new processes
for large scale automotive production
of composite applications

Dr.-Ing. Marcus Schuck[1]

Stuttgart, 19.05.2011, *Automotive Interiors Expo 2011*

[1] Jacob Plastics GmbH

Bergstraße 31 - 35
91489 Wilhelmsdorf
Deutschland / Germany
Tel.: +49 (0)9104 / 8270-492
Fax: +49 (0)9104 / 8270-455
m.schuck@jacobplastics.com

www.jacobplastics.com

Jacob Plastics Group

- Introduction Jacob Plastics
- process technology
  - CTSF ® (Composite Twin-SheetForming)
  - CTB® (Composite ThermoBending)
  - FIT-Hybrid
  - SpriForm
- Summary

Jacob Plastics Group

Sites

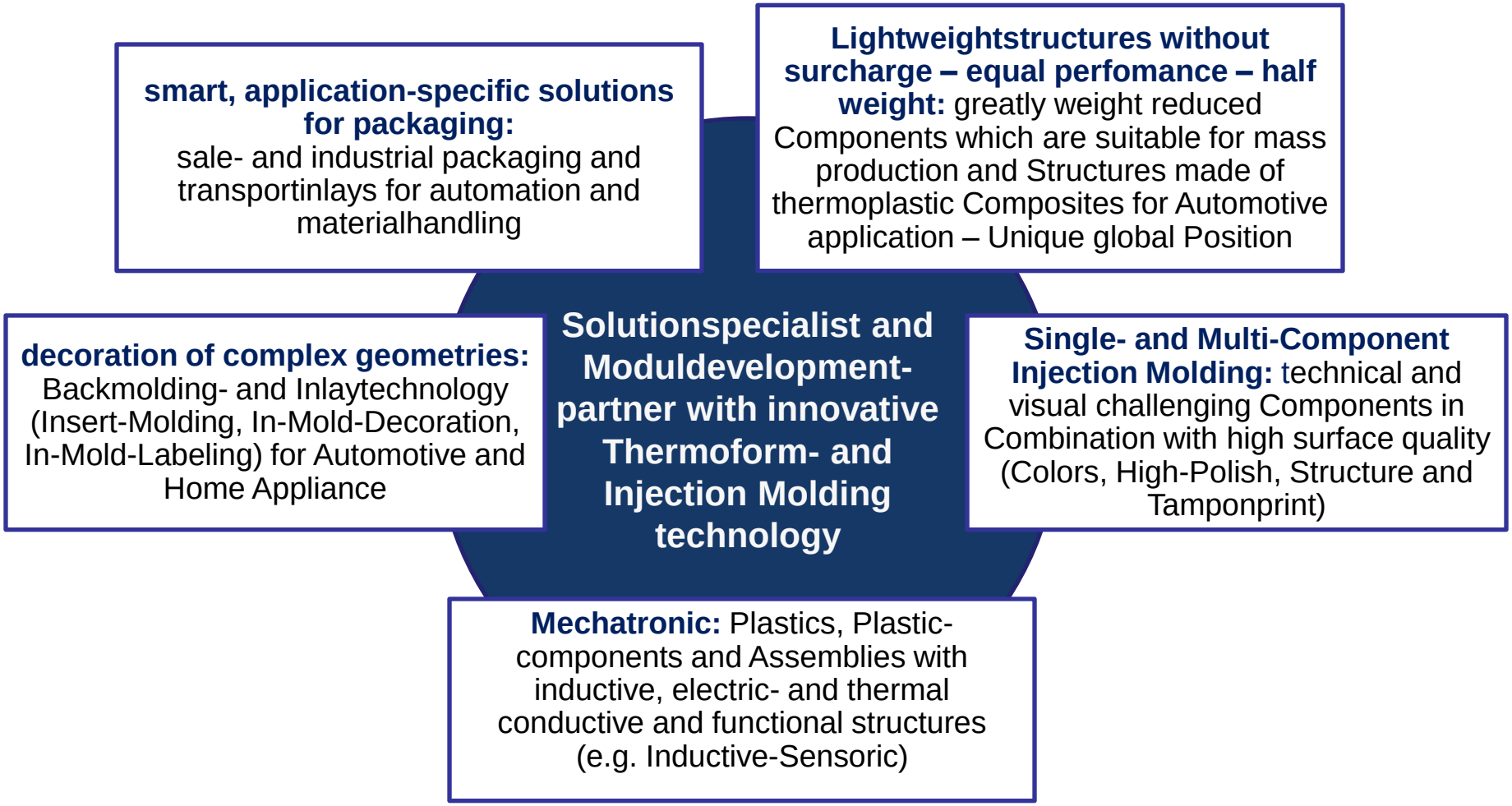
Wilhelmsdorf (D); 12.000 m²

Obermichelbach (D); 6.500 m²

Nizná (Slovakia); 2.200 m²

Jacob Plastics Group

Positioning



lightweight construction

1886 → **2011**

125 years

Benz Patent Motorwagen Nummer 1

Weight: 265 kg

gas consumption: 10 Litre / 100 km

S-Klasse 221

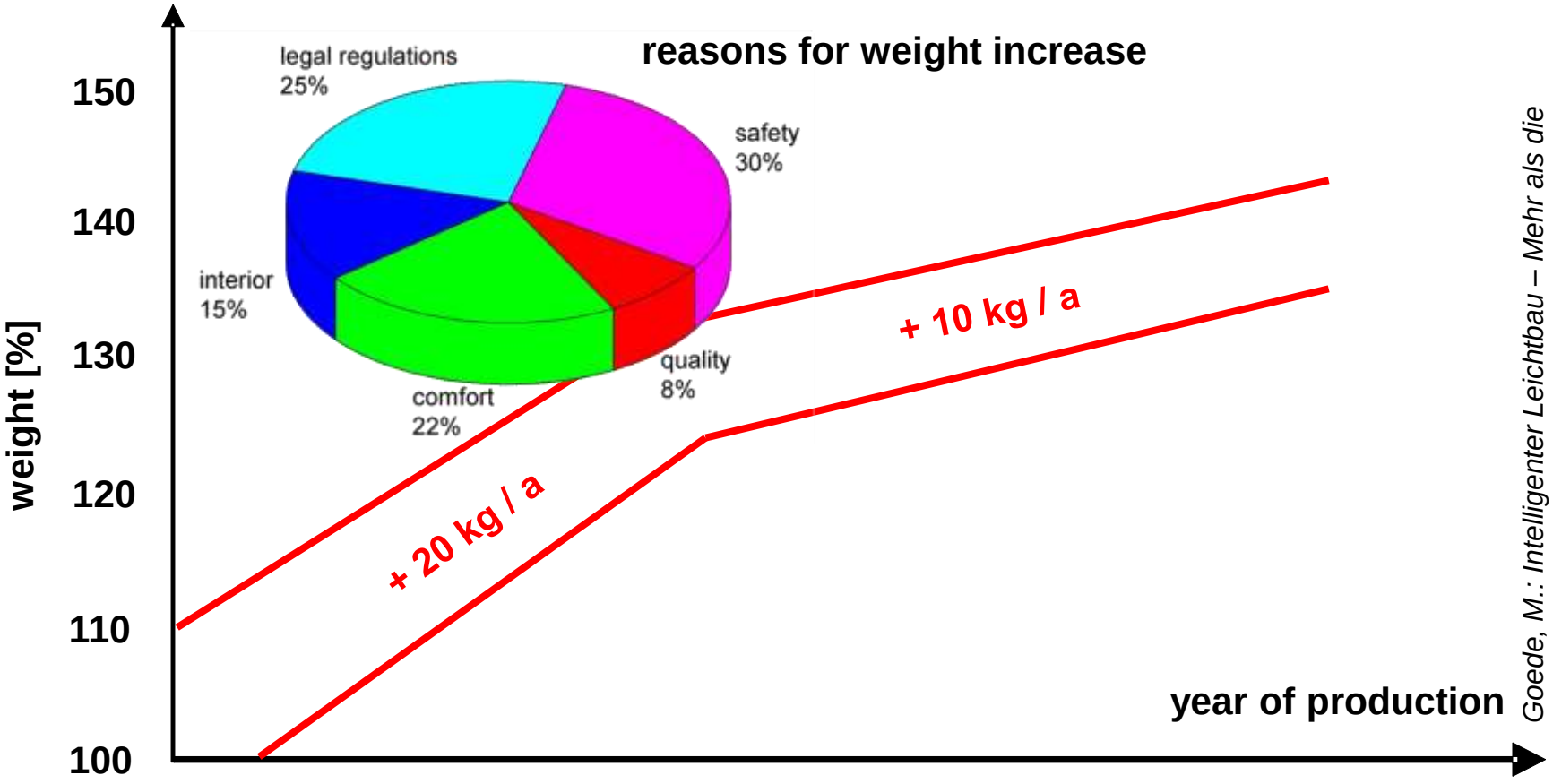
Weight: 2.075 kg

gas consumption: 10 Litre / 100 km

S500 4Matic BlueEfficiency

Source: Mercedes

lightweight construction (VW Golf II – V)



source: *Goede, M.: Intelligenter Leichtbau – Mehr als die Summe der Einzellösungen 5. Fachtagung Fortschritte im Automobil Leichtbau, Wolfsburg, 2004*

Porsche Carrera GT

thermoset material

1380 kg

autoclave

1500 cars / lifetime

→ small amount of cars
→ expensive
→ slow cycle time

due to process

Quelle: Porsche

Porsche Carrera GT

thermoset material

1380 kg

autoc

1500

no suitable processes with thermosets for large scale production

→ small amount of cars
→ expensive
→ slow cycle time

due to process

Quelle: Porsche

process properties

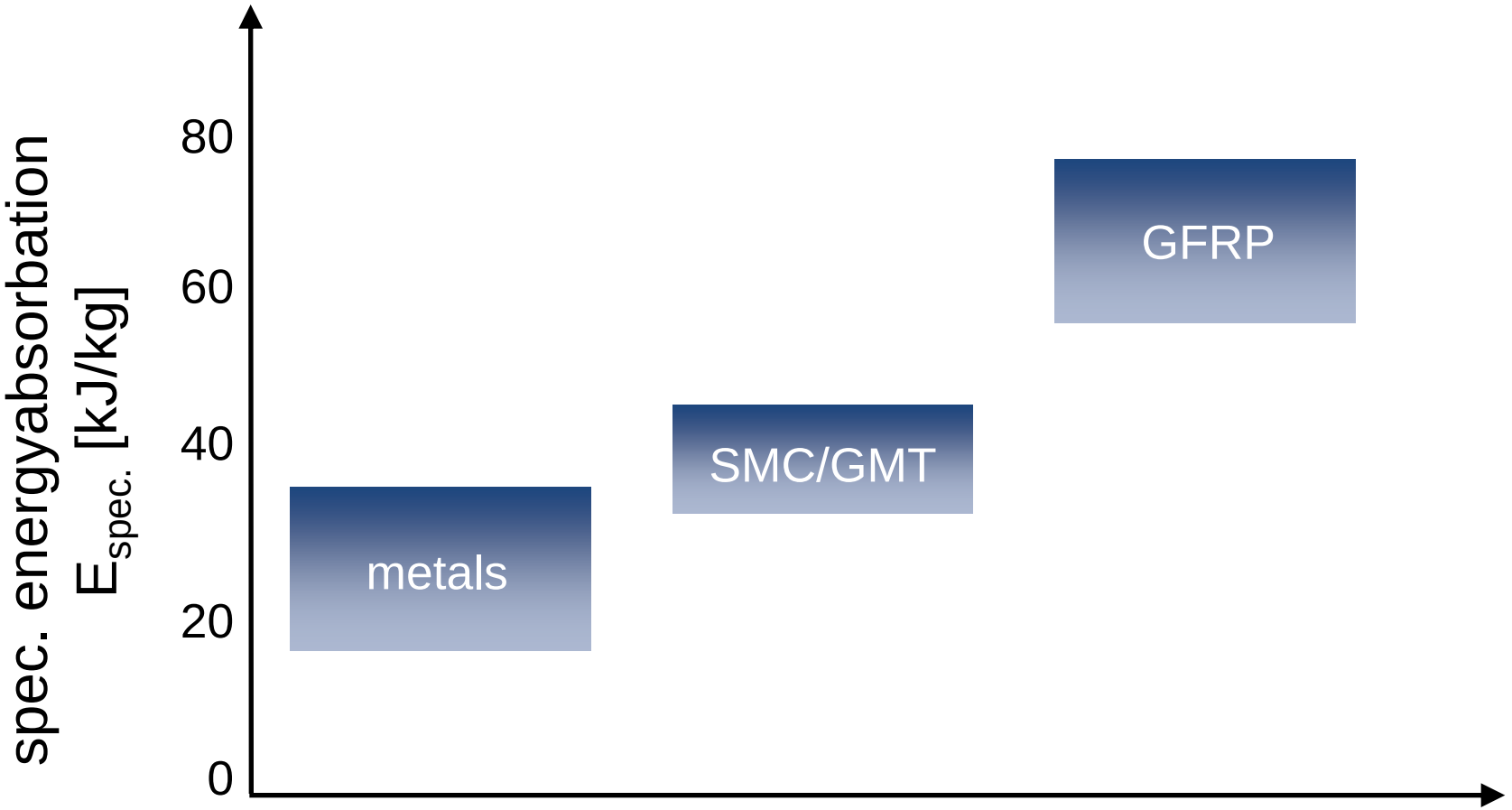
for composites

	thermoset			thermoplast
	handmaking	**autoclave**	**RTM**	**thermoforming**
machine cost	low	high	average	average
mold expenses	low	high	high	high
wages / loan	high	average	average	low
material cost	low	high	low	high
cycle time	3-24 h	5 h	0,25 – 3 h	0,05 h
parts p.a.	< 1000	< 3000	< 50.000	500 – 500.000
health problems	pollution	average	difficult	no problems

source: Umdruck Vorlesung ETH Zürich "Composite Technologien"

lightweight and safety

properties of thermoplastic advanced composites



source: *M. Nohr, Faserkunststoffverbunde, 8. NASY SAMPE, Kaiserslautern, 2002*

Jacob Plastics Group

process technology

Lightweightstructures without surcharge – equal perfomance – half weight: greatly weight reduced Components which are suitable for mass production and Structures made of thermoplastic Composites for Automotive application – Unique global Position

- CTSF ® (Composite Twin-SheetForming)
- CTB® (Composite ThermoBending)

→ **processes < 30.000 pcs. / year**

Lightweightstructures without surcharge – equal perfomance – half weight: greatly weight reduced Components which are suitable for mass production and Structures made of thermoplastic Composites for Automotive application – Unique global Position

- SpriForm

Single- and Multi-Component Injection Molding: technical and visual challenging Components in Combination with high surface quality (Colors, High-Polish, Structure and Tamponprint)

- FIT-Hybrid

Initial Situation

Steel in an Automobile / BMW M3

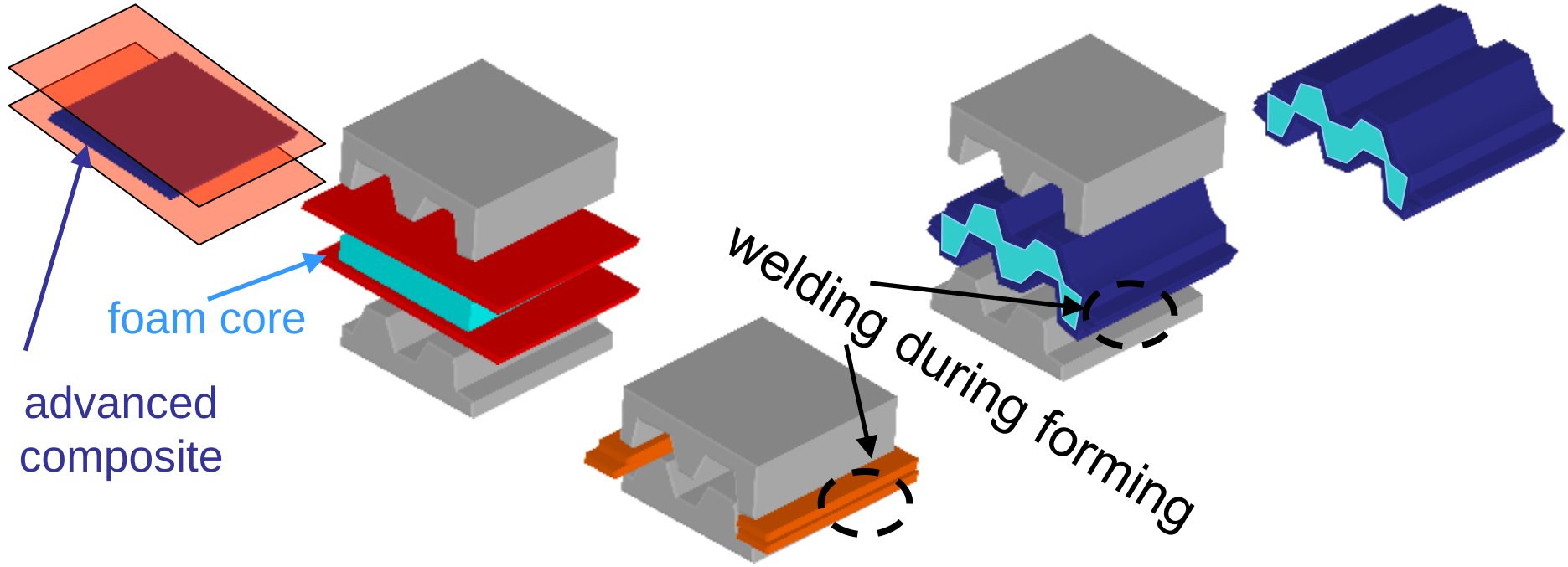
Bumper (rear)
Steel, 11 kg

Back seat rest
Steel, 12,5 kg

Bumper (front)
Steel, 9 kg

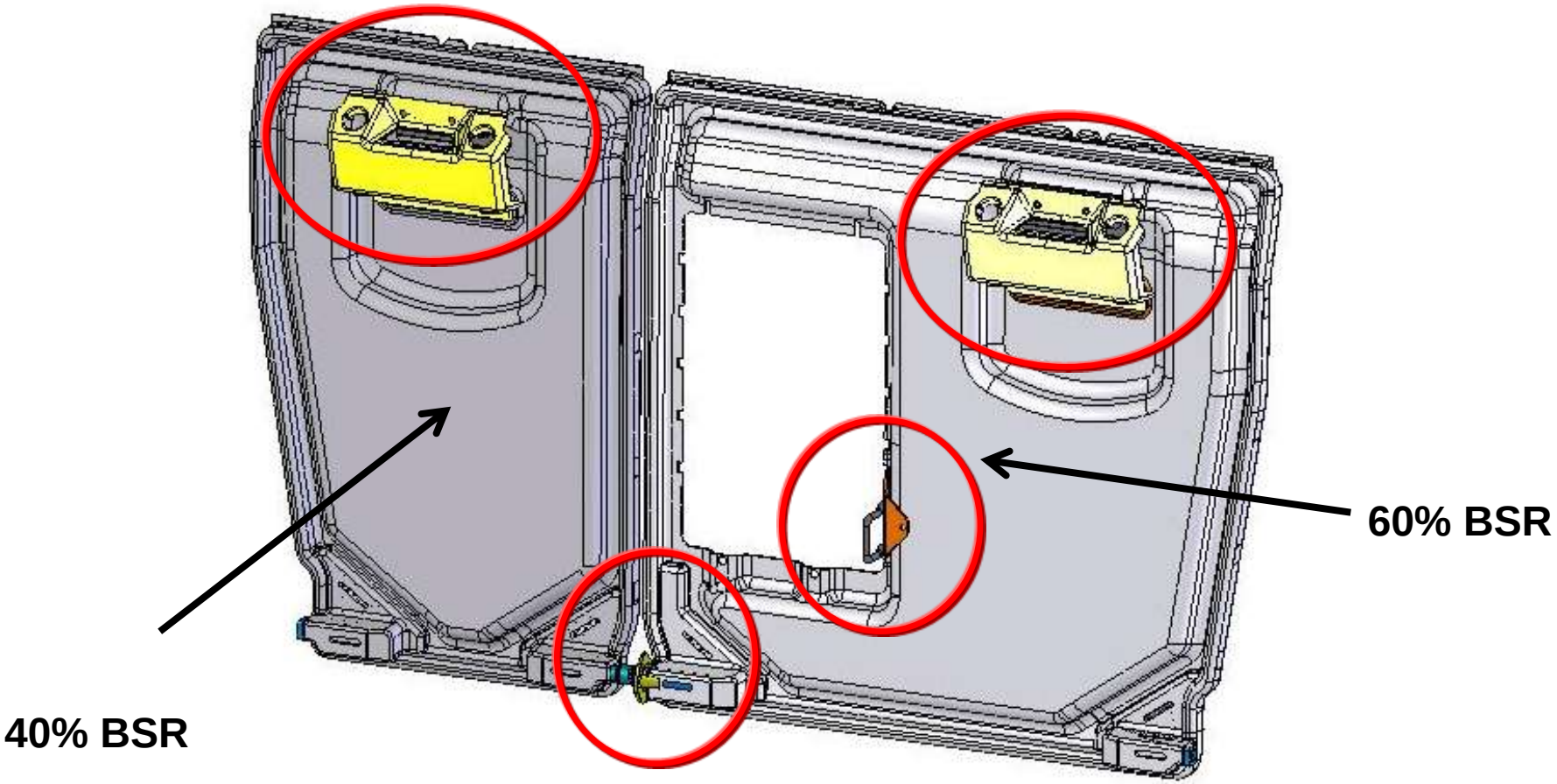
CTSF ® (Composite Twin-Sheet Forming)

Heating (IR) → Transportation → Forming & Cooling → Deforming → Post Processing (Cutting, Welding)



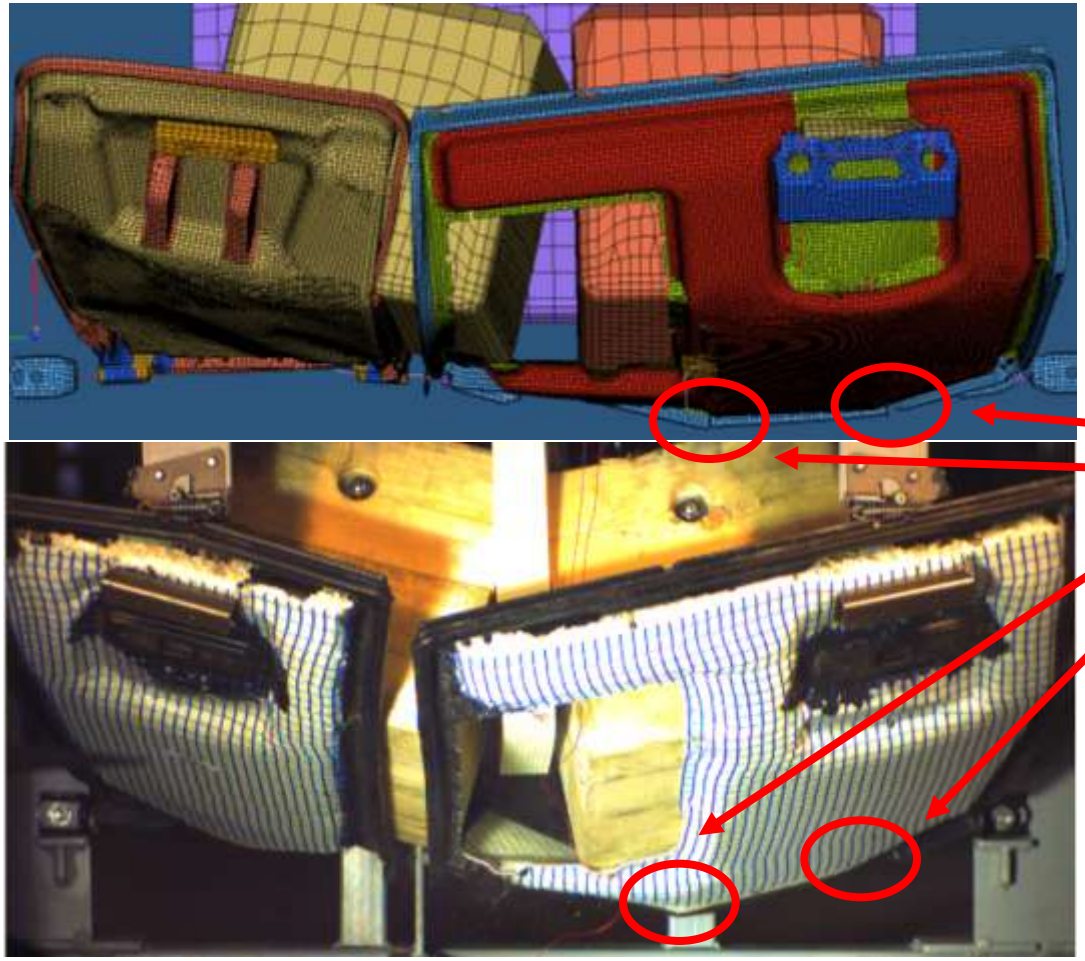
CTSF ® (Composite Twin-SheetForming)

integrative construction



CTSF ® (Composite Twin-SheetForming)

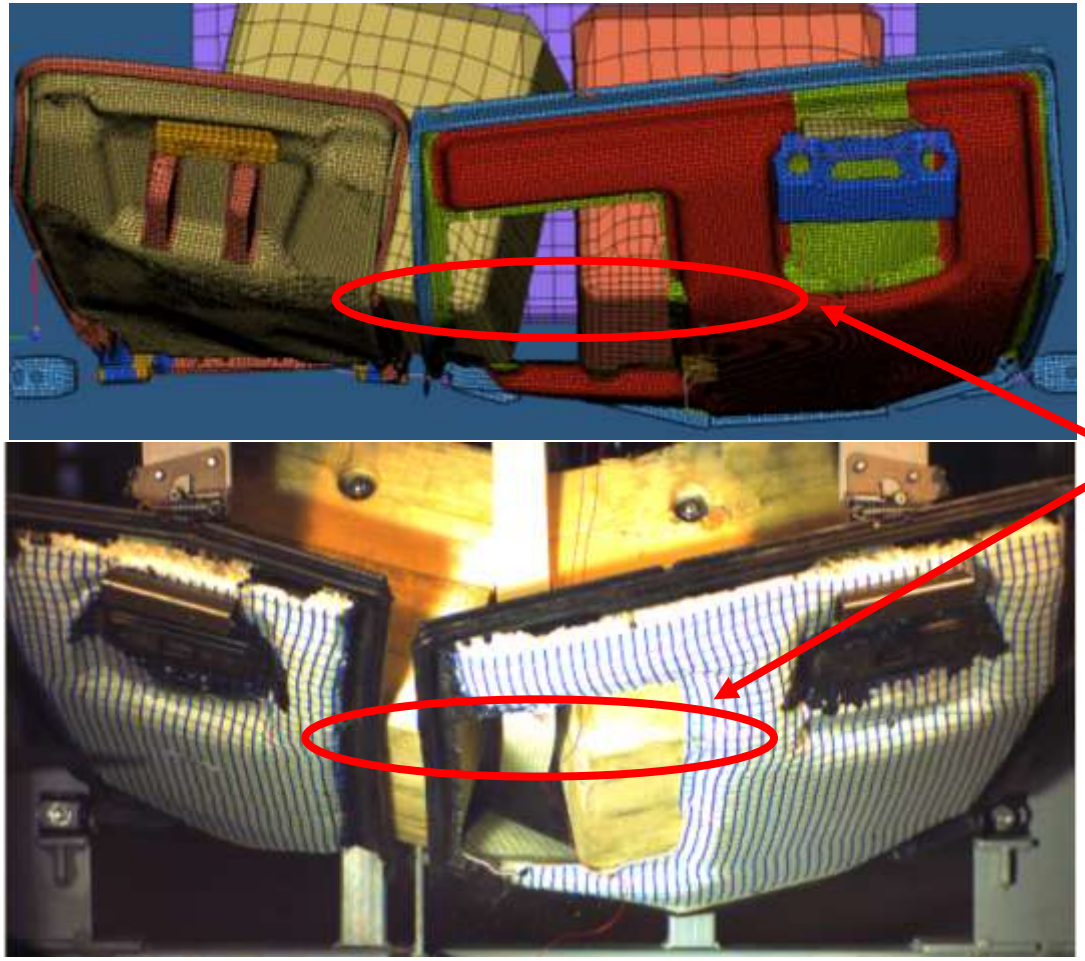
Analysis – Comparison Experiment / Simulation



Bend in 60% BSR

CTSF ® (Composite Twin-SheetForming)

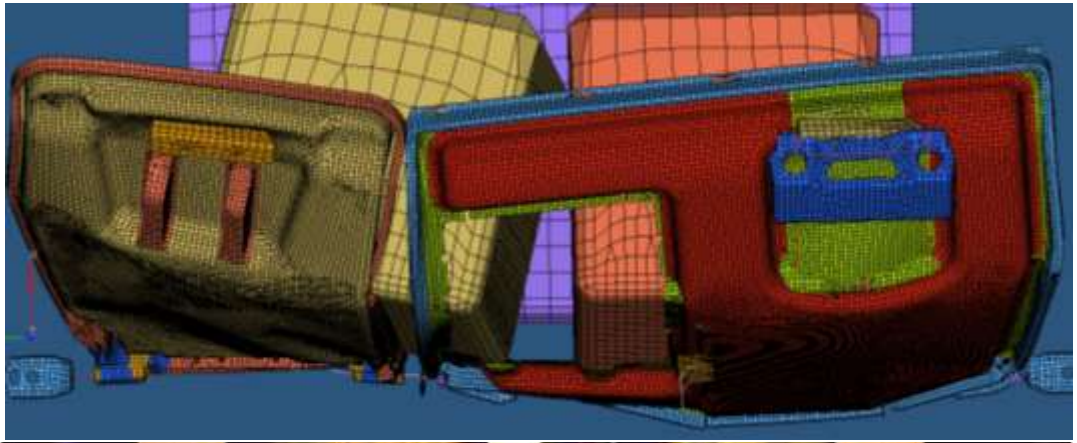
Analysis – Comparison Experiment / Simulation



Bend through upper Edge

CTSF ® (Composite Twin-SheetForming)

Analysis – Comparison Experiment / Simulation



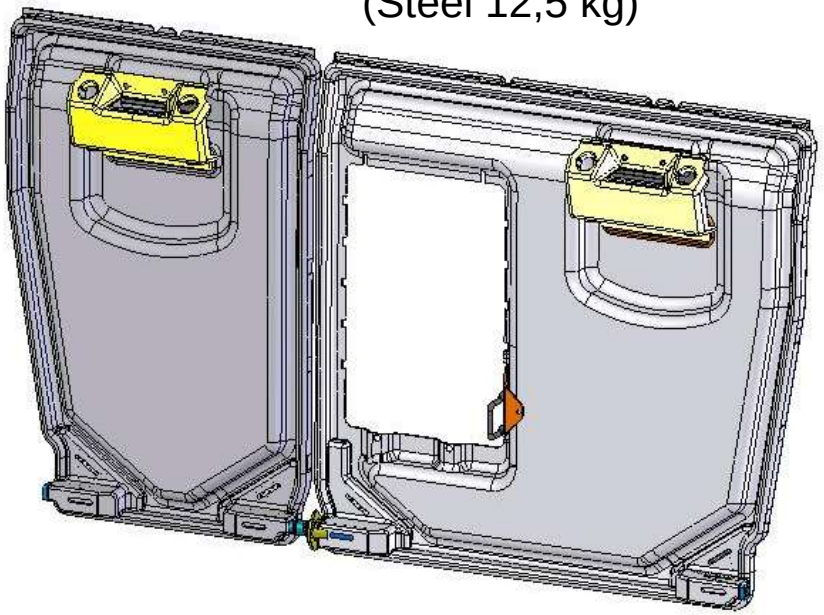
☑ **Test passed**

TFC® (TailoredFlowableCompositeForming)

BSR BMW M3

55% Weight savings:
Composite: 3,4 kg (Steel 7,3 kg)

52% Weight saving:
Composite: 6 kg
(Steel 12,5 kg)



50% Weight savings:
Composite: 2,6 kg (Steel 5,2 kg)

Initial Situation Bumper

Steel in an Automobile/ BMW M3

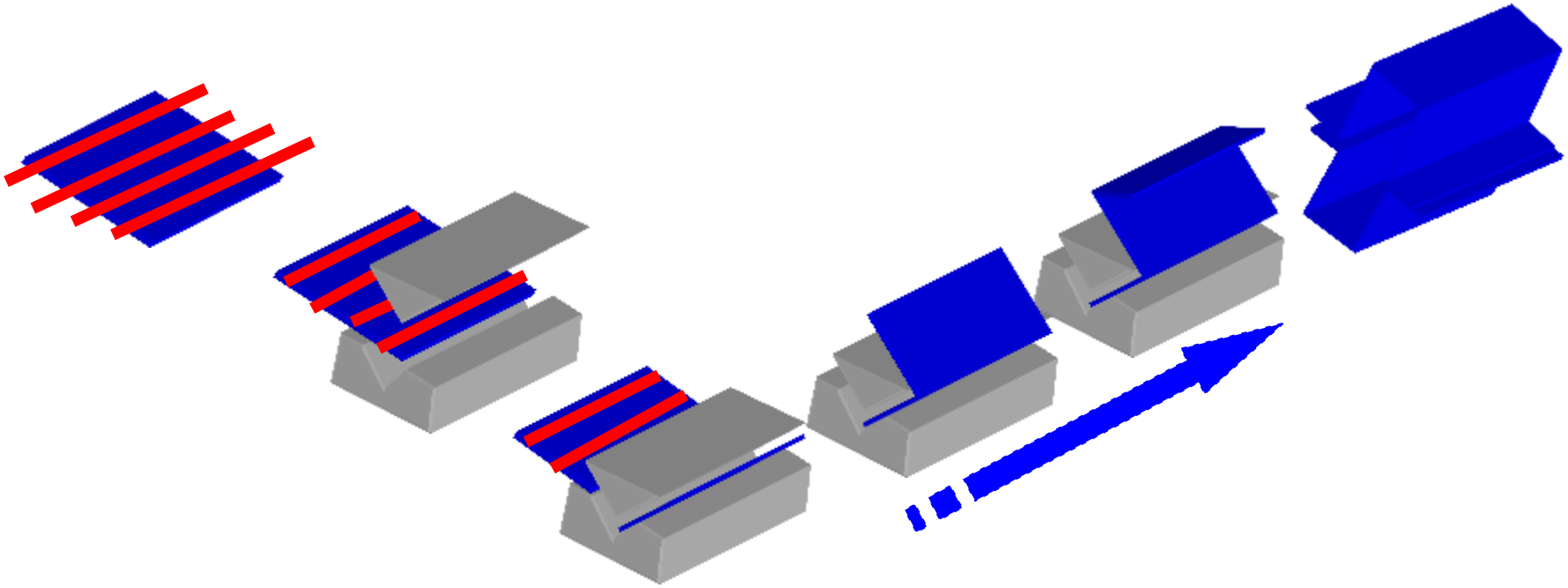
Bumper (rear)
Steel, 11 kg

BSR
Steel, 12,5 kg

Bumper (front)
Steel, 9 kg

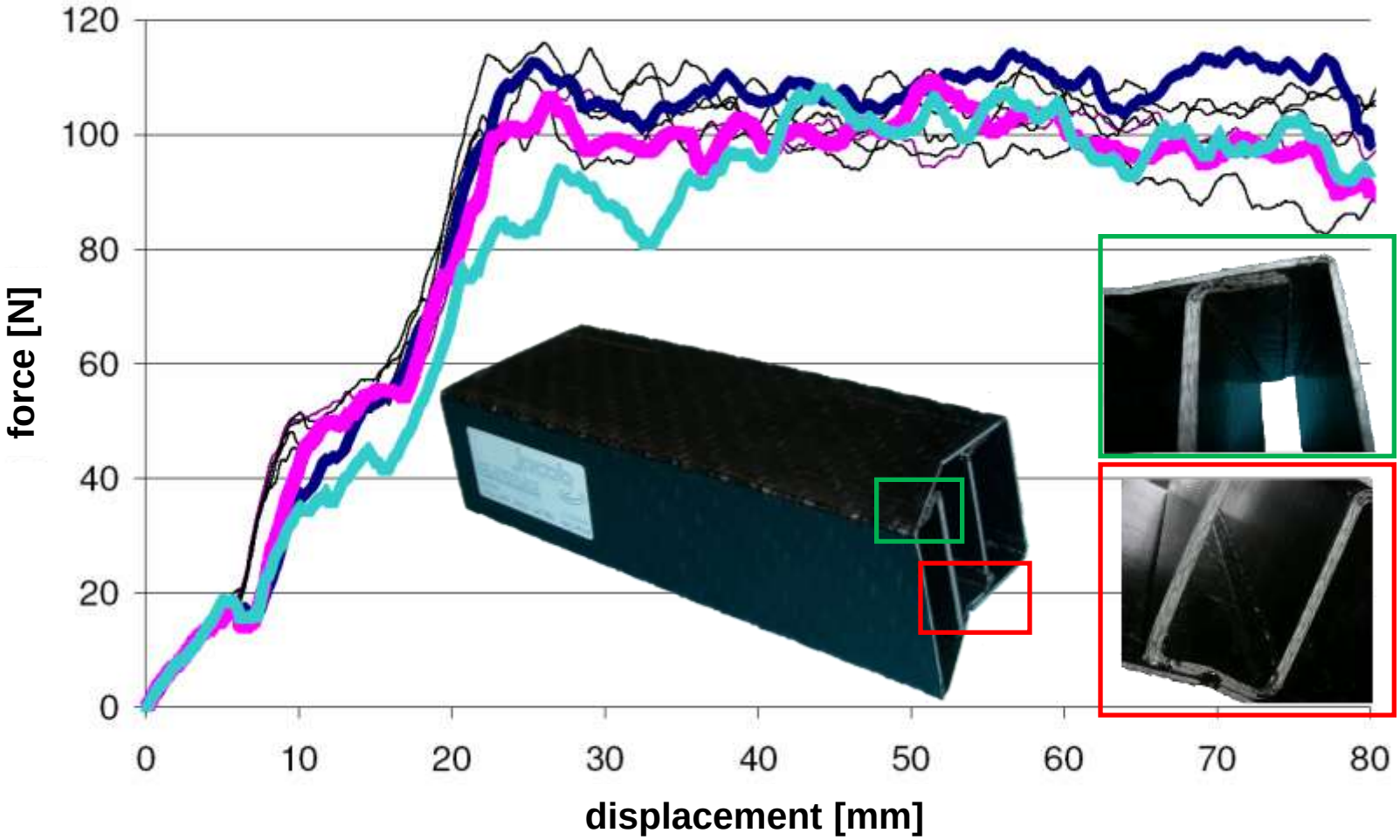
CTB® (Composite Thermo Bending)

Heating (IR) → Transportation → Bending → Bending (2x, 3x, …) → Post Processing (Welding)



CTB® (Composite ThermoBending)

crash element testing

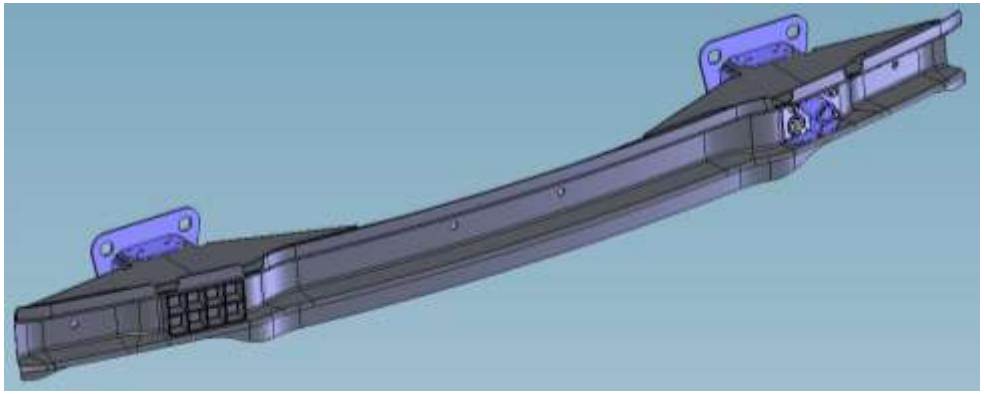


Initial Situation Bumper

Steel in an Automobile/ BMW M3

Bumper (rear)
Steel, 11 kg

71% Weight saving:
Composite: 3,2 kg



Jacob Plastics Group

functional integrated lightweight construction due to processcombination

Lightweightstructures without surcharge – equal perfomance – half weight: greatly weight reduced Components which are suitable for mass production and Structures made of thermoplastic Composites for Automotive application – Unique global Position

- CTSF ® (Composite Twin-SheetForming)
- CTB® (Composite ThermoBending)

Lightweightstructures without surcharge – equal perfomance – half weight: greatly weight reduced Components which are suitable for mass production and Structures made of thermoplastic Composites for Automotive application – Unique global Position

- SpriForm

Single- and Multi-Component Injection Molding: technical and visual challenging Components in Combination with high surface quality (Colors, High-Polish, Structure and Tamponprint)

- FIT-Hybrid

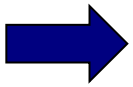
→ **processes > 30.000 pcs. / year**

Product / Process requirements

lightweight construction– equal performance, less weight:
weightreduced components and structures made for automotive structures

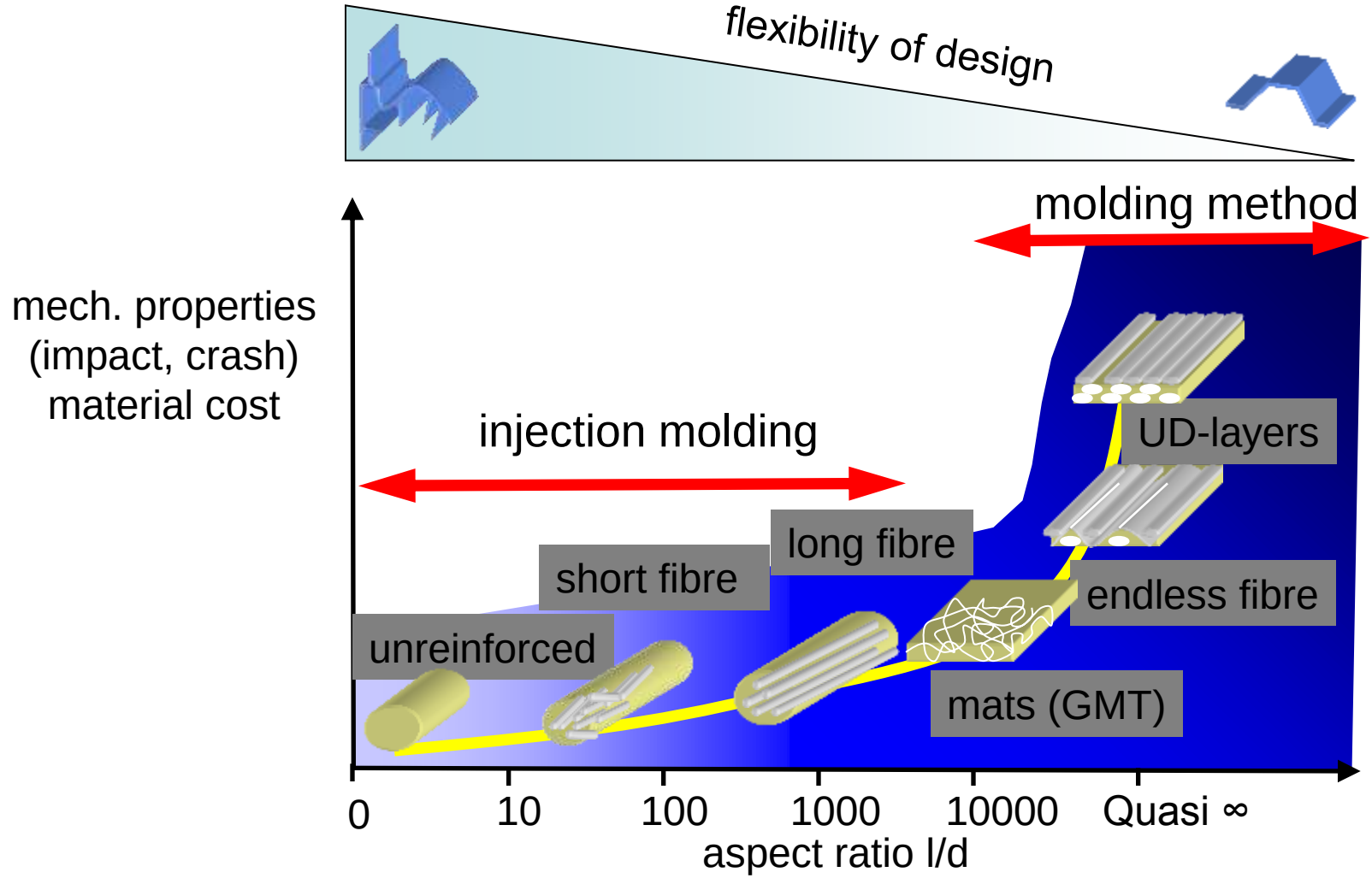
functional integration:
connection technique (fabric- and form closure), shaping / supportstructure for assembly (foil and composite), cost effectivness

large scale production:
high output, short cycle time, high processintegration, low material waste, energy efficiency, continious process



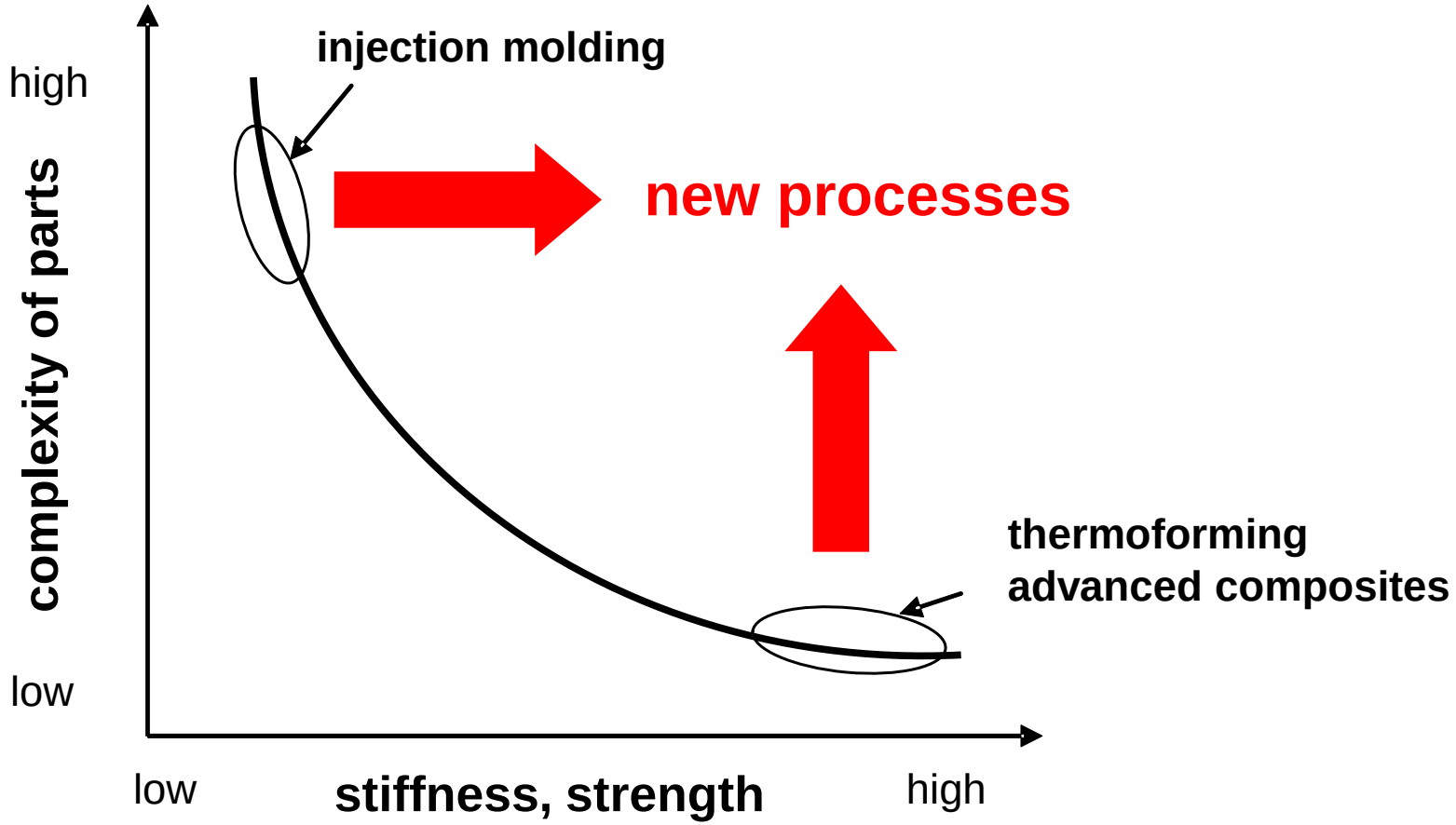
- cost effective & technical robust manufacturing process to produce complex assemblies that are used in the automobile outskirt area
- combination of material and structural lightweight construction

technical framework conditions



technical framework conditions

enhancement of individual process limits



Projekteam

SpriForm

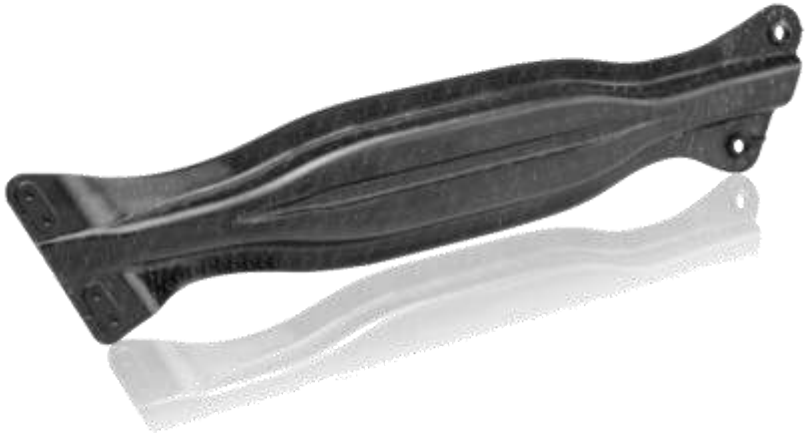
GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

JACOB PLASTICS GROUP

Verarbeitung, Prozessentwicklung
(Projektführer)

BOND LAMINATES

Halbzeug-
entwicklung



Audi

Demonstrator

LANXESS

Rohstoffhersteller,
Simulation

KraussMaffei
PEOPLE FOR PLASTICS

Werkzeug,
Prozessentwicklung

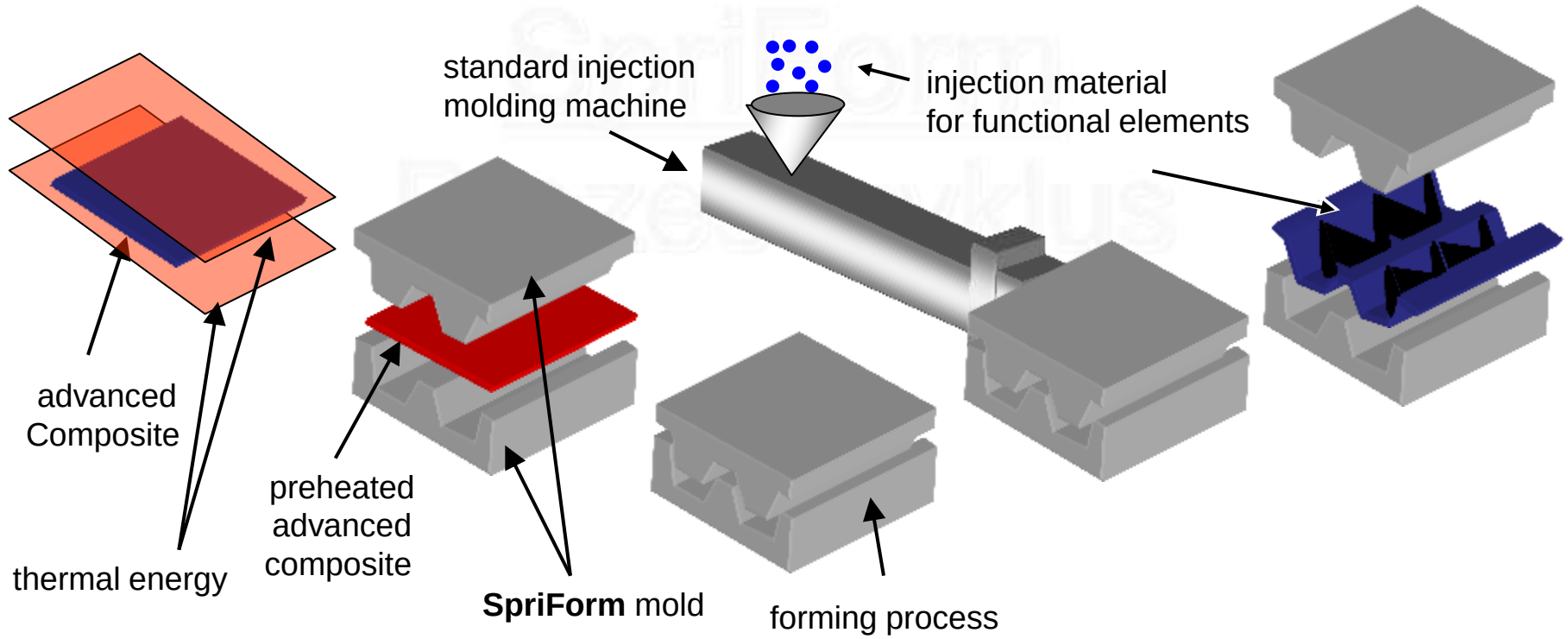
Institut für Verbundwerkstoffe

Prozessentwicklung

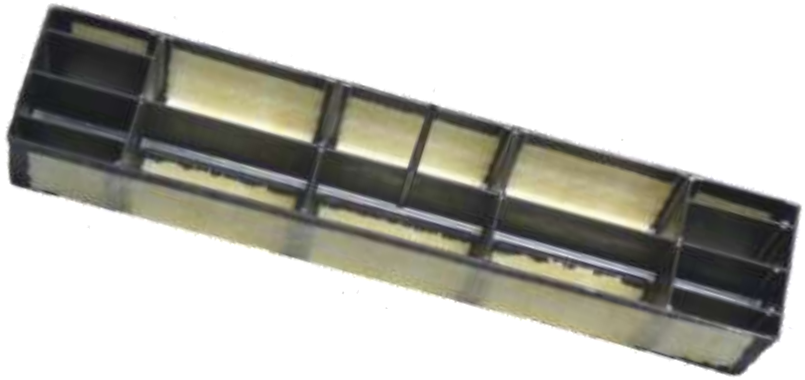
SpriForm
Process

JACOB PLASTICS GROUP

Heating (IR) → Transport → Forming → Injection Molding → Eject



SpriForm beam

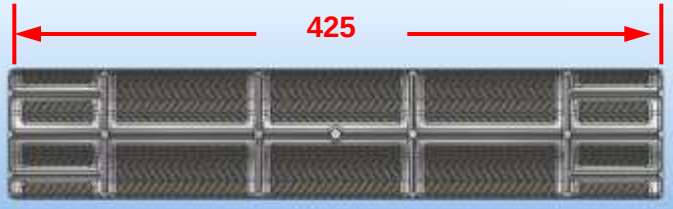


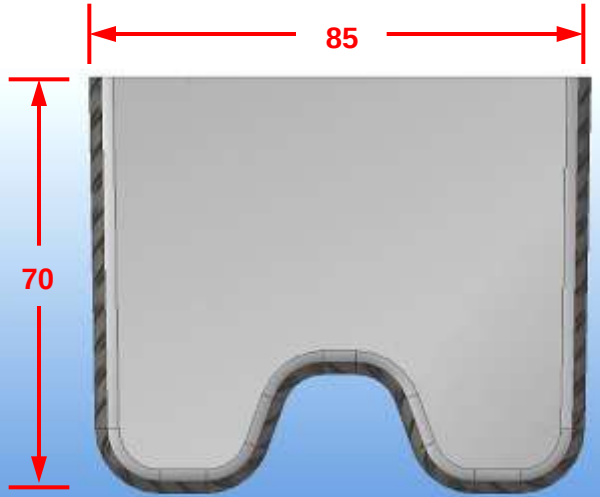
mechanical test

1. 3-point bending
2. fin adhesion test

aterial

PA 6, PPS, PP



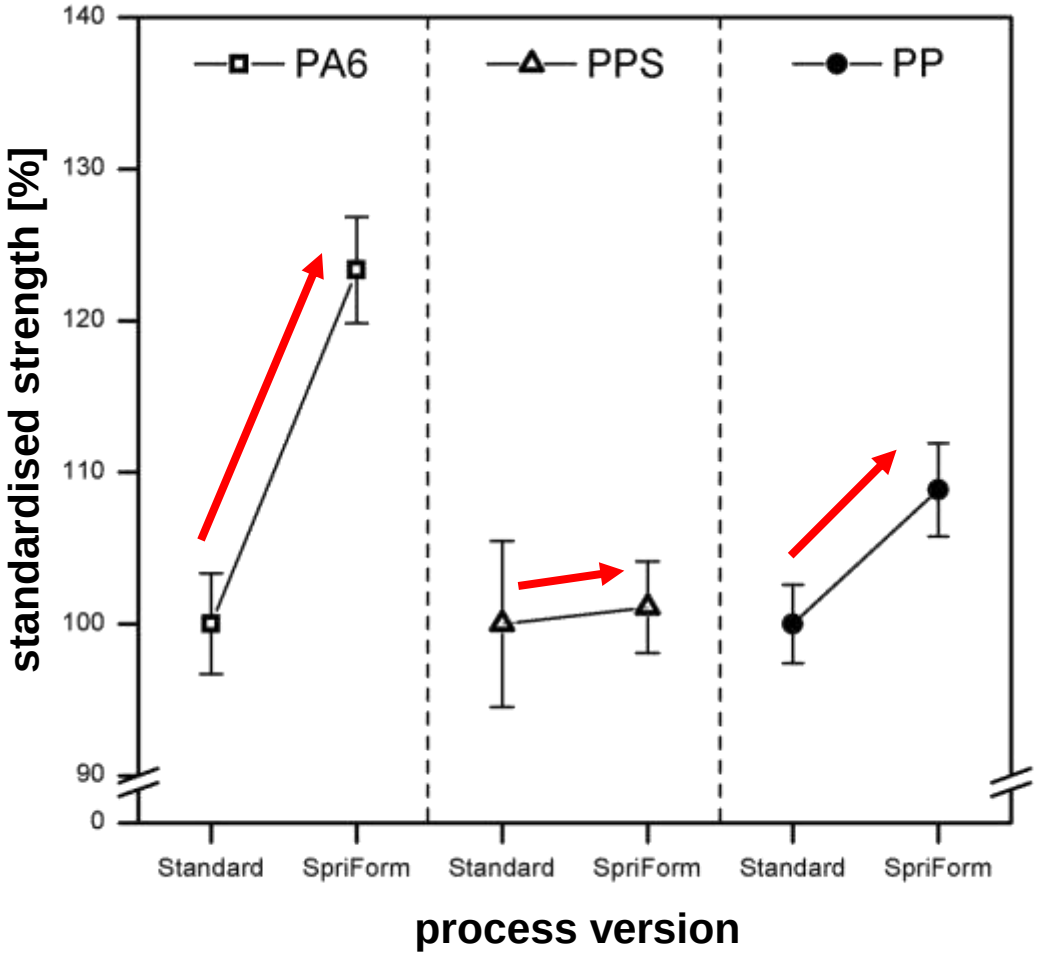


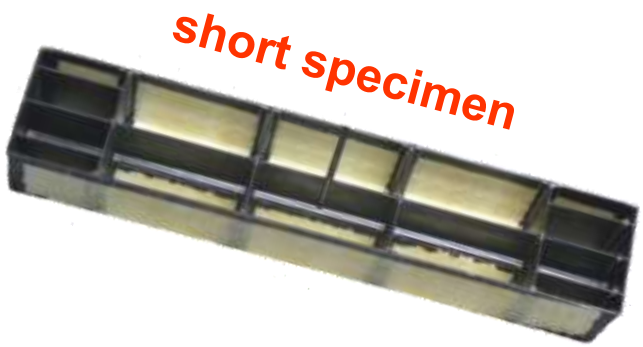
SpriForm

standard vs. SpriForm

JACOB PLASTICS GROUP

better performance at 3-point-bending test by SpriForm





→ **higher bending strength (up to 30%)**

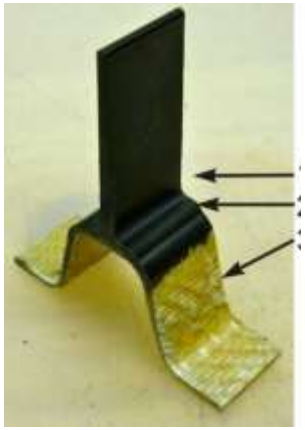
→ **shorter cycle time**

→ **robust process (small standard deviation)**

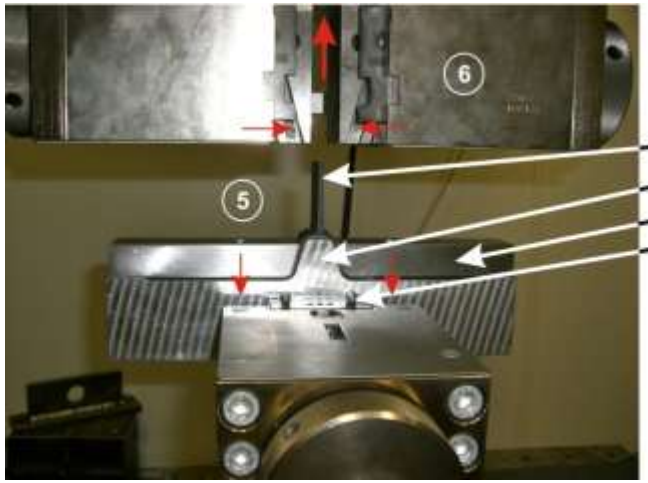
standard: discrete forming process and injection process

SpriForm

fin adhesion test



1) fin
2) root of fin
3) basic form



fin adhesion test experimental set-up

1) specimen
2) clamping tool
3) Clamps
4) position beams

5) screws
6) clamps testing machine

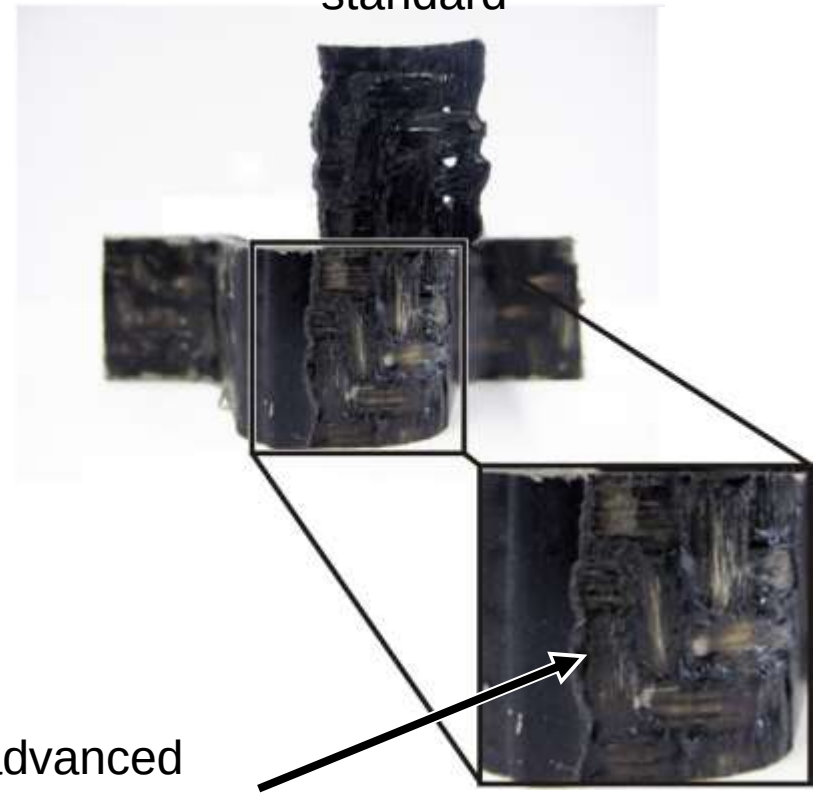
SpriForm

fin adhesion test

adhesion failure
SpriForm

glas fibres

cohesion failure
standard



glas fibres covered with advanced composite → weak bonding

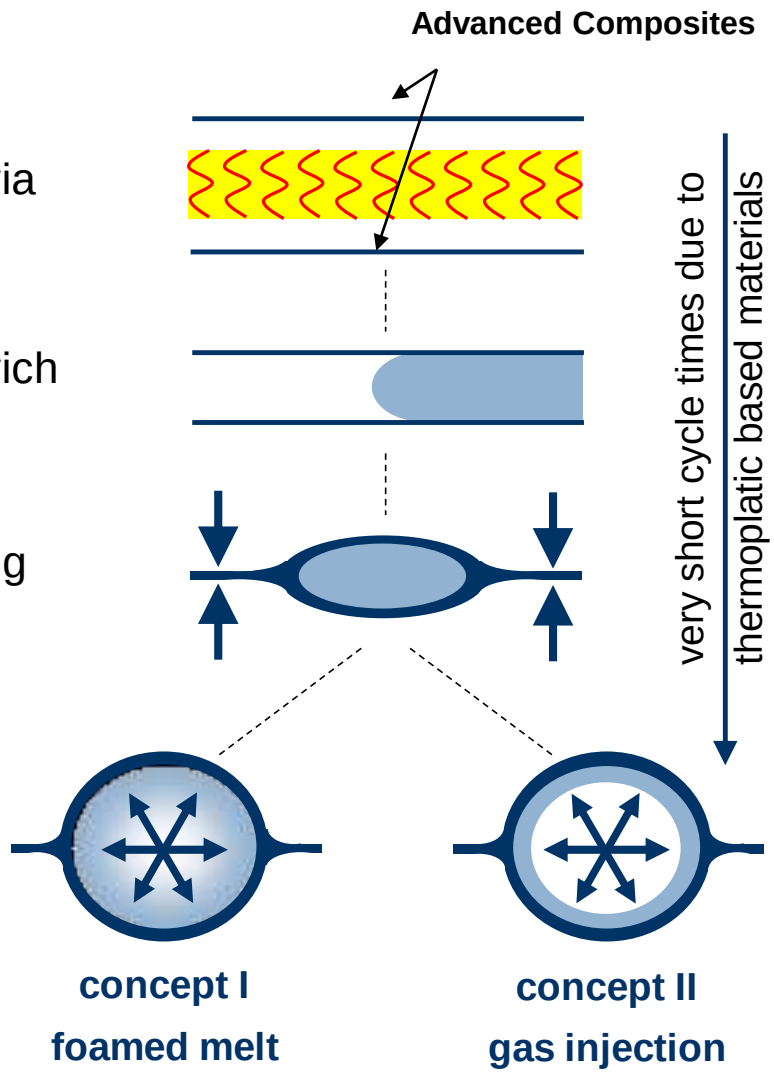
2010 in Düsseldorf at the K-Show

it's time
27 Oct – 3 Nov
2010
Düsseldorf
Germany

FIT-Hybrid (Fluid-Injection-Technology)

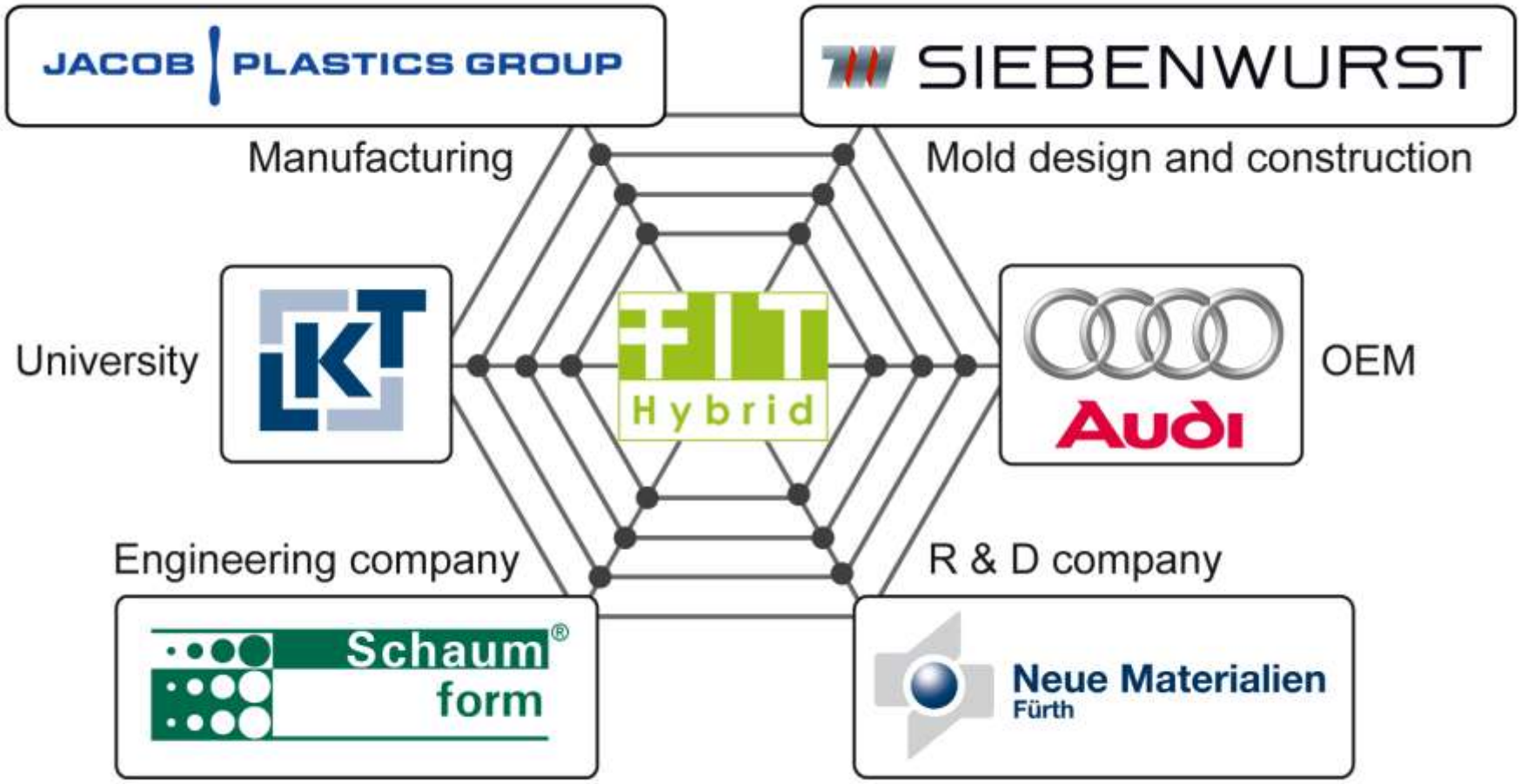
JACOB PLASTICS GROUP

- Pre-heating of organosheets via IR radiators
- Injection moulding as a sandwich
- Pre-forming by melt-embossing
- Shaping via gas pressure



Source: LKT, Erlangen

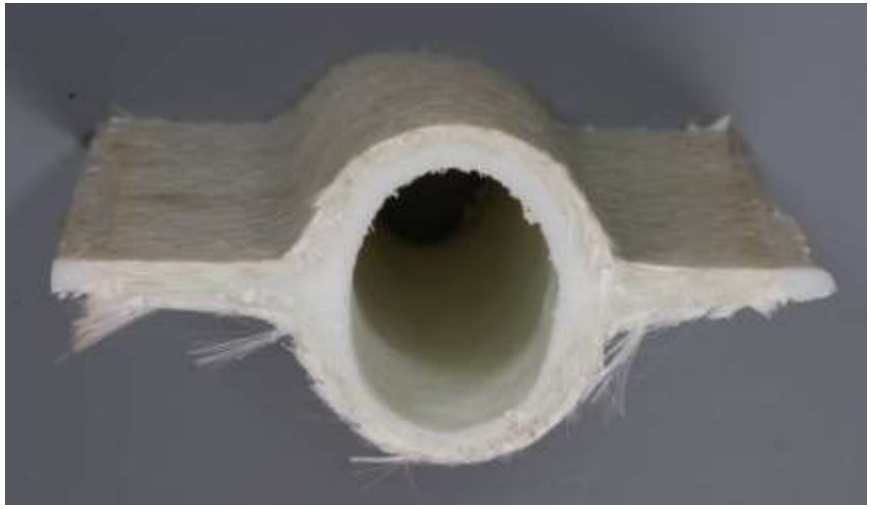
Project consortium



Funded by BMBF, Projektträger Jülich, support code: 03X3016

cavity + gas injection

short specimen



hollow structur short specimen

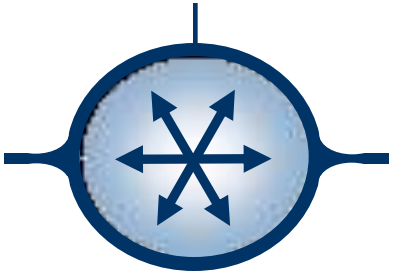
Source: LKT, Erlangen

FIT-Hybrid

large-scale hollow profiles

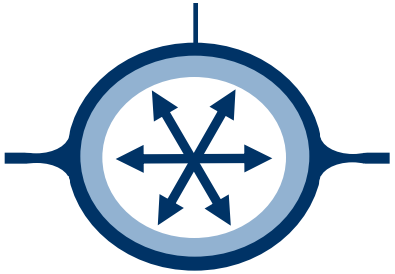
Forming via

gas enriched melt



concept I

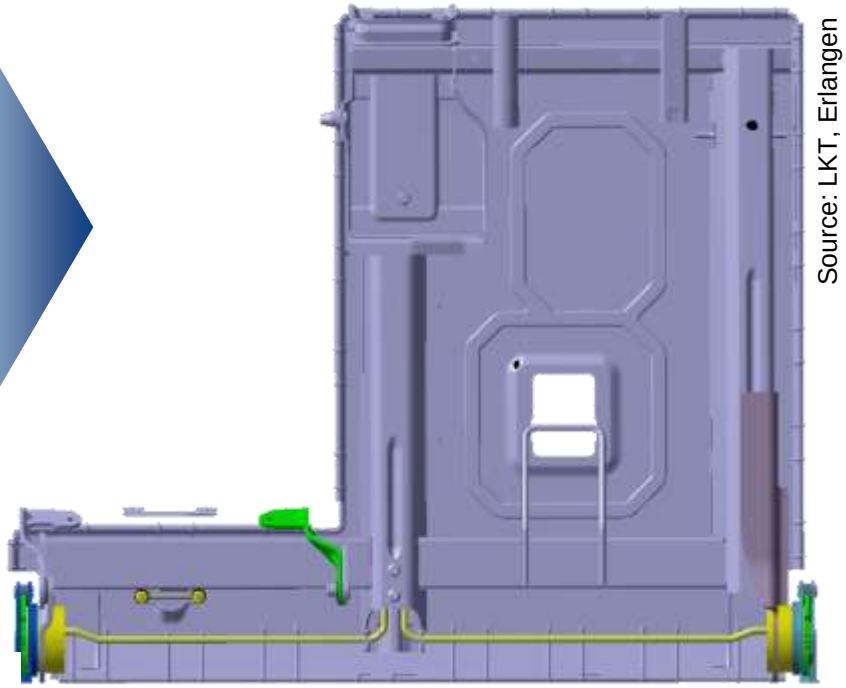
gas injection



concept II

Transfer

reference specimen

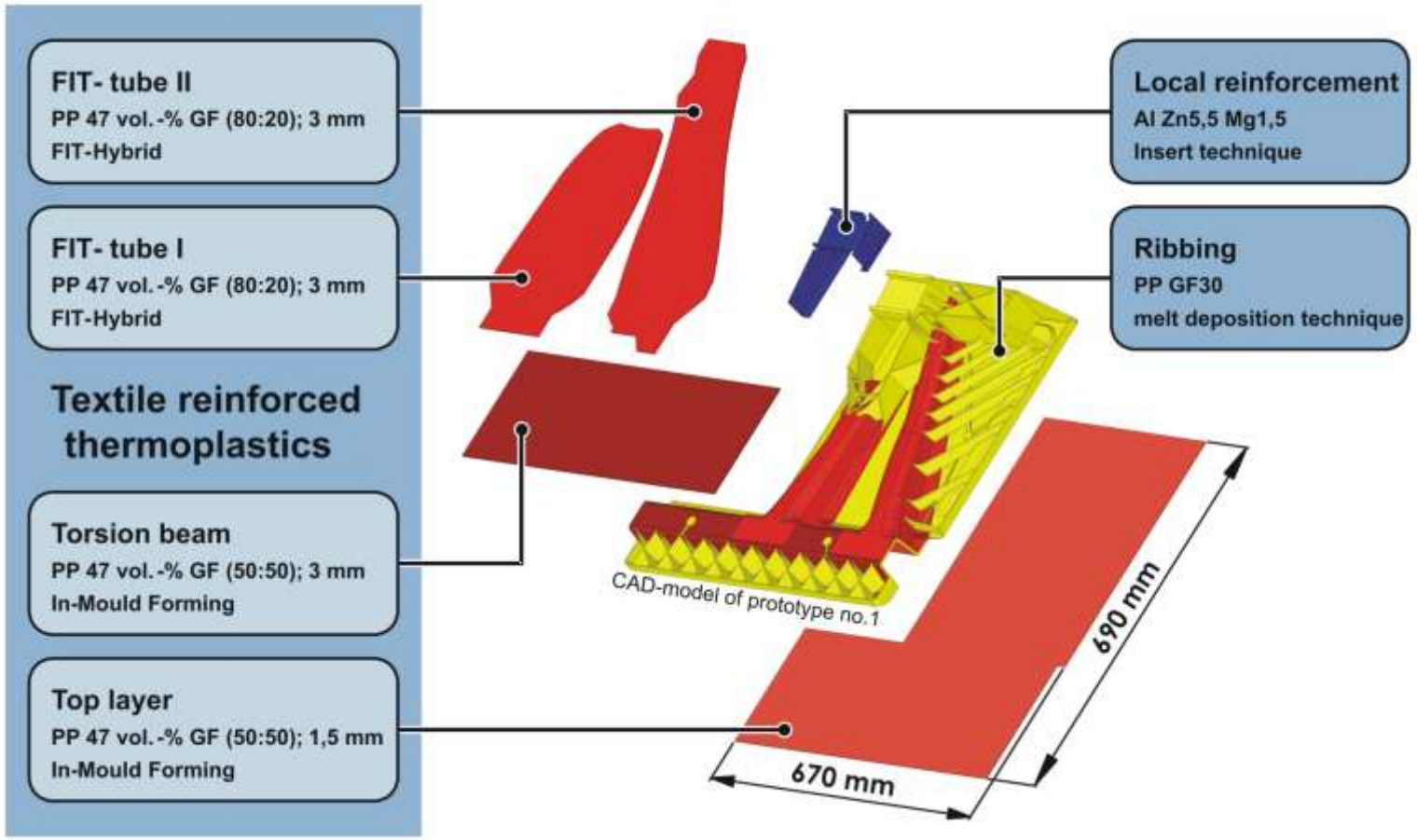


Source: LKT, Erlangen

- production of complex structures with high bending- and torsionstiffness
- high lightweight constr. potential
- cost effective production

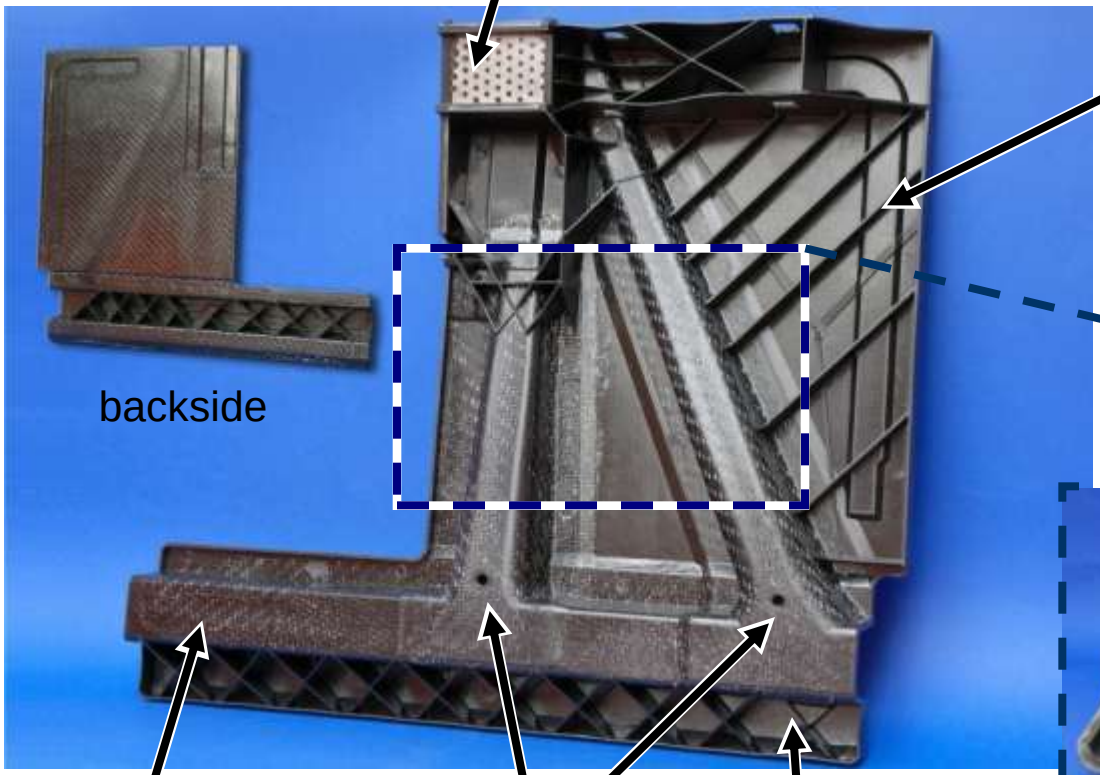
FIT-Hybrid

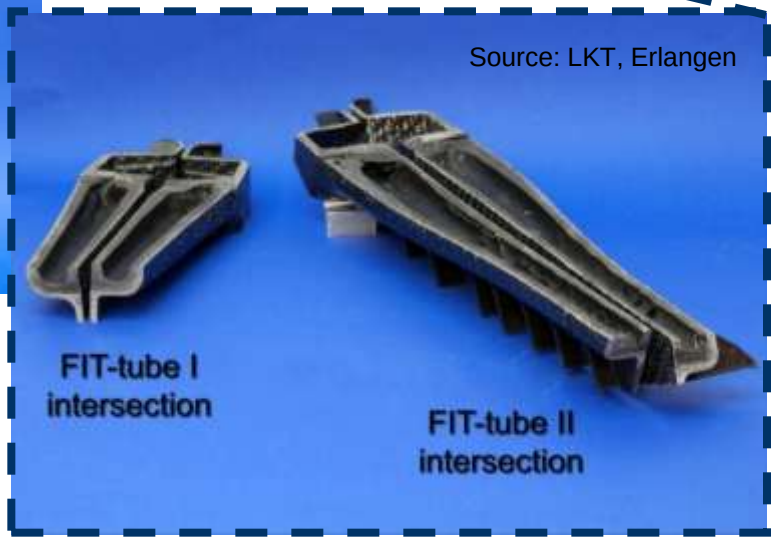
combination structure- and
material lightweight construction



Source: LKT, Erlangen

process cycle time < 90 sec



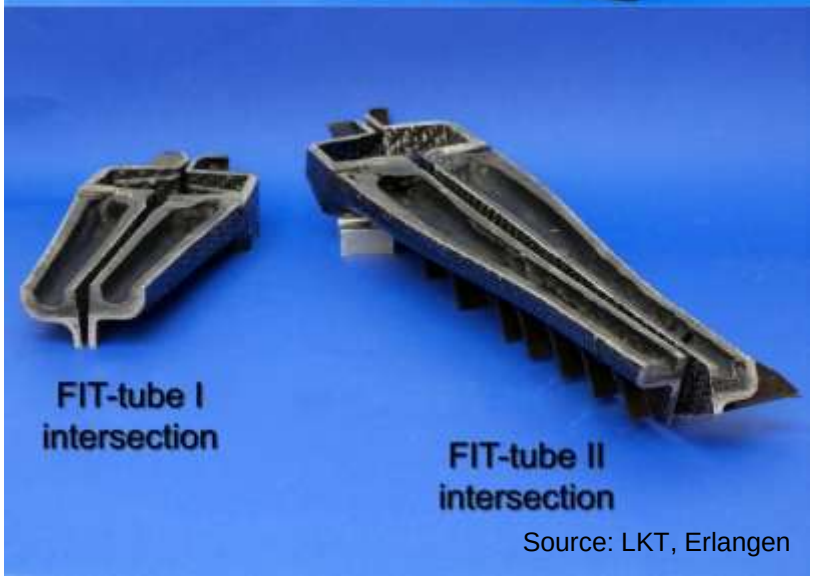


FIT-Hybrid → Showcase Area

key benefits

- shortened process chain due to process integration
- suitable for mass production due to very short cycle times
- cost and energy savings
- outstanding function integration
- high freedom of design
- great lightweight performance by means of lightweight design and lightweight materials
- recyclable due to the application of thermoplastic based materials

Development Phase: Prototype No.1



Source: LKT, Erlangen

JEC COMPOSITES
WINNER OF 2011 INNOVATION AWARD

Innovation-Champion TOP 30

NoAE Innovations-Wettbewerb 2010

Source: LKT, Erlangen

summary new processes

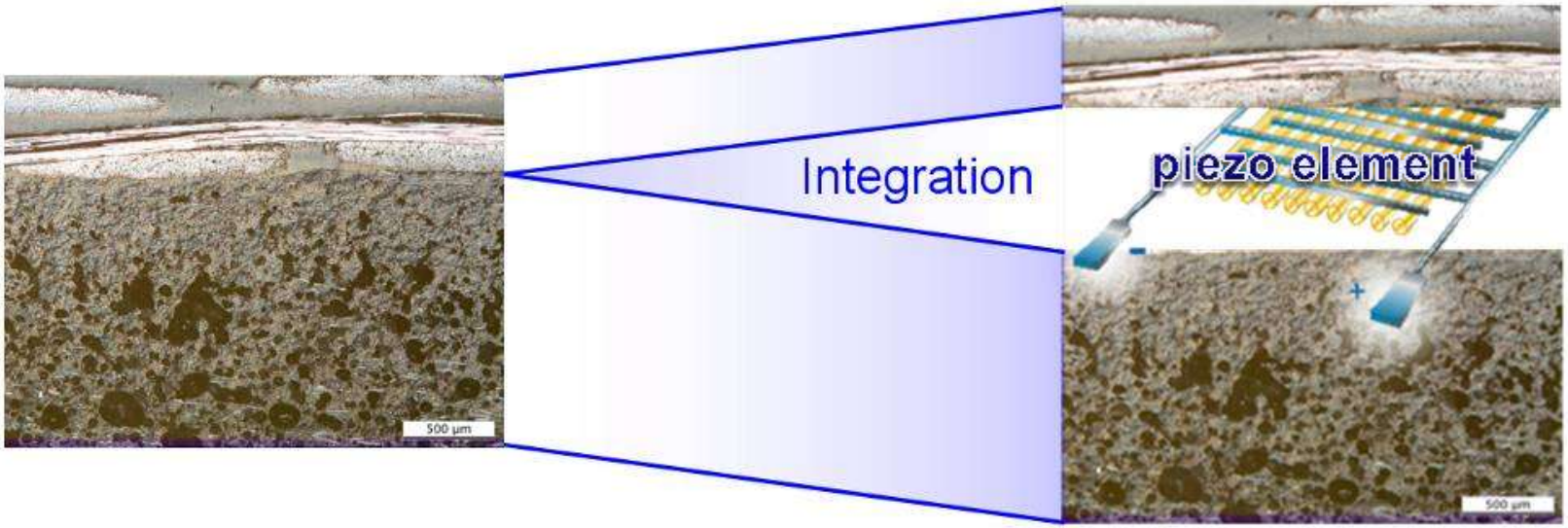
FIT-Hybrid / SpriForm

- Capabilities: high lightweight construction potential due to well-adepted mechanical properties that meet the demands (high performence composite materials)
- Cost effectivness: cost-effective method because the process is based on a thermoplastical manufaction with short cycle times
- Functional integration: direct for forming of geometries for mechanical functions and joints
- Processintegration: direct joining of additional passiv and active materialfractions during the shaping process

outlook

higher functional integrated products

composite



core material
(thermoplastic)

deformationcontrol | shock absorption | health monitoring

Thank you for your attention.