (glassfiber roving instead of mats)
- Reduction of waste
- Reduction of scap, no sinkmarks and no shrinkage



- Short cycle times
- High flexibility (adjustable fiber content and fiber length from shot to shot)
- Integration of inserts
- High degree of automation

## Fendt Roof Module

Fa.-Fritzmeier Composite



Size:	1760*1630*235 mm
Wall thickness:	4 – 10 mm
Area:	3,1 m <sup>2</sup>
Foil:	2% PMMA clear 13% PMMA white 85% ABS white total tickness 1,5 mm
Weight PUR:	10,5 kg
Weight GF:	3,5 kg ( 25% )
Injection time:	22 s
Reaction time:	7 min.



## Side panel Class Baling press Fa.-Fritzmeier Composite



Size:	2370*1530 mm
Wall thickness:	ca. 4,5 mm
Area:	3,860 m <sup>2</sup>
Foil :	PMMA/ABS Green colored thickness 1,5 mm
Weight PUR:	14,3 kg
Weight GF:	4,6 kg ( 26% )
Weight Foil:	6,1 kg
Total weight:	25,0 kg

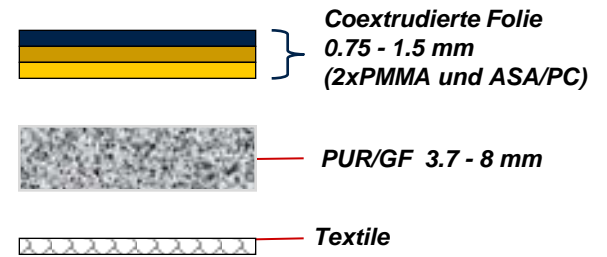
## Side panel Class Forage Harvester Jaguar

Fa.-Fritzmeier Composite

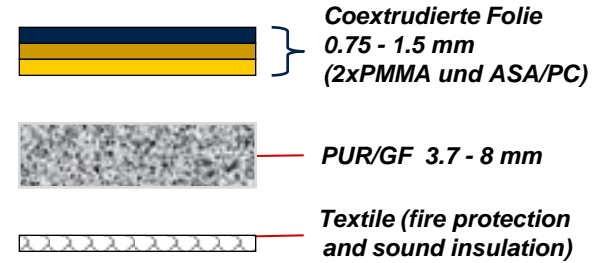




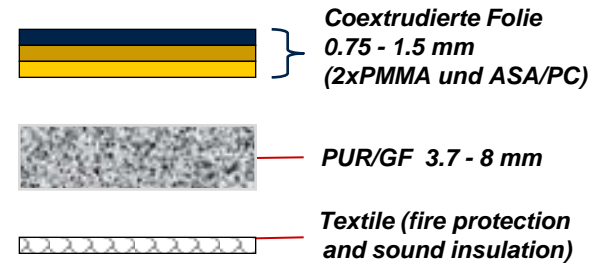
## Tractor engine hood New-Holland



## Tractor engine hood Fendt



## Tractor engine hood



## Motor hood for Mercedes ZETROS





## Application example of LFI:

- MAN Front Grill
- PU GF25 frame with plastic film,

## Innovation:

- Perfect wetting and distribution of the glass fibres
- Fibre length and volume locally adjusted, no fibre orientation
- Suitable for large body panels

## Benefit:

- High dimensional stability structure and accurate fit
- Direct foil lamination in a single working process

## Application example of LFI:

- 30 different types of air channels for busses
- PU GF25 with 35% fiber content and flexible foil
- Large part size (LxWxH 500 – 1000cm, 50-70cm, 0,5-1cm)

## Innovation:

- Perfect wetting and distribution of the glass fibres
- Fibre length and volume locally adjusted, no fibre orientation
- Suitable for large body panels

## Benefit:

- High dimensional stability structure and accurate fit
- Direct foil lamination in a single working process



## Actros Storage Box Mercedes Actros



## Actros Storage Box Mercedes Actros





## Instrument panels made with LFI and flexible Foil



## A unbeatable combination of different characteristics

### Properties of LFI exterior Panel



#### Application:

- Mobile Home
- PUR LFI with thermoformed Skin

Part dimension 2420 x 1600 x 20

A side Foil ABS/PMMA with 30% LV

Color Fiat-bianco-white, with

PE Protection foil

Final thickness 3mm, Thermoformed

B-side Polyurethane with 10% Glass fiber

Back foamed by using LFI technology

Density 0,3 – 0,4

Edge trimmed afterwards

**Application example of LFI:**

- Flexible Smart Roof Module
- PU GF15 frame with 2xPMMA and ASA/PC plastic film, 6000 g

**Innovation:**

- Intergration of fixing elements
- Fibre length and volume locally adjusted, no fibre orientation
- Suitable for large body panels

**Benefit:**

- High dimensional stability structure and accurate fit
- Direct foil lamination in a single working process
- Less process steps



## **Application references** Automotive

### **Application example of LFI:**

- Opel Zafira Roof Module
- PU GF22 frame with GEP Lexan SLX plastic film, 8300 g

### **Innovation:**

- Perfect wetting and distribution of the glass fibres
- Fibre length and volume locally adjusted, no fibre orientation
- Suitable for large body panels

### **Benefit:**

- High dimensional stability structure and accurate fit
- Direct foil lamination in a single working process
- Less process steps (integration of xxx lines possible)





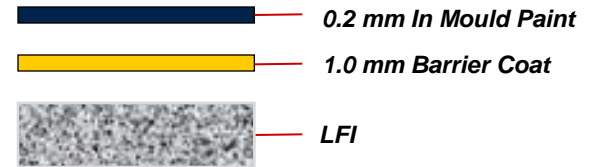
**LFI Technology + InMould Painting**  
Realized Application Samples

Krauss Maffei



## Tractor engine hood SAME DEUTZ FAHR GROUP

In-mould painting



Applications  
Automotive

*Krauss Maffei*





Krauss Maffei



*KraussMaffei*



*KraussMaffei*



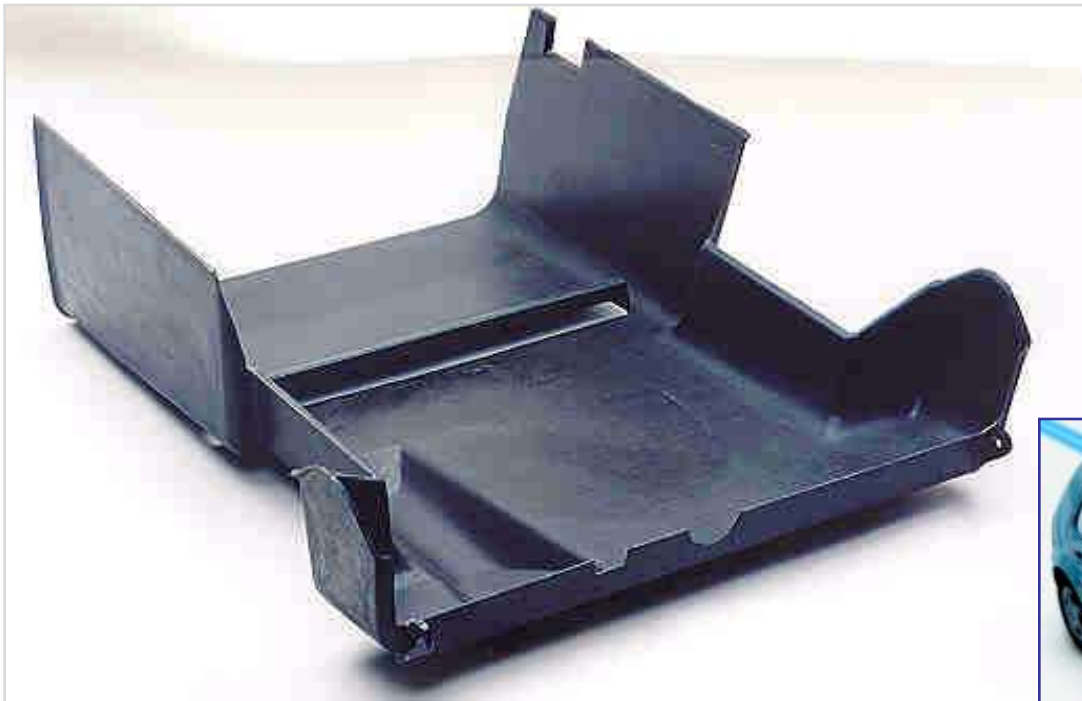
*KRAUSSMAFFEI*



Application references  
Automotive – Instrument panels



## Engine Encapsulation Jehil Urethane Korea



Glass Content: 30%

Density: 0,6 g/cm<sup>3</sup>

Wall thickness: 2,5 - 8,0 mm

Heat resistant up to 150° C





- Door extension
- Bumper
- Front mask and front panel
- Side covers
- High roof
- Crosswind spoiler
- Roof spoiler





- Front mask and bumper
- Front and rear end
- Side walls
- Mudguards





**DCPD Technology**  
Realized Application Samples



## Heavy Truck

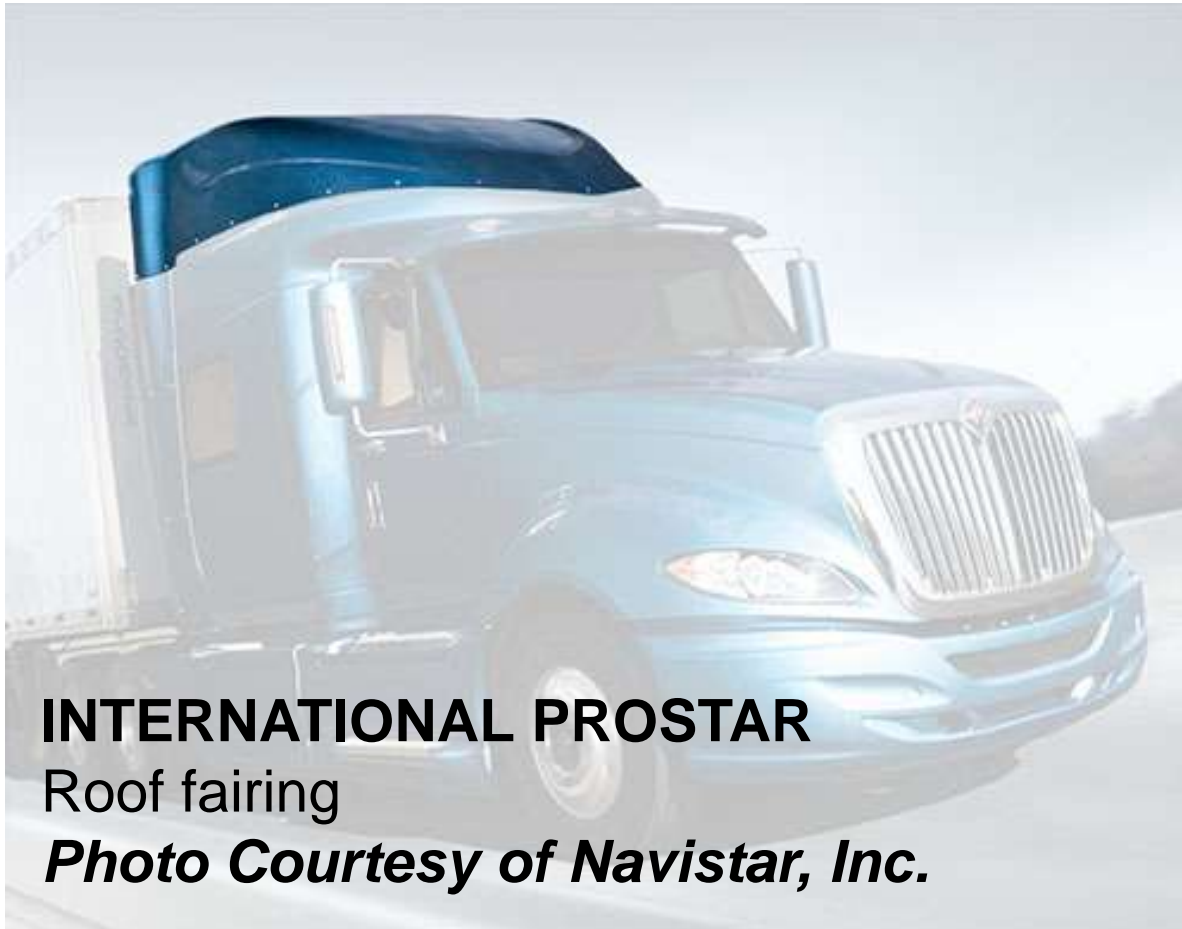


**CATERPILLAR CAT STAR**

Hood

*Photo Courtesy of Caterpillar, Inc.*

## Heavy Truck



**INTERNATIONAL PROSTAR**

Roof fairing

*Photo Courtesy of Navistar, Inc.*

## Heavy Truck

### **IVECO STRALIS**

Bumper, hood, grill

*Photo Courtesy of IVECO S.P.A.*



## Heavy Truck

### **KAMAZ 6450**

Bumper, fender, steps

*Photo Courtesy of Kamaz Group*



## Heavy Truck



## Heavy Truck



**VOLVO VNL 430**

Roof fairing

*Photo Courtesy of Volvo Trucks North America, Inc.*

## Heavy Truck

**KENWORTH W-900**

Hood

*Photo Courtesy of Kenworth Truck Company*



## Heavy Truck

**MERCEDES ATEGO**

Fenders

*Photo Courtesy of Mercedes-Benz International*





## Agricultural and heavy Equipment



**CATERPILLAR SERIES II**

Doors

*Photo Courtesy of Caterpillar, Inc.*

## Agricultural and heavy Equipment



## Agricultural and heavy Equipment



**JOHN DEERE 6 SERIES TRACTOR**

Fenders

*Photo Courtesy of Deere & Company*

## Agricultural and heavy Equipment



CATERPILLAR BACKHOE LOADER SERIES

## Agricultural and heavy Equipment



CATERPILLAR

## Agricultural and heavy Equipment



John Deere 6000  
Series Tractors



## S-RIM and RIM Technology Realized Application Samples

## Applications of Baydur 60



Baydur® 730 IBS  
rear flap (30 kg) of  
John Deere Combine  
Al-mold with Ni-shell



Baydur® 730 IBS  
roof (25 kg) of  
John Deere Combine  
polished steel mold

### core competencies

- high stiffness with light weight through integral structure
- complex mold geometries feasible
- variable wall thicknesses in one part
- good self releasing properties
- good flame retardancy



Baydur® 730S IBS  
rear door (12 kg) of  
John Deere Combine  
Al-mold with Ni-shell



## Applications of Baydur 60



- 12 panels

- 2 r. spoilers  
(2.3 / 2.7 kg)

- 2 l. spoilers  
(2.3 / 2.7 kg)

- 2 rear panels  
(18.6 / 24 kg)

- 2 rear side panels  
(9.1 / 11.3 kg)

- 2 middle side panels  
(19.5 / 23.6 kg)

- 2 fore side panels  
(25.4 / 25.4 kg)

### Baydur® 730 IBS

Case New Holland Combine  
Al-molds with Ni-shell  
12 parts from 2,3 to 25,4 kg



Bayer MaterialScience

## Applications of Baydur 110

### core competencies

- economical production of large and complex parts
- high stiffness with thin walls
- high quality surfaces
- good self releasing properties
- good flame retardancy

- volume: ~29,5 l
- weight: 33 kg
- thickness: 6-8 mm

molder: Pestel  
OEM: Claas



Bayer MaterialScience

## Applications of Baydur 110



Front and back view of the instrument panel

molder: CF-Maier  
OEM: Liebherr



## Applications of Baydur 110

Instrument panel

molder: CF-Maier  
OEM: Liebherr



## Applications of Baydur CSP



molder: Formtec  
OEM: Putzmeister

### core competencies

- economical processing
- surface quality: sufficient
- long filling times possible
- moldings: thin, complex, large
- mould of epoxy resins feasible
- lower requirements for machines



**SCS Structural Composite Spraying Technology**  
Realized Application Samples

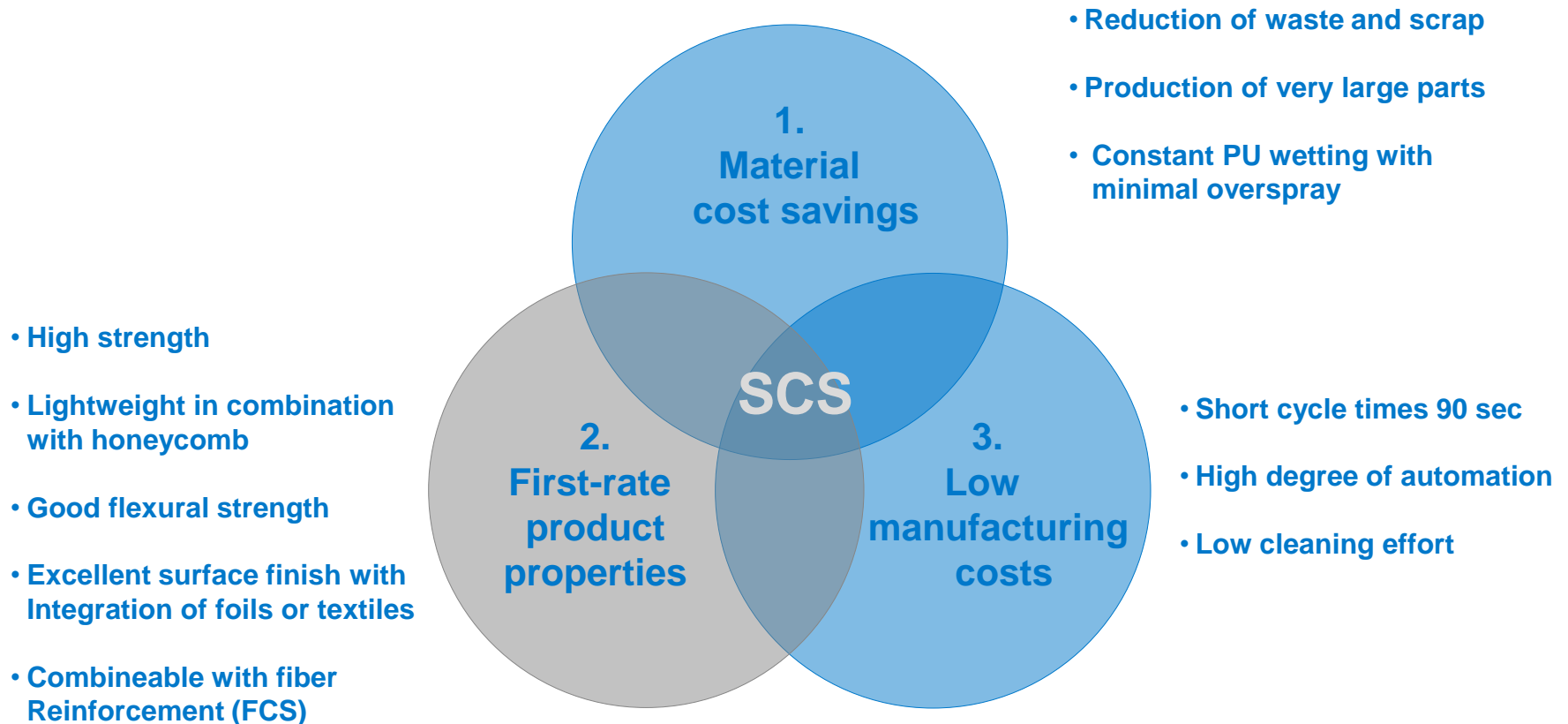
## Trunk Floor

Video: SCS Production



## SCS for benefits at all levels

SCS (Structural Composite Spray) – core benefits





## Application Examples Honeycomb Technology





## Application Railway

### Application:

- Diesel Engine cover
- Sandwich panel (PU/Glass/Honeycomb/Glass/PU)

### Innovation:

- Weight reduction >45% compared to the aluminum reference structure
- Cost-effective manufacturing process for large sandwich structures

## Finished Part design

Approved and finished parts





**FSC Fiber Composite Spraying Technology**  
Realized Application Samples

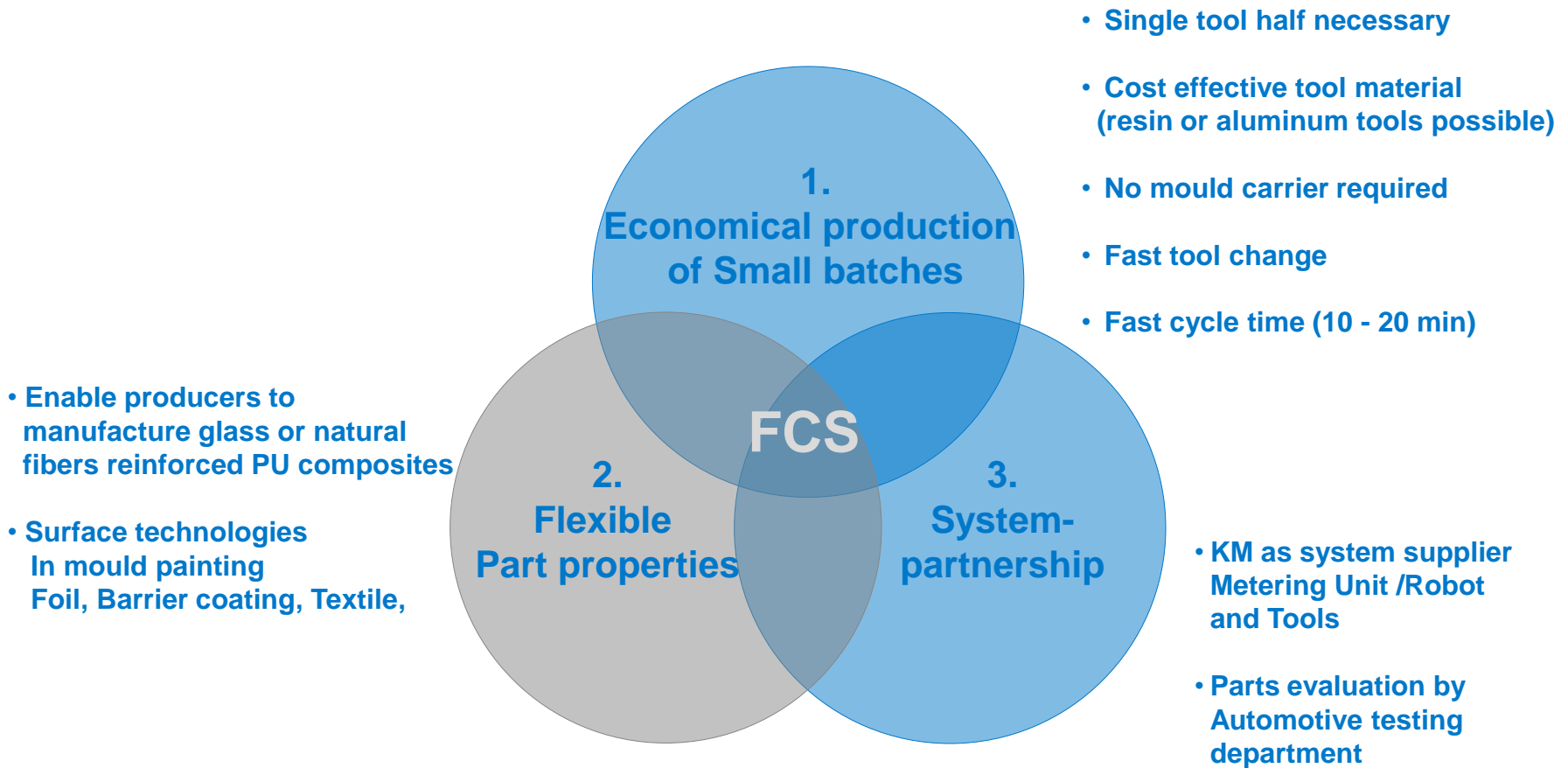
## **Engine Cover**

Video: FCS Production



## A unbeatable combination of different characteristics

### FCS Fibre Composite Spraying – Main Advantages



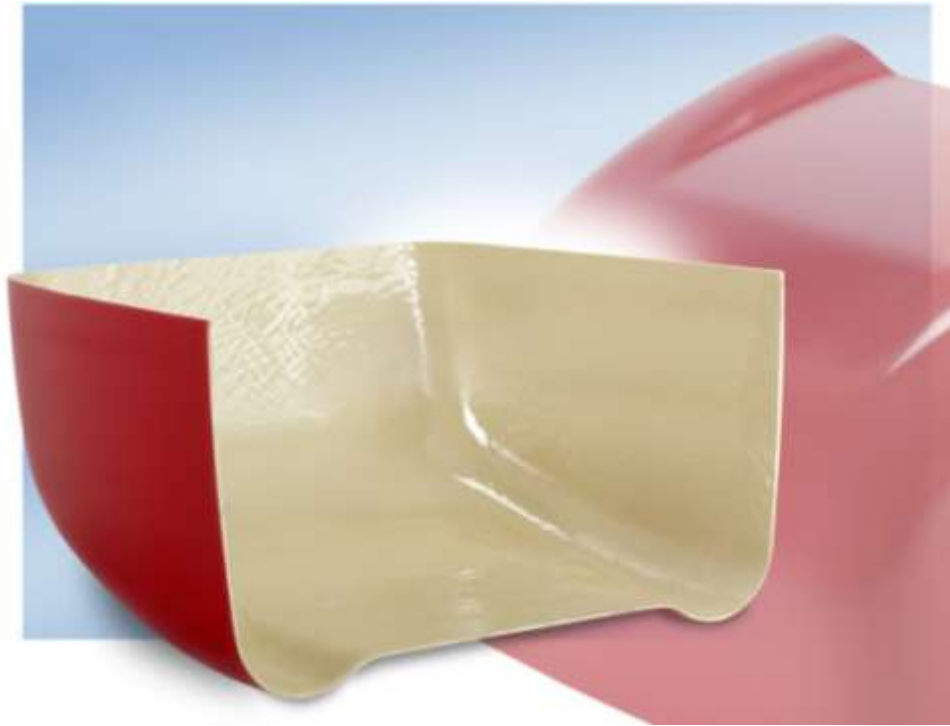
## Spray Head FCS Process

Exterior cladding parts for industrial vehicle



## Spray Head FCS Process

Exterior cladding parts





## External and internal coverings for ambulances – Customer Ruberti for Aricar



## FCS Process Bathtubs





**RRIM – Reinforced Reaction Injection Molding**  
Realized Application Samples

## RRIM (Reinforced Reaction Injection Molding)

Video: RRIM Production

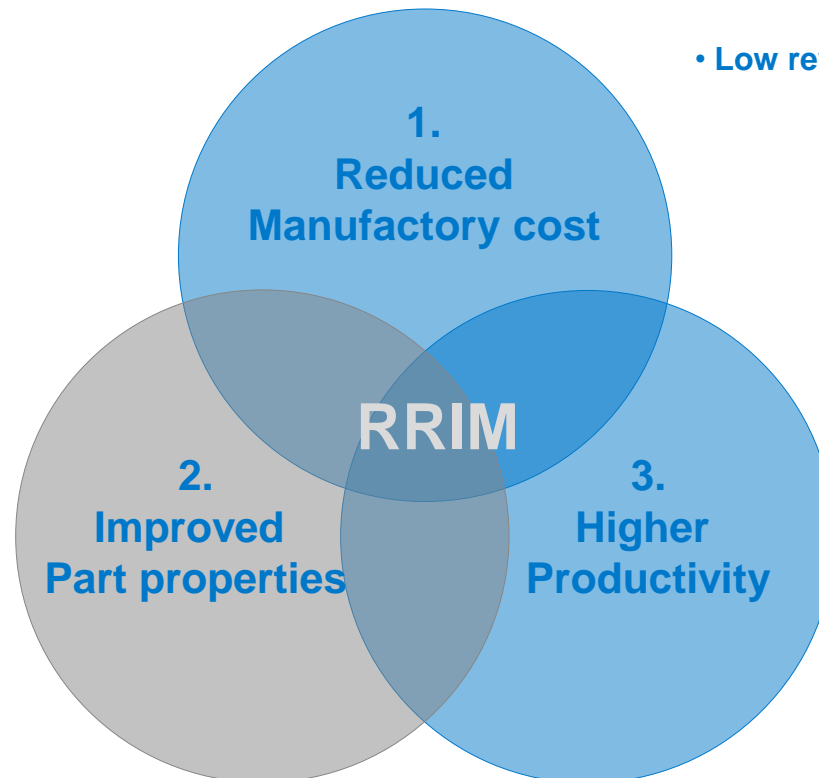


## A unbeatable combination of different characteristics

### RRIM Reinforced Reaction Injection Molding – Main Advantages

Excellent Impact resistance

- High Heat resistance
- Corrosion resistance
- No absorption of humidity
- High design freedom
- Paintable surfaces



- Flexible and modular system for different material throughput (parts size)

- Low reworking and scrap

- High degree of automation
- Fast cycle times due to High speed RIM systems (<90 s)
- Material with good flow properties (thin wallthickness < 2mm)



## R-RIM Technology

### Application example of RRIM:

- Touareg Fender
- Bayflex 190 with mineral fibres, 3000 g

### Innovation:

- High speed piston dosing machine
- Accurate shot weight in less than 0,6 s shottime
- Perfect material mixing quality

### Benefit:

- Fast cycle time
- Online paintable
- High geometric design freedom

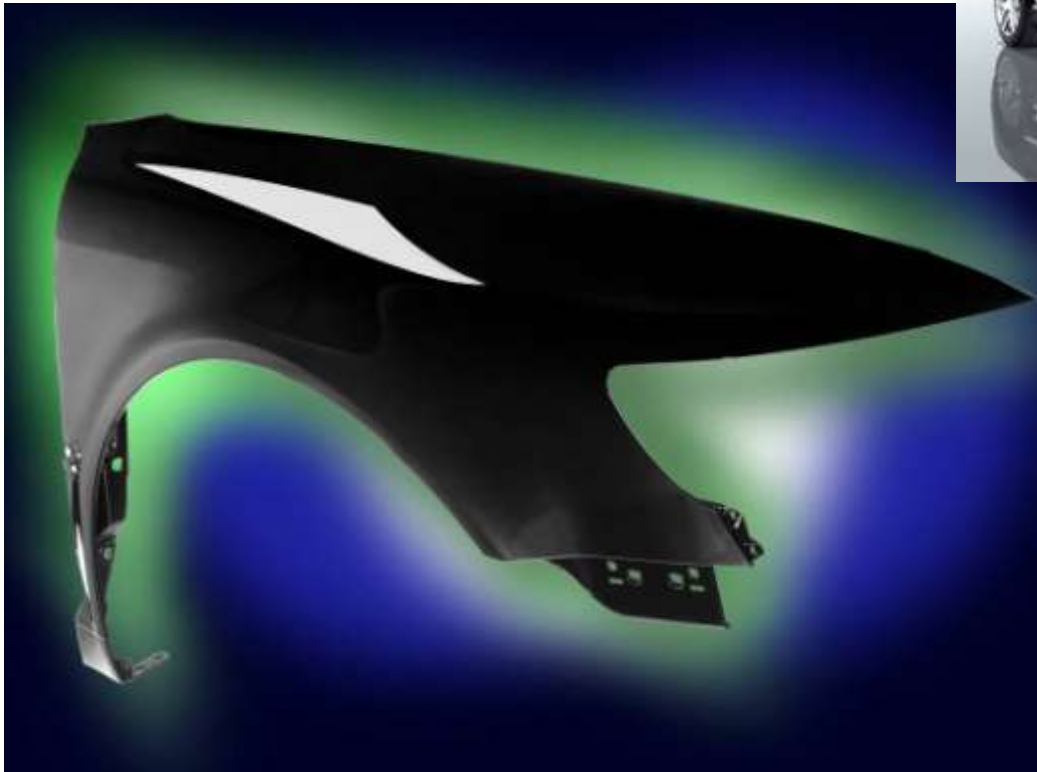
## R-RIM Technologies

Product: Fender Corvette



## R-RIM Technologies

Product: VW Phaeton Fender







## R-RIM Technology

### Application example of RRIM :

- Front spoiler Daimler
- Material Bayflex 180 with 20% Mineralfiber , Partweight 5000 g

### Innovation:

- High speed piston machine for high output volume
- Exact shot weight, also with a shot time < 0,5s
- Excelent mixing quality

### Benefit:

- Fast cycle time
- Online paintable
- High geometric design freedom



## R-RIM Technology

### Application example of RRIM :

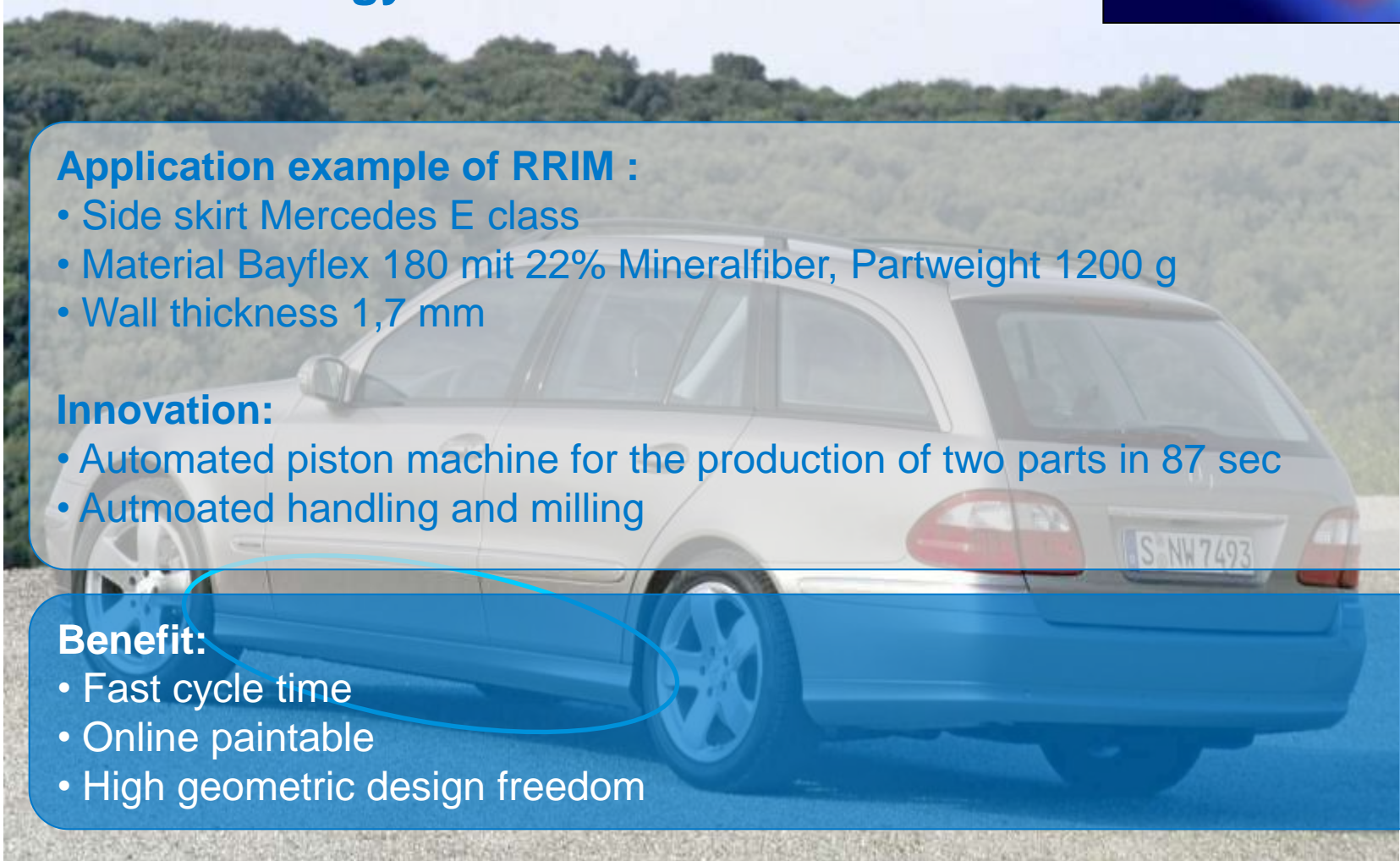
- Side skirt Mercedes E class
- Material Bayflex 180 mit 22% Mineralfiber, Partweight 1200 g
- Wall thickness 1,7 mm

### Innovation:

- Automated piston machine for the production of two parts in 87 sec
- Automated handling and milling

### Benefit:

- Fast cycle time
- Online paintable
- High geometric design freedom



## R-RIM Technologies

Product: Exterior Body Parts ARTEGA





## R-RIM Technologies

Product: Front and rear spoiler for BMW X6





## R-RIM Technologies

Product: 49 different exterior parts for Mercedes AMG G-Modell



- Front spoiler
- Radiator grill
- Fender extensions
- Different covers



## R-RIM Technologies

Product: Different bus parts



## R-RIM Technologies

Product:





**RTM Technology**  
Comeback for Electro Mobility



## HP- RTM (High Pressure Resin Transfer Moulding)

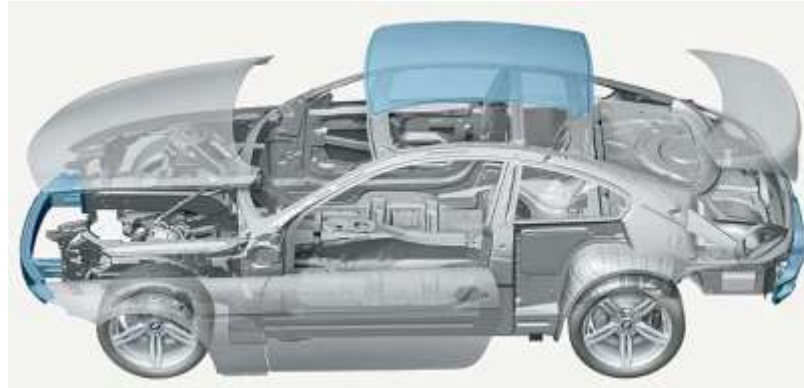
Video: Surface - RTM



## Which are typical applications for HP-RTM?

Structural parts and carbon designer parts

Underbody structure



Side Frame



Bumper



Quelle: Alcan

Roof and Bonnet





## Visible carbon roof

BMW M3 Coupé

### Application:

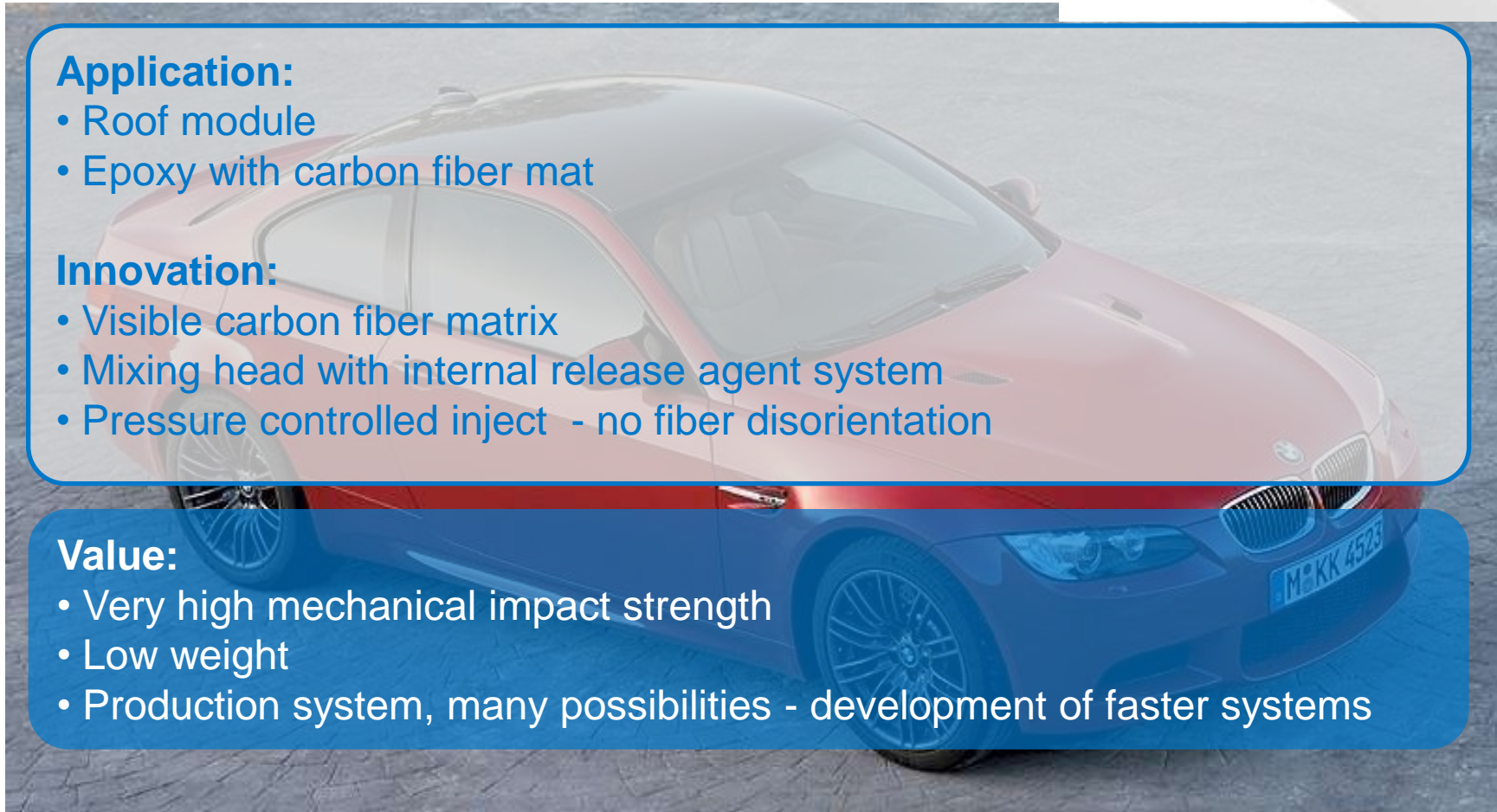
- Roof module
- Epoxy with carbon fiber mat

### Innovation:

- Visible carbon fiber matrix
- Mixing head with internal release agent system
- Pressure controlled inject - no fiber disorientation

### Value:

- Very high mechanical impact strength
- Low weight
- Production system, many possibilities - development of faster systems



## Lightweight design & high quality surfaces efficient combination of two megatrends force further developments

### 2013 Roof element Roding R1



### Key characteristics

- |                                                     |                   |
|-----------------------------------------------------|-------------------|
| ■ Dimensions                                        | 772x585 mm        |
| ■ Total part weight<br>(weight of surface material) | 2.570 g<br>(230g) |
| ■ Substrate thickness                               | 2 mm              |
| ■ Surface layer thickness                           | 0,2 mm            |
| ■ Fiber content (by volume)                         | 50%               |
| ■ Fiber Layup                                       | quasiisotrop      |
| ■ Cycle time                                        | 6 min             |

Surface Quality met the specification of german automotive OEMs

## Visible carbon side panel

Audi R8



## Structrual bumper carrier

BMW M3 Coupé

### Application:

- Cross – Beam / BMW
- Epoxy with carbon fiber mat

### Innovation:

- Piston dosing unit for RTM
- Mixing head MK 6/10-ULKP2KVV
- Injection into closed mold

### Value:

- Very high mechanical impact strength
- Low weight
- Production system, many possibilities - development of faster systems



## Structural underbody frame or monocoque

Lamborghini Aventador



## Structrual monocoque

BMW i3 or i8



Bildquelle Internet





## Non automotive exterior part: Side Panel

Claas Harvester



### Application:

- Side Panel
- Epoxy with carbon fiber mat / rigid foam core

### Innovation:

- Further weight reduction due to light weight foam core
- Mixing head with internal release agent system
- Injection into closed mold

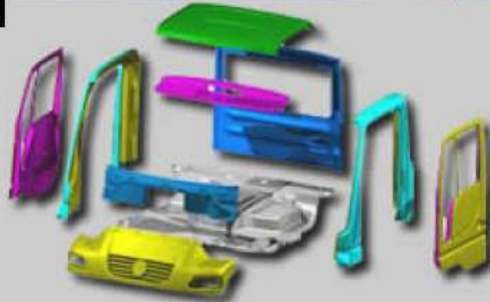
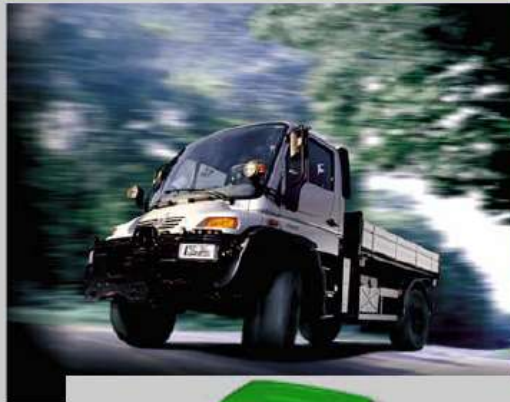
### Value:

- Very high mechanical impact strength
- Low weight
- Production system, many possibilities - development of faster systems

## Non automotive exterior part: drivers cabin

Mercedes Unimog

### Mercedes - UNIMOG Fahrerkabine

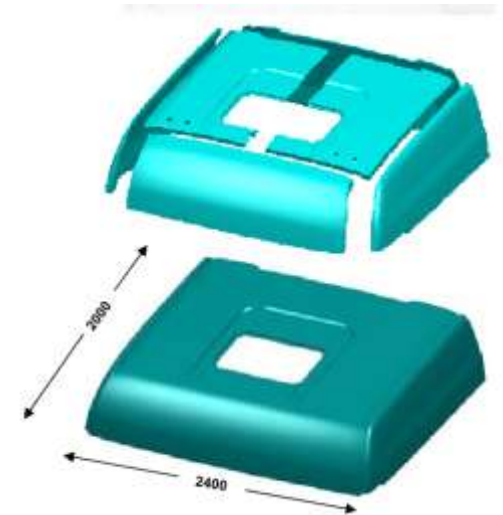


#### **UNIMOG Fahrerkabine**

- 10 Einzelteile im RTM-Verfahren hergestellt
- Verbindung durch Strukturverklebung

*(Hersteller: ACE GmbH, Immenstaad)*

## Non automotive exterior part: Roof modul MAN truck



**Non automotive exterior part: Jetski**





Our Technology –Your Advantage

Thank you for listening