ELN CONFERENCE SPAIN 2026

6TH EDITION · 2026

ELN CONFERENCE SPAIN 2026

EUROPEAN LIGHTWEIGHTING NETWORK

Shaping Europe's lightweight future for sustainable mobility

7–8 OCTOBER 2026 · PALAU MACAYA · BARCELONA

ORGANISED BY

ELN

elca
European Lightweight Clusters Alliance

ACCIÓ
Catalonia Trade & Investment

Generalitat de Catalunya

Mav

eurecat
Centre Tecnològic

bax

DAY 2 · THURSDAY 8 OCTOBER

Welcome & Opening

09:00 – 09:30 · Main Auditorium



EVENT MODERATOR

Ricardo del Valle

ELCA / BAX (ES)

ORGANISED BY

The organisers

European Lightweighting Network

Brings together public authorities to accelerate lightweighting in Europe

european-lightweight.net

European Lightweight Cluster Alliance

Pan-European network of industry hubs, research institutions and enterprises

elcanetwork.eu

ACCIÓ

Catalan Government agency for business competitiveness

accio.gencat.cat

Clúster MAV

The cluster driving innovation in advanced materials and technologies in Catalonia

clustermav.com

Eurecat

The leading technology centre of Catalonia

eurecat.org

Bax Innovation

Innovation consultancy · conference organisation and ELCA secretariat

baxcompany.com

HELD ALONGSIDE

MAV Lightweight Expo
First edition · Rooms 3 & 4 · organised by Clúster MAV, Eurecat, ACCIÓ and BAX
Plus a B2B Brokerage Event in Rooms 5 & 6, via b2match

Organising Committee

The team behind the 6th ELN Conference

ELN CONFERENCE SPAIN 2026



Riánsares López

ACCIÓ



Sofia Calvino

ACCIÓ



Mª Eugenia Rodríguez

EURECAT



Ona Bombí

Clúster MAV



Magdalena Valldosera

Clúster MAV



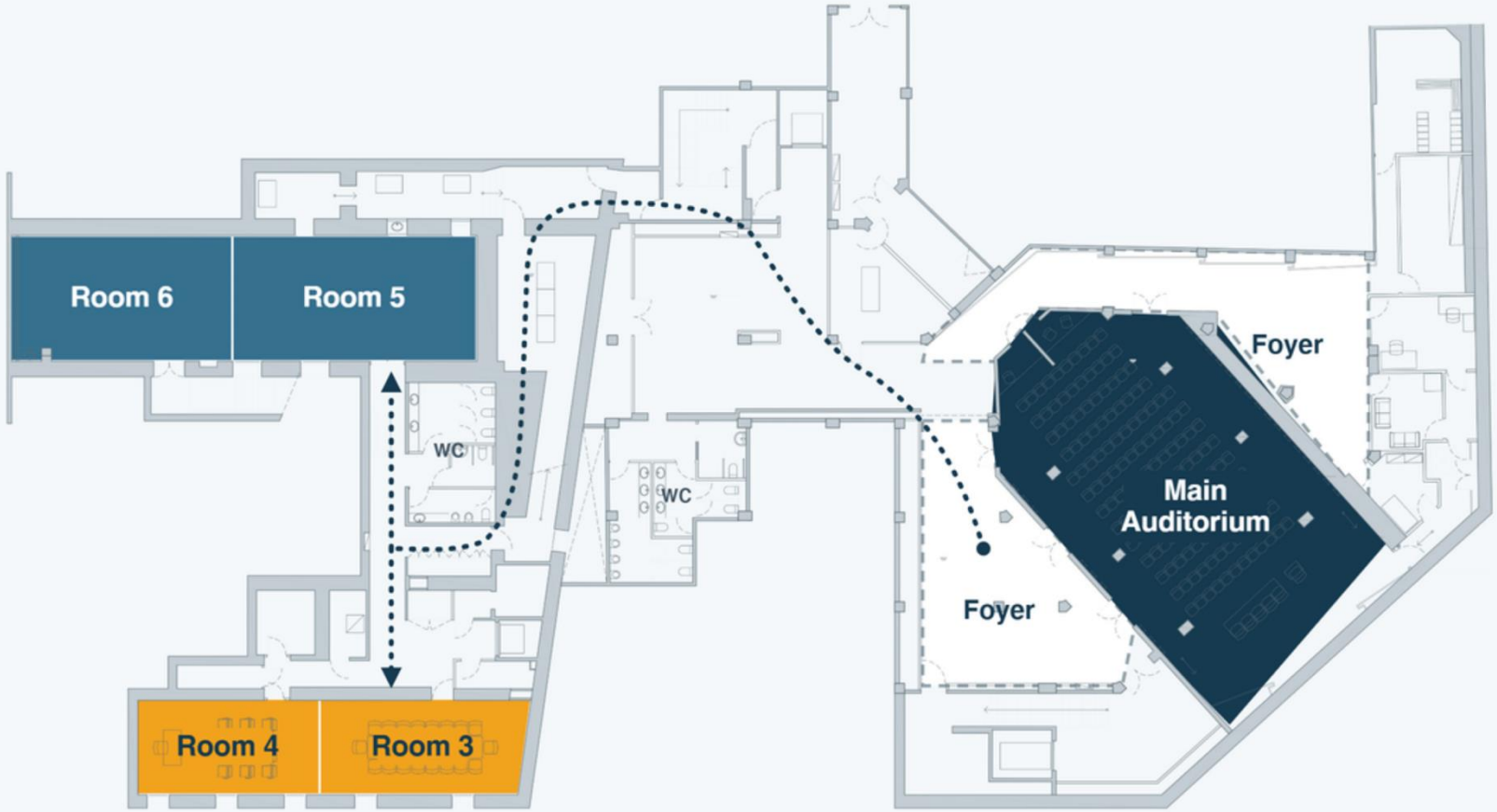
Ricardo del Valle

ELCA / BAX

Venue · Palau Macaya

Passeig de Sant Joan, 108, 08037 Barcelona

ELN CONFERENCE SPAIN 2026



WHERE TO GO

Main Auditorium
ELN Conference sessions

Rooms 3 & 4
MAV Lightweight Expo

Rooms 5 & 6
Brokerage Event · workshops in Room 5

Foyer
Next to the Main Auditorium · coffee breaks and lunch

PRACTICAL INFORMATION

Accreditation: Palau Macaya entrance hall

Wi-Fi: WIFI_PALAU_MACAYA

Programme · Day 2

Thursday 8 October 2026 · ELN Conference, Main Auditorium · Event moderator: Ricardo del Valle, ELCA / BAX

ELN CONFERENCE SPAIN 2026

08:30 *Registration*

09:00–09:30 **Welcome & Opening**
Welcome and opening of Day 2

09:30–11:00 **Railway**
Moderator: **Ignasi Gómez-Belinchón, IN MOVE cluster (ES)**
Francisco Javier Vallejo (IDEKO) · Jaume Casals (Refisa) · Robert Schlosser & Maximilian Denk (Leitz) · Stefanie Brickwede (Mobility goes additive)

11:00 *Coffee break · foyer*

11:30–13:00 **Automotive II**
Moderator: **Iker Arroyo, Eurecat (ES)**
Pierre Daniel (BTECH) · František Simančík (IMMM-SAS) · Carlos Muñoz (Gestamp) · Herfried Lammer (HEAD)

13:00 *Lunch · foyer*

14:00–15:30 **Defence, Security and Dual-Use Technologies**
Moderator: **Stephany Rivero, AeroS Ecosystem (ES)**
Thomas Hipke (Fraunhofer IWU) · Manuel García (2M Engineering) · Samanta Simon (Airbus GeoTech) · Stanislav Landa (DTI)

15:30 **Closure of the conference**

IN PARALLEL TODAY

MAV Lightweight Expo
Rooms 3 & 4
All day

Brokerage Event
Rooms 5 & 6 · b2match
09:00–15:30 Rooms 5 & 6
15:30–17:30 Room 6 only

Room 5
Same space as Brokerage
15:30–17:30 ELN Workshop (ELN members)

Coffee breaks and lunch are served in the foyer next to the Main Auditorium.

DAY 2 · THURSDAY 8 OCTOBER

Railway

09:30 – 11:00 · Main Auditorium



MODERATOR

Ignasi Gómez-Belinchón

IN MOVE cluster (ES)

SPEAKERS

Francisco Javier Vallejo IDEKO (ES)

Jaume Casals Refisa (ES)

Robert Schlosser & Maximilian Denk Leitz GmbH & Co. KG (AT)

Stefanie Brickwede Mobility goes additive (DE)



PRESENTATION 1 OF 4

Francisco Javier Vallejo

Researcher, IDEKO (ES)

From Lab to Market: Automated, Ultra-Fast and Clean Manufacturing of Fiberglass-Reinforced Polyester Components

A success story from low TRL to market-ready technology and startup creation

IDEKO MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

ESTIO by IDEKO MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

FROM LAB TO MARKET
Automated, Ultra-Fast and Clean Manufacturing of Fiberglass-Reinforced Polyester Components.

A success story from low TRL to market-ready technology and startup creation

Francisco Javier Vallejo Rasero, PhD
Manufacturing Processes
fjvallejo@ideko.es

IDEKO MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

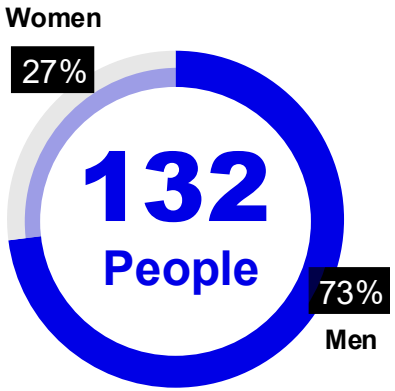
WHO WE ARE

IDEKO is a **Research Center** member of BRTA, specialized in **Advanced Manufacturing.**

SPECIALIZATION

- **DYNAMICS & CONTROL**
- **MANUFACTURING PROCESSES**
- **DESIGN & PRECISION ENGINEERING**
- **ICT & AUTOMATION**

FIGURES





SECTORS

- CAPITAL GOODS
- AERONAUTICS
- ENERGY
- STEEL
- PAPER
- AUTOMOTIVE
- RAILWAY

DANOBAT · SORALUCE · GOIMEK · FAGOR ARRASATE · ekin · SIKULAN · LANBI · MYL · ALDAKIN · Korta · TORRES · ZUBIOLA · ITP Aero · AIRBUS · AERnnova · SAFRAN · MITSUBISHI · DASSAULT SYSTEMES · BOEING · SIEMENS Gamesa · LAULAGUN bearings · Guascor Energy · Ingeteam · sidenor · TUBACEX GROUP · Tenaris · lantier · GC · LUCART · TORRASPAPEL · NAVIGATOR · RONALGROUP · Gestamp · KNI · epc · CAF · Talgo

ESTIO

The challenge



The composite manufacturing industry is facing three converging challenges

Health & safety

Styrene emissions and glass-fibre exposure

Productivity

Manual processes → variable quality and long lead times

Sustainability

Waste, energy consumption and end-of-life challenges

Implementing a clean, automated, cost-effective process for fiberglass composite manufacturing

Application sectors



The technology

UV curing transforms hours of thermal processing into minutes



UV curing resins

Excellent features

- **Ultrafast curing** → reduced processing time
- **Selective curing** → no curing without UV irradiation
- **No need** for large curing ovens
- **Deep-curing** → BAPO photoinitiators
- **Very low pollutant emissions** (elimination of styrene)

Disadvantages

- **Need for UV-transparent materials** → Fiberglass

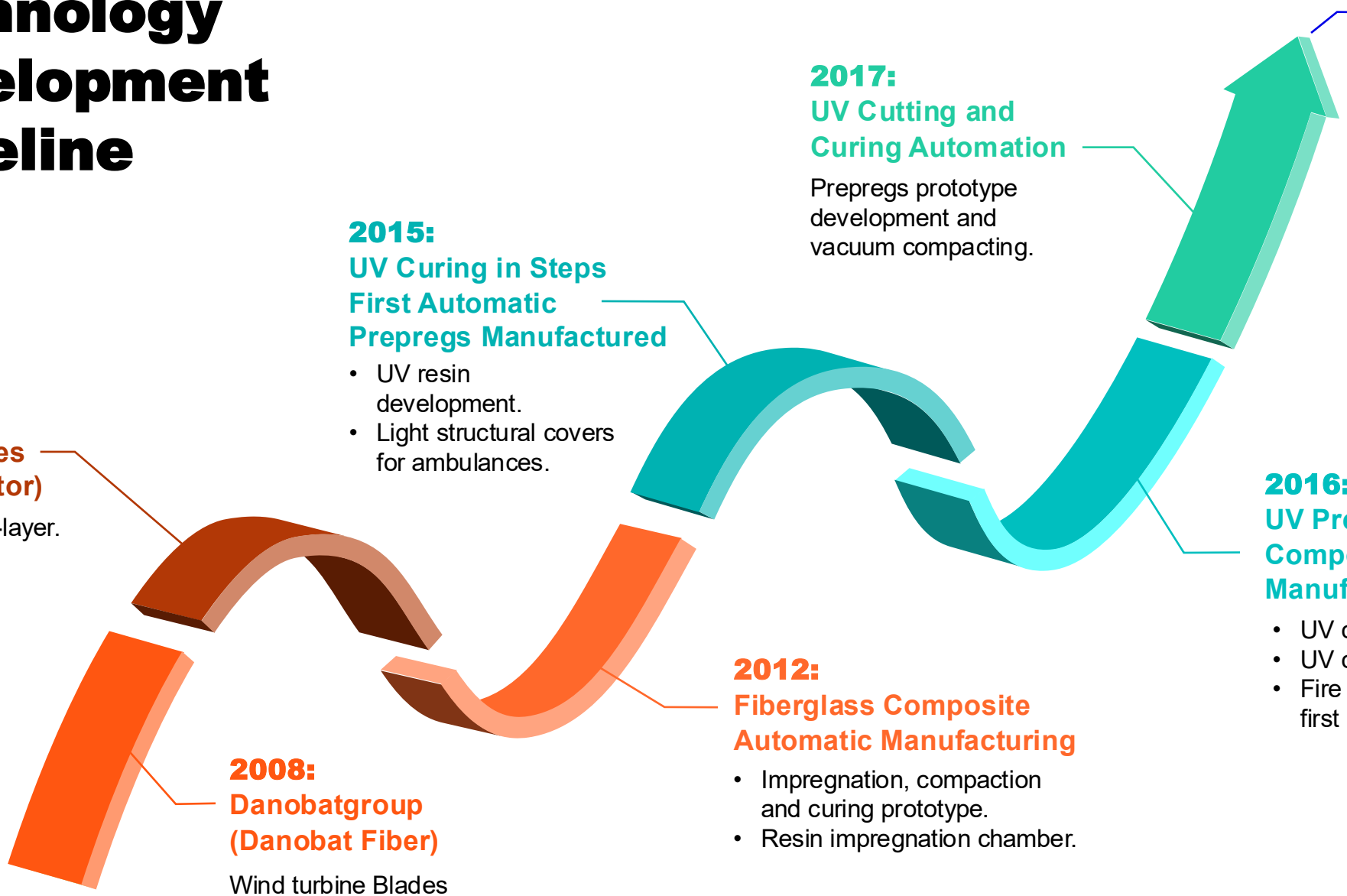


From lab to Industrial technology

15 years of development transformed UV curing into an industrial manufacturing technology



Technology Development Timeline



2008:
Danobatgroup (Danobat Fiber)

Wind turbine Blades complete automatisation.

2011:
UV Cured Composites (Eolic sector)

Curing layer-layer.

2012:
Fiberglass Composite Automatic Manufacturing

- Impregnation, compaction and curing prototype.
- Resin impregnation chamber.

2015:
UV Curing in Steps First Automatic Prepregs Manufactured

- UV resin development.
- Light structural covers for ambulances.

2016:
UV Prepregs and Composites Prototype Manufactured

- UV cured Prepregs.
- UV compaction Robot.
- Fire retardant components first development (rail sector).

2017:
UV Cutting and Curing Automation

Prepregs prototype development and vacuum compacting.

2020:
Fire Retardant Composites Development

End fire retardant components manufactured.

Technology Development Timeline





2008:
Danobatgroup (Danobat Fiber)

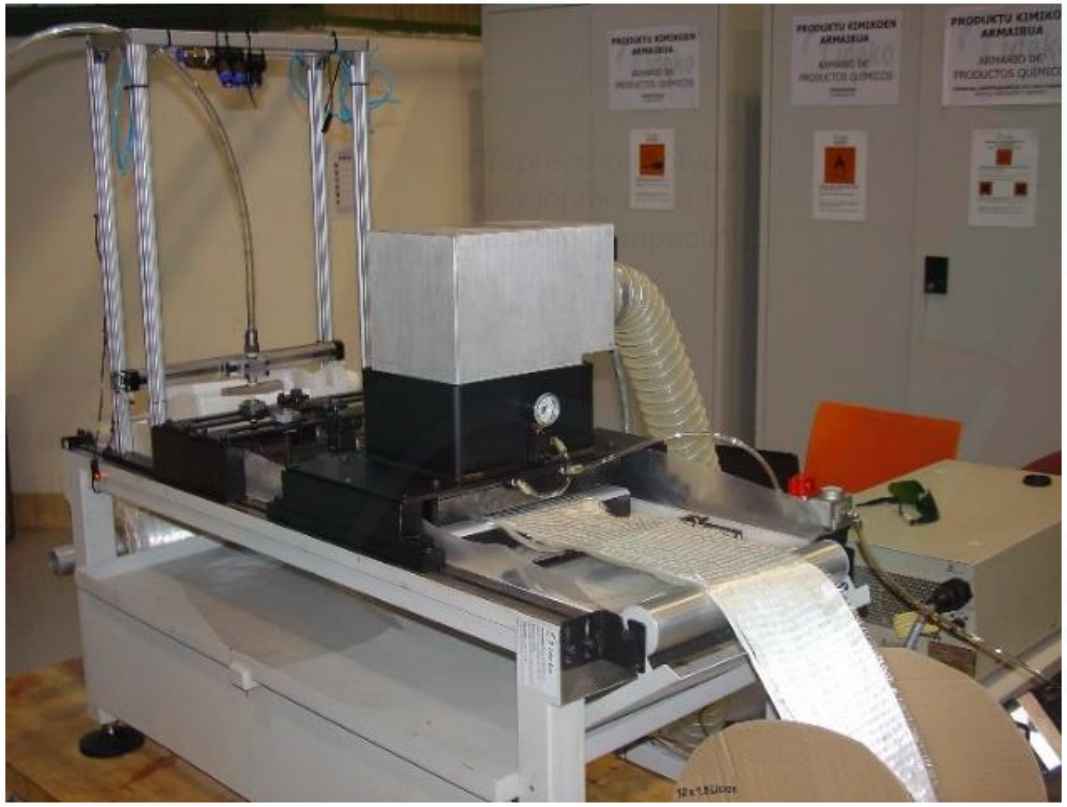
Wind turbine Blades complete automatisation.

Technology Development Timeline

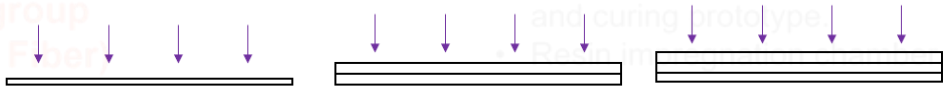
2011:
UV Cured Composites (Eolic sector)

Curing layer-layer.

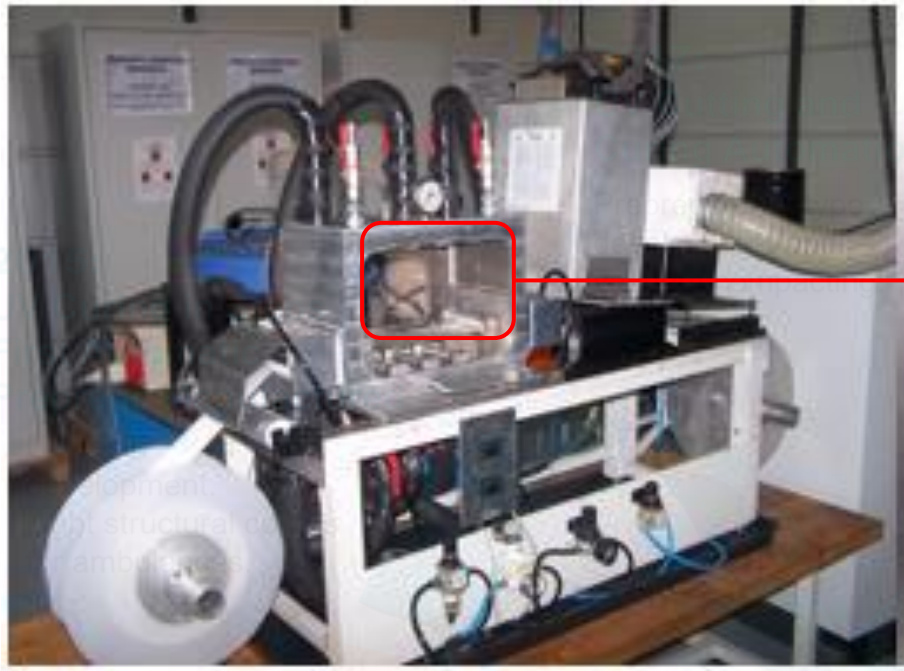




Impregnation, compaction and curing prototype



Technology Development Timeline





2012:
Fiberglass Composite Automatic Manufacturing

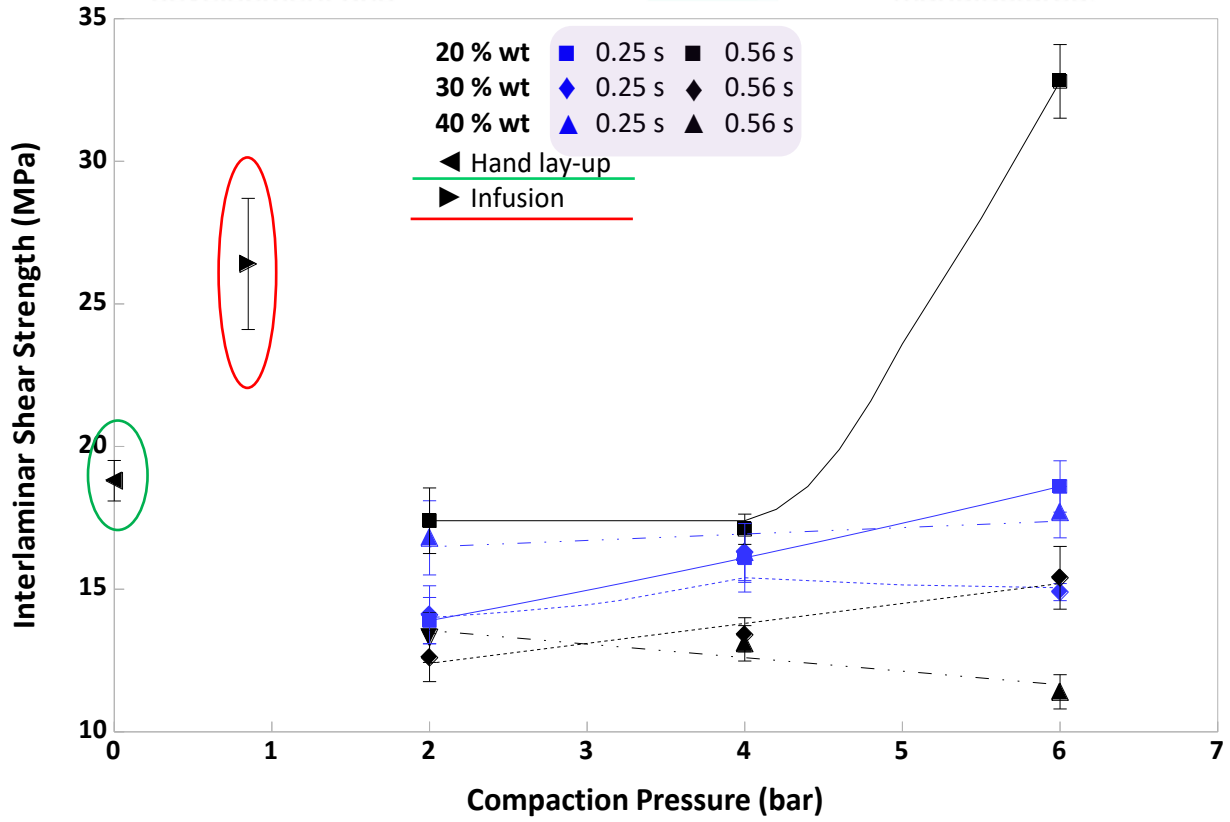
- Impregnation, compaction and curing prototype.
- Resin impregnation chamber.

Technology Development Timeline

To perform impregnation, lamination, and curing in a single stage→ Inefficient

Proposal: 2 Stages

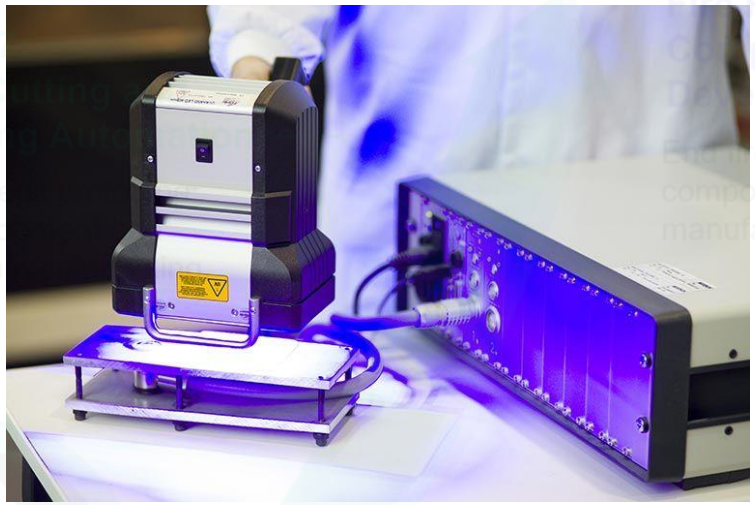
1. **Prepreg Manufacturing: Resin formulation.** *(EP-21382661,3).*
2. **Composite Consolidation: Feasibility study of an automated process.** https://doi.org/10.3390/jcs4010030



Technology Development Timeline

2015:
UV Curing in Steps First Automatic Prepregs Manufactured

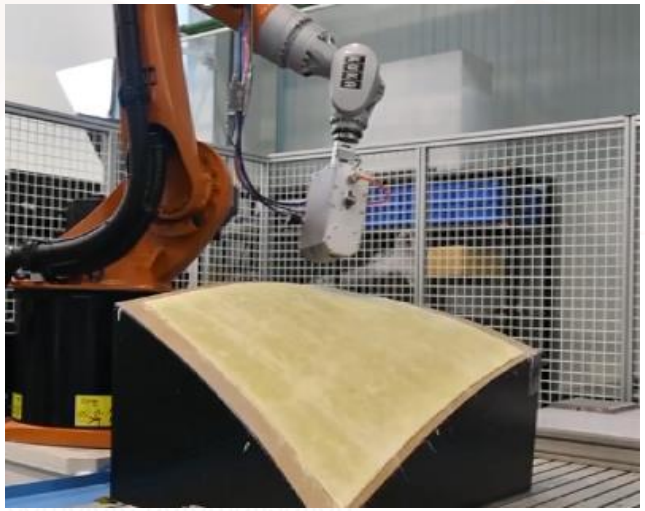
- UV resin development.
- Light structural covers for ambulances.





Technology Development Timeline



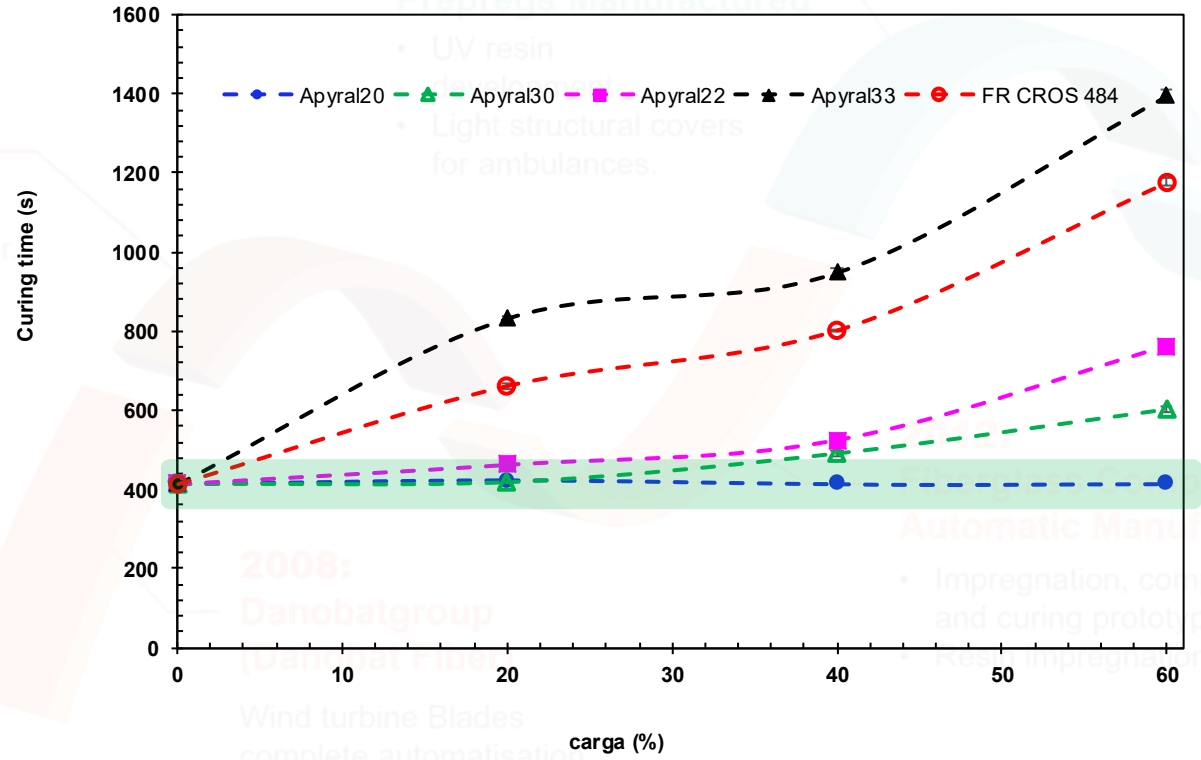


2016:
UV Prepregs and Composites Prototype Manufactured

- UV cured Prepregs.
- UV compaction Robot.
- Fire retardant components first development (rail sector).

Technology Development Timeline

Flame-retardant formulations can be UV-cured without compromising curing rate.

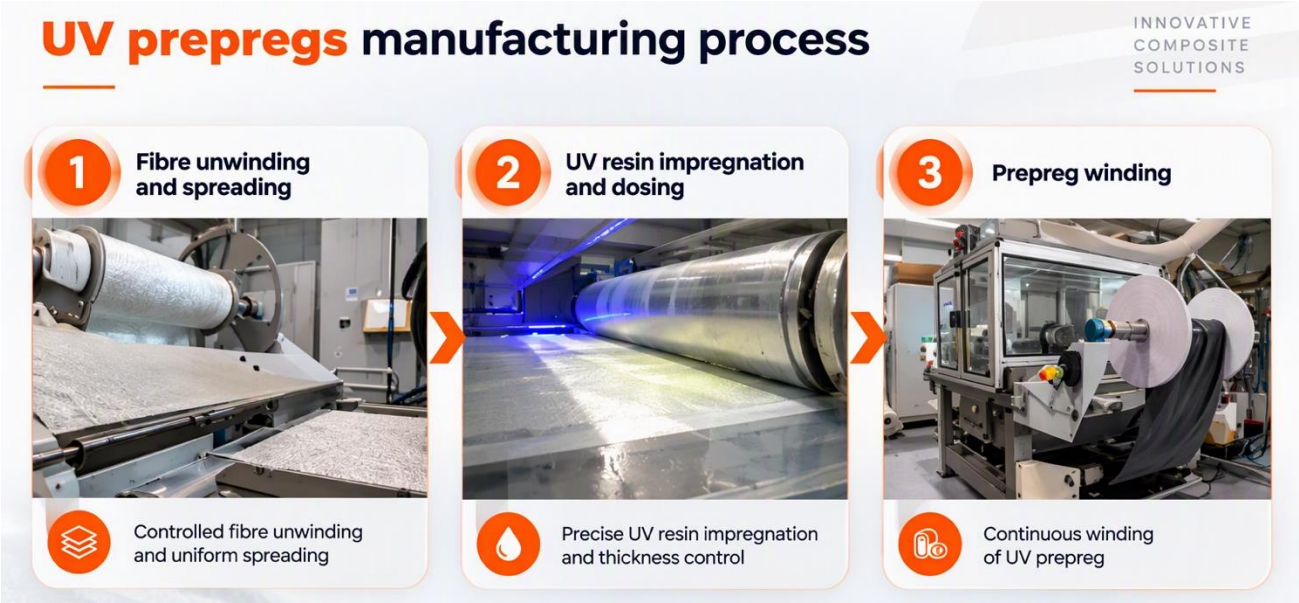


2020:
Fire Retardant Composites Development

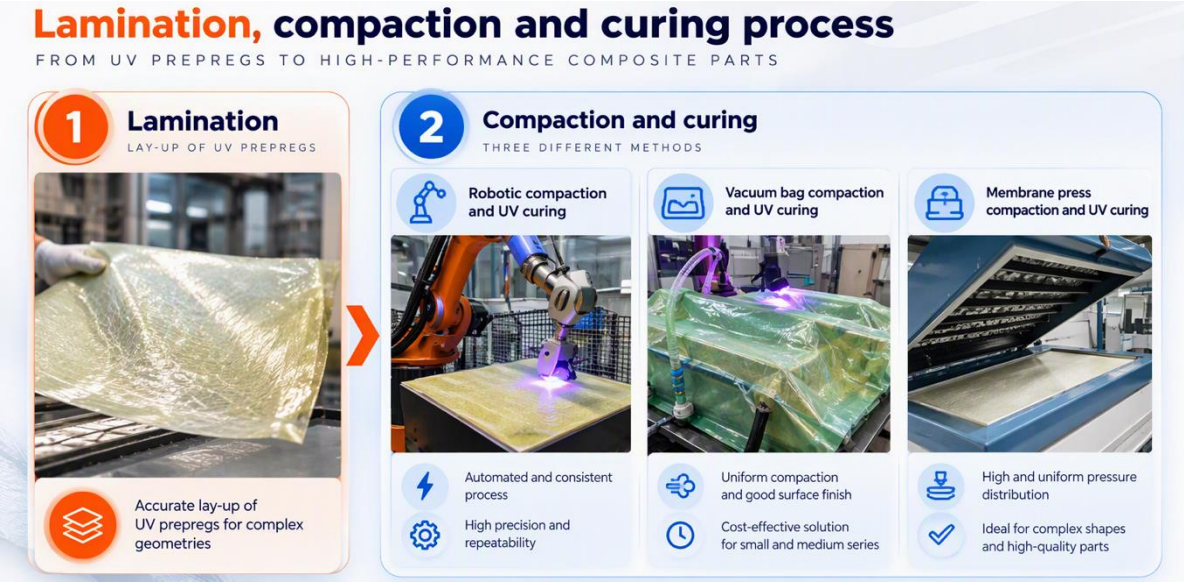
End fire retardant components manufactured.


The technology is now integrated into an automated manufacturing cell

UV prepreg and composite manufacturing cell








ESTIO
by
IDEKO
MEMBER OF
BASQUE RESEARCH
& TECHNOLOGY ALLIANCE
Automated, ultrafast and clean technology for fiberglass reinforced components manufacturing

ESTIO

Automated, ultra fast and clean technology for fiberglass reinforced polyester components manufacturing

Manufacturing of short-series composite parts






Manual processes, low quality, unhealthy environment






ESTIO

UV COMPOSITES FOR A BETTER TOMORROW

OUR CONTRIBUTION TO THE MARKET

Cleaner. Faster. Smarter.



INNOVATIVE COMPOSITE SOLUTIONS FOR A MORE SUSTAINABLE INDUSTRY

HIGHER PRODUCT QUALITY

UV curing ensures consistent, high-performance components with superior mechanical and surface properties.

FROM HOURS TO MINUTES

UV curing reduces cure time from hours to minutes.

UP TO 20% ↓ LOWER PRODUCTION COSTS

Less energy, shorter cycles, lower labour and tooling costs.

CLEANER WORKING ENVIRONMENT

No styrene, no airborne fibres. Safer for people and the planet.

MARKET ACCESS

Fertisa · InCom Group · VEPLAS · isovolta · Composite Concept · afe · INPRE Composites · Gorfiber, S.L. · resitex · Riquer · maristone, s.l. · TTC Focus · Stadler · Talgo · irtzar · CAF · LASAI. · Norantz

BUSINESS MODEL

- NEW MATERIALS UV PREPREGS
- NEW ENERGY-EFFICIENT INSTALLATIONS BASED ON LOW POWER UV LED SOURCES
- TECHNOLOGY + TRAINING

VALUE PROPOSITION

- PROTOTYPE MANUFACTURING
- CUSTOMER VALIDATION
- PILOT CUSTOMER COMMITMENT
- RESULT EVALUATION
- INDUSTRIAL ORDER

MARKET

2000-2500 M€



EUROPEAN MARKET
WITH STRONG GROWTH POTENTIAL

Thank you for your attention.

ESTIO

ZAMUDIO

CFAA
Technological Park of
Zamudio (Bizkaia)

ELGOIBAR

Arriaga kalea, 2
20870 Elgoibar (Gipuzkoa)

+34 943 748 000

ideko.es

DONOSTIA

Zuatzu Business Park
Donostia – San Sebastián
(Gipuzkoa)



PRESENTATION 2 OF 4

Jaume Casals

Project Manager, REFISA (ES)

From Lightweight Composite to Industrialised Railway Components

FROM LIGHTWEIGHT COMPOSITE TO RAILWAY-READY COMPONENT

Design, adhesive bonding and process control

Industrialising large railway structures

JAUME CASALS BRENUY · REFISA

ELN Conference 2026 · Barcelona



What a railway component must enable

01 **MANUFACTURABLE**

tooling, process and handling

02 **INTEGRABLE**

interfaces and assembly

03 **INSPECTABLE**

access and evidence

04 **REPEATABLE**

stable series quality



Engineering requirements

01 **LIGHTWEIGHT**
weight and stiffness

02 **SAFE**
impact, fire and smoke

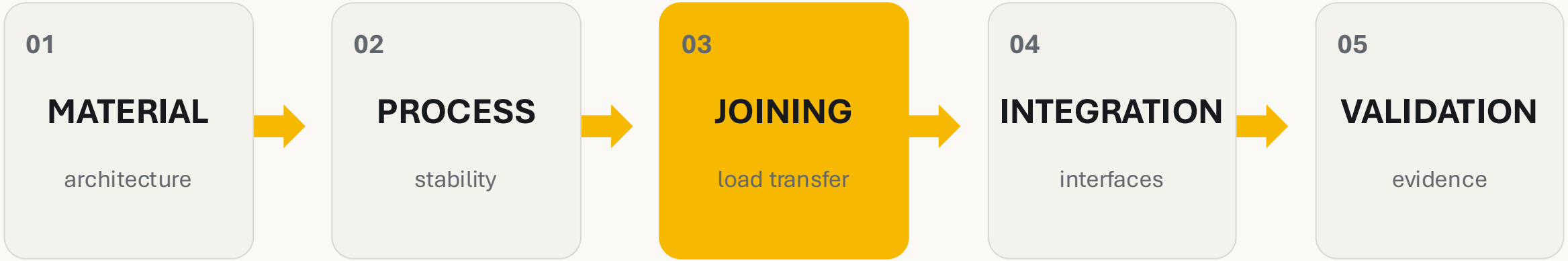
03 **PRECISE**
interfaces and tolerances

04 **DURABLE**
finish and environment

05 **TRACEABLE**
traceability and cost



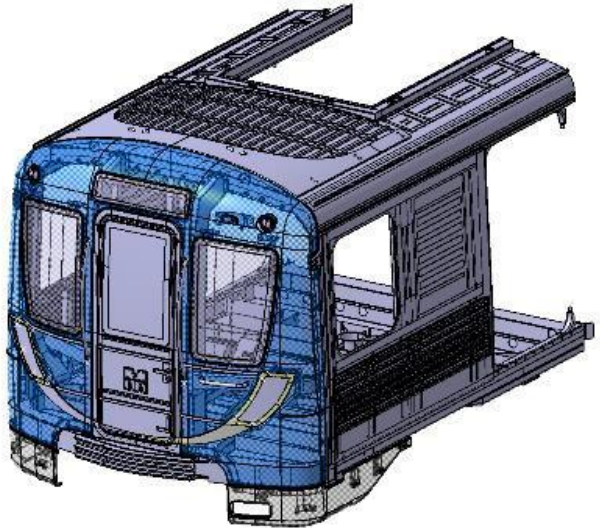
The industrial system



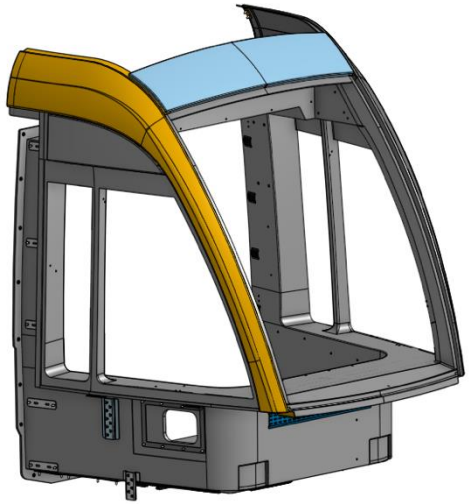
An unstable link can cancel the benefit of lightweighting.

INDUSTRIAL EVIDENCE

Cab structures and front-end modules



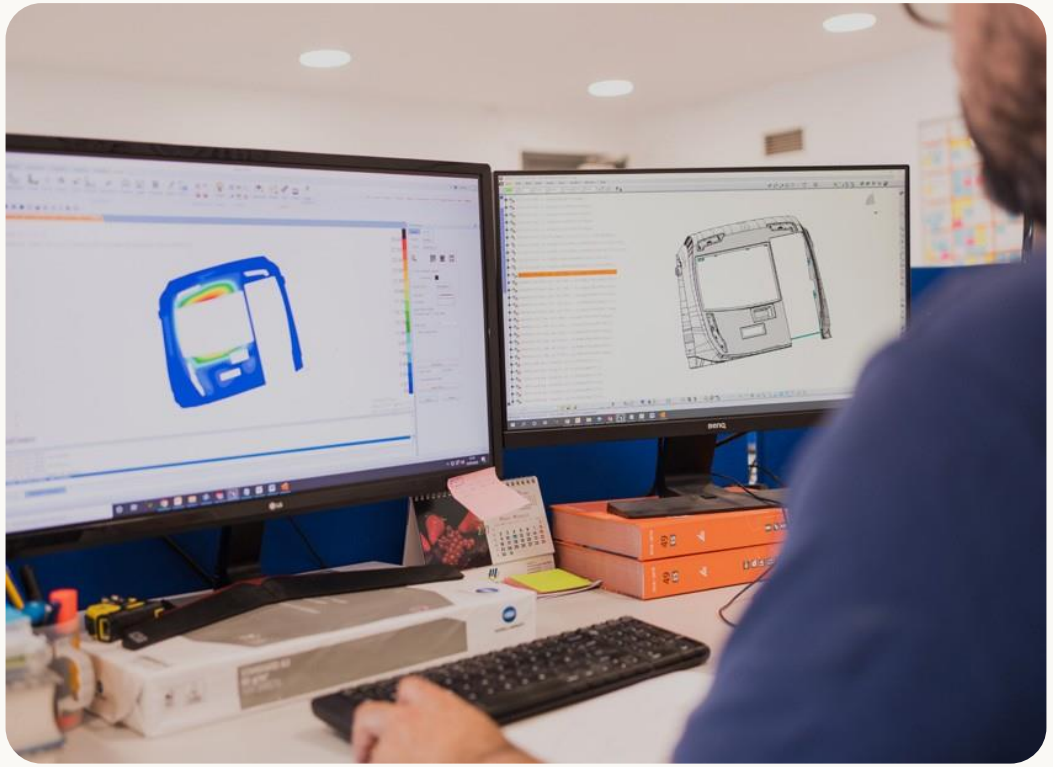
FRONT-END MODULE



CAB STRUCTURE

Geometry · Interfaces · Joining · Series stability

Design decisions define the interface





01 DESIGN

tooling, machining and handling

02 INTERFACE

geometry, tolerances and access

The joining process cannot correct an uncontrolled interface.

Controlled adhesive bonding



01 **JOINT DESIGN**

loads and bead geometry

02 **SURFACE**

preparation and condition

03 **APPLICATION**

environment and timing

04 **CURING + EVIDENCE**

inspection and traceability

EN 17460
Railway applications - Adhesive bonding of rail vehicles and their components

A railway component takes shape in design,
is controlled in the process and proven in series production.

Thank you! / Gràcies! / Gracias! / Merci! / Grazie!

Dankeschön! / Arigatō! / Спасибо!

متشكرم /شكراً

JAUME CASALS BRENUY

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415-416
25191 Lleida · Spain
www.refisa.com





PRESENTATION 3 OF 4

Robert Schlosser & Maximilian Denk

Leitz GmbH & Co. KG (AT)

High Precision in Lightweight – The way of manufacturing cutting tools for industrial woodworking



Solutions
in new
Dimensions

High Precision in Lightweight

The way of manufacturing cutting tools for industrial woodworking

R. SCHLOSSER & M. DENK
Leitz GmbH & Co.KG, Austria



leitz 150
1876 • 2026

We are proud of our roots

- Founded by Albert Leitz in 1876 in Oberkochen
- We are a fifth generation family business



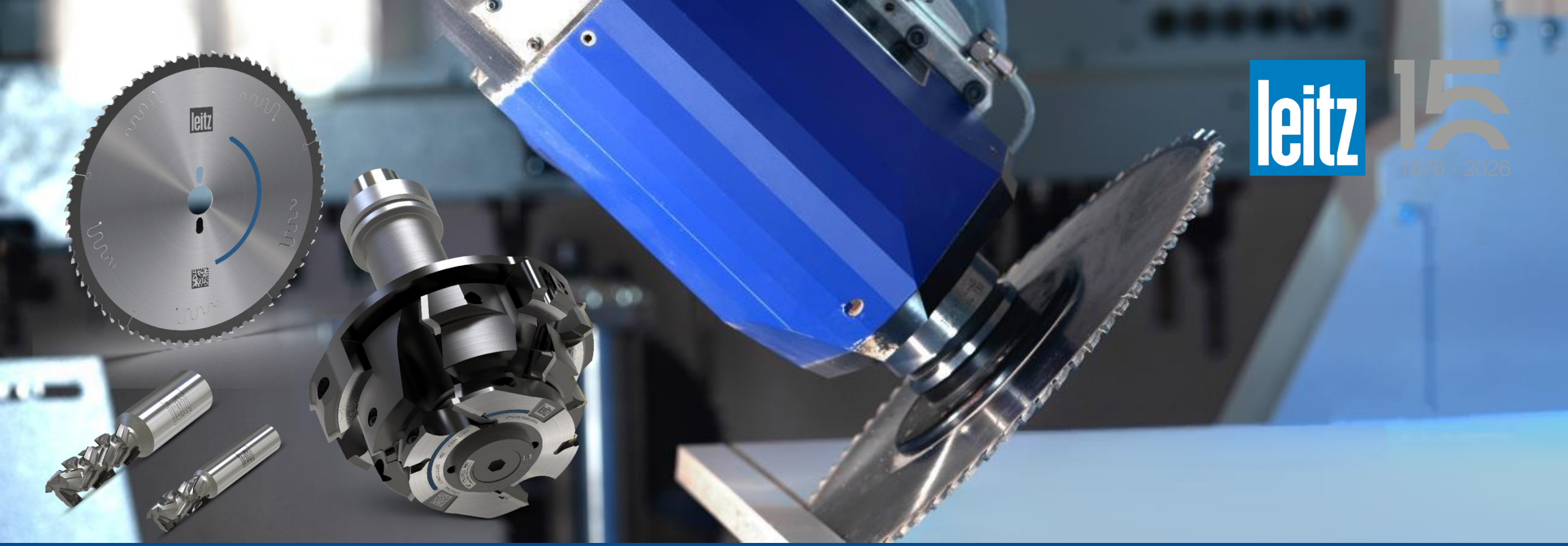
Together we are strong

- 4,000 employees worldwide
- 500 Mio. Euro turnover
- 17 production plants, 38 sales- and service-companies with 139 premises



Who we are

- World market and innovation leader
- Globally operating, manufacturing service provider
- Partner for small / medium enterprises and international industry



What we do

Precision tools, tool systems and services for wood, wood derived materials, plastics, compound materials and NF-metals.

High Precision in Lightweight

From early cutterhead systems to lightweight high-speed tools











1920

Early cutterhead systems

1940

First indexable tool systems

1970

Professional cutterheads
Vc_{max} = 70 m/s

2020s

ProfilCut Q Premium
Vc_{max} = 120 m/s

2027+

Next development step
Vc_{max} >> 120m/s

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High Precision in Lightweight

Challenges in manufacturing high-performance cutting tools

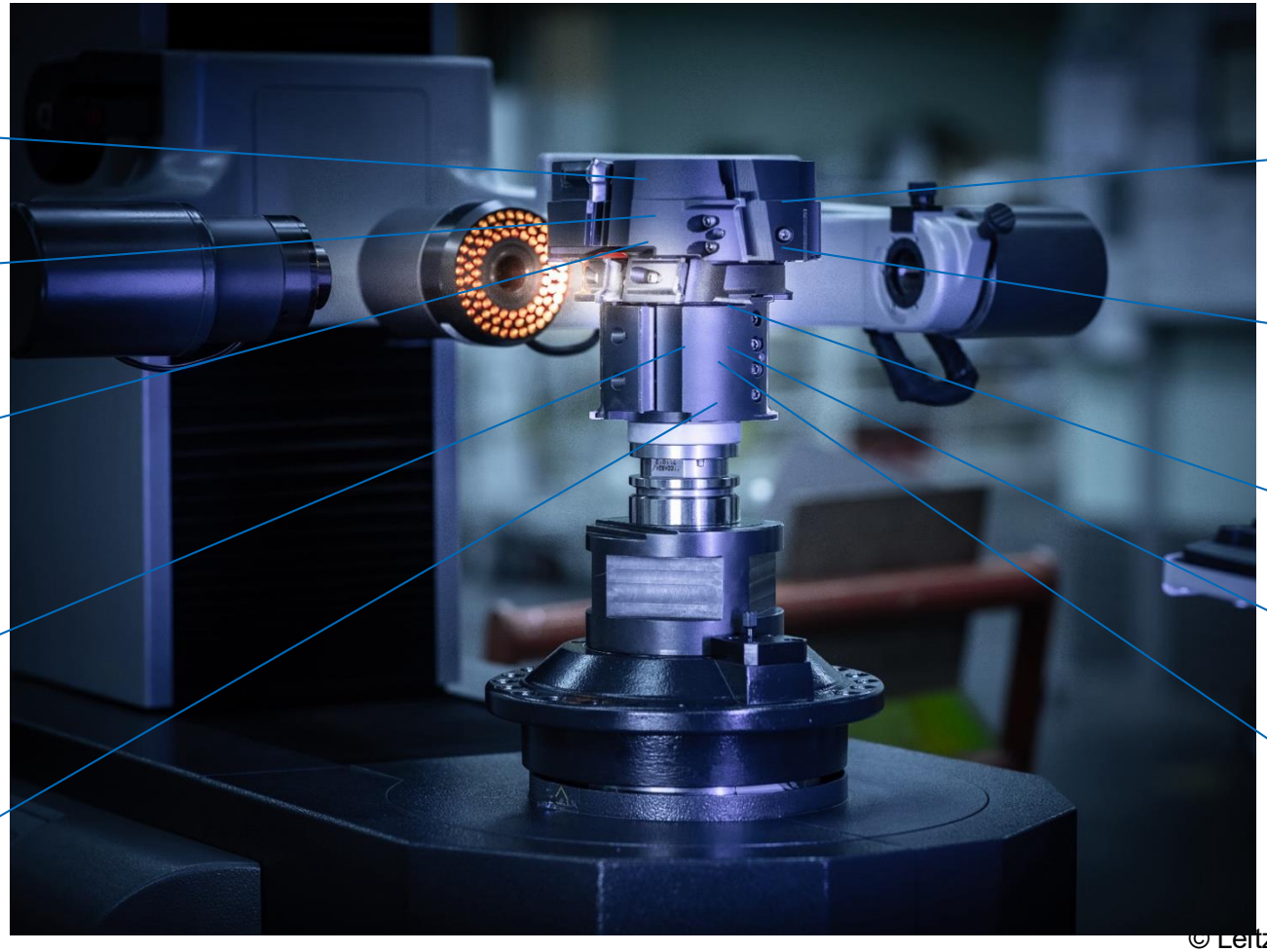
15+ years
of service life

< G 2,5
Balance quality

< 0,05 mm
axial / radial
runout

Sustainabilit
y
Reuse
Resharpen
Recycle

EN 847
Compliance



120 m/s
Cutting speed (up to)
~14.000 rpm @ D=160mm

Low inertia
Low energy demand
in process

Noise reduction
Worker protection

Fatigue resistance

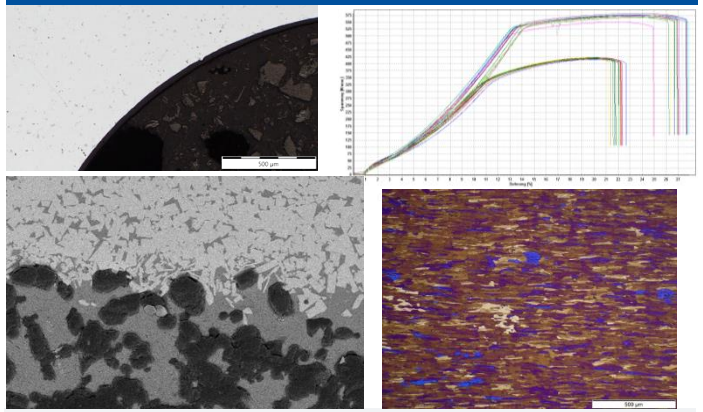
Product variety
High degree of
customization

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High Precision in Lightweight

Lightweight engineering approaches at LEITZ

Material

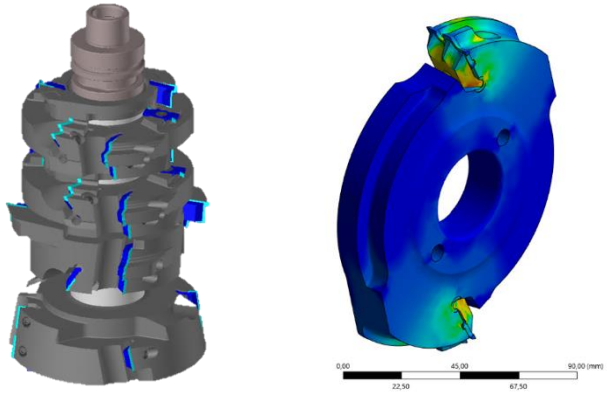


High-strength aluminum alloys

Material mix for load optimization and weight reduction

Cutting materials: PCD, WC-based hard metals

Design



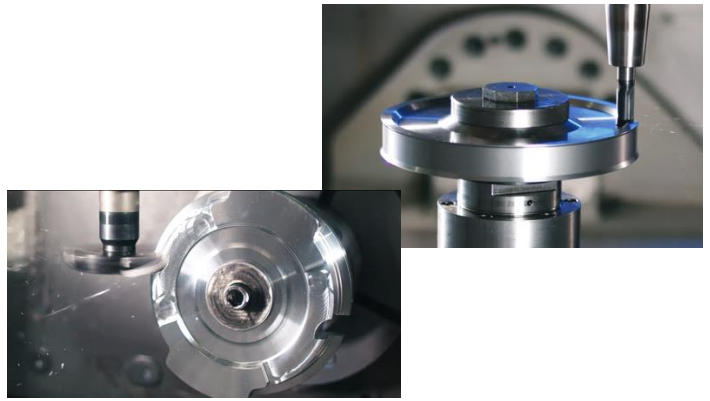
Load-oriented geometry

Material only where required

Optimized mass distribution

Balanced construction

Manufacturing



High-precision machining

Surface engineering: glass-bead blasting (hard-)anodizing

Wear resistant coatings

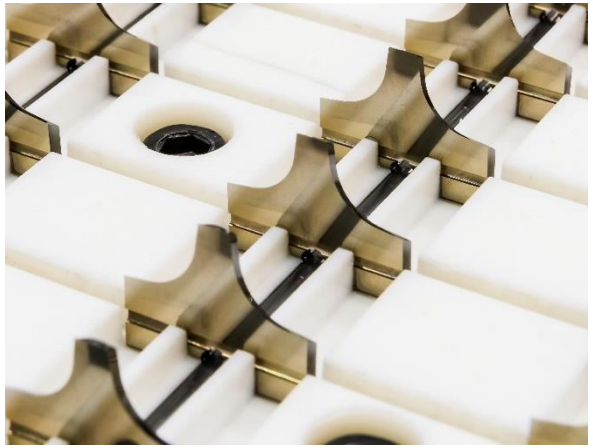
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High Precision in Lightweight

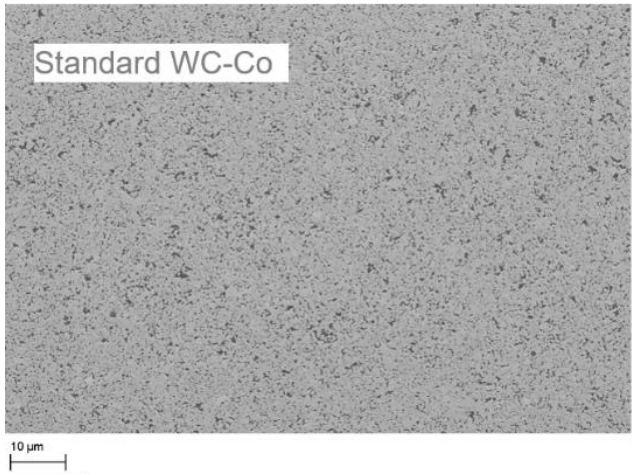
Lightweight functional materials

Modified WC - Co - based cutting materials

- Reduced density through innovative material composition
- Reduced tungsten demand
- Comparable performance in solid wood
- Functional coatings



Property	Standard WC-Co
Hardness HV30	1650
Fracture toughness K_{IC} $MNm^{-3/2}$	10,4
Density g/cm³	**14,40**

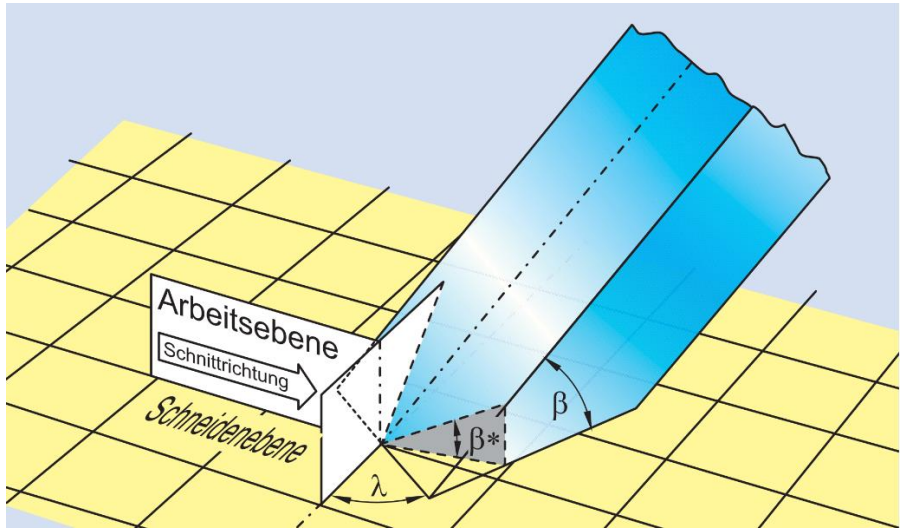


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High Precision in Lightweight

Machining challenges of lightweight materials

„fibre separation instead of chip formation“



Cutting geometry and tool angles

Tool geometry

Sharp tip geometry (low wedge angle)

Positive cutting geometry (cutting angle >> 0°)

Shearing cut using an axial angle

Ultra-sharp cutting edge: < 3 µm

Process parameters

Cutting speed: 80–120 m/s (metal machining: m/min)

High feed rates up to 100 m/min:
- reduced friction and heat input
- prevent melting / burning

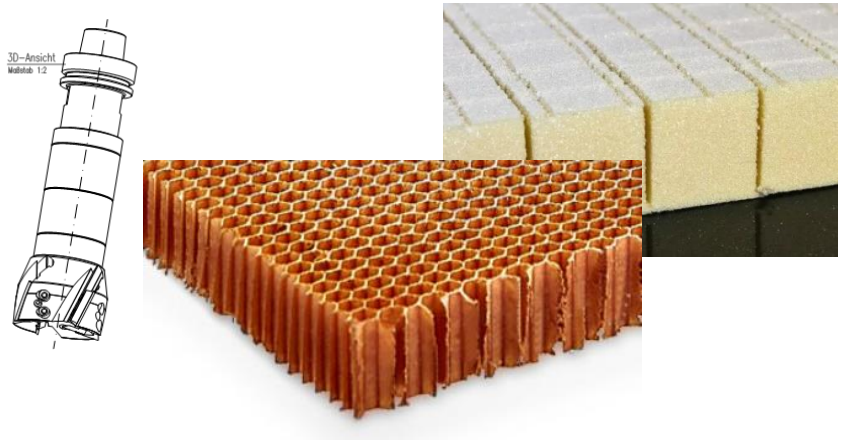
Polished or coated gullets

Typical applications: Composites / FRP • honeycomb • foams • technical plastics • non-ferrous metals

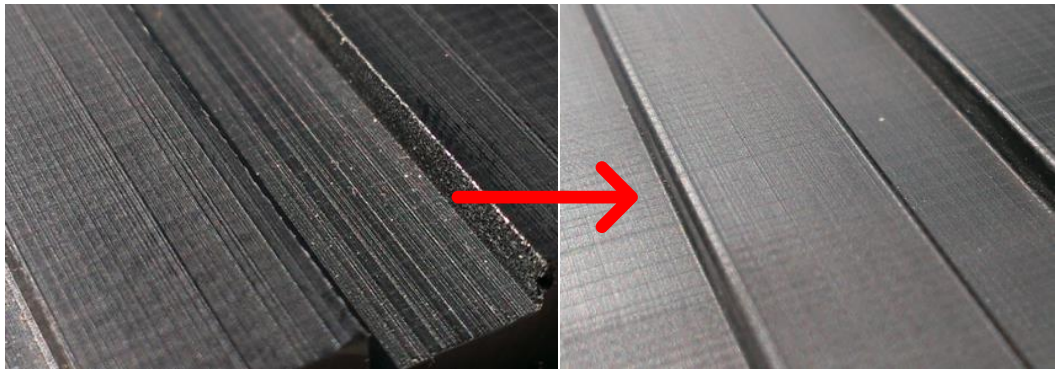
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High Precision in Lightweight

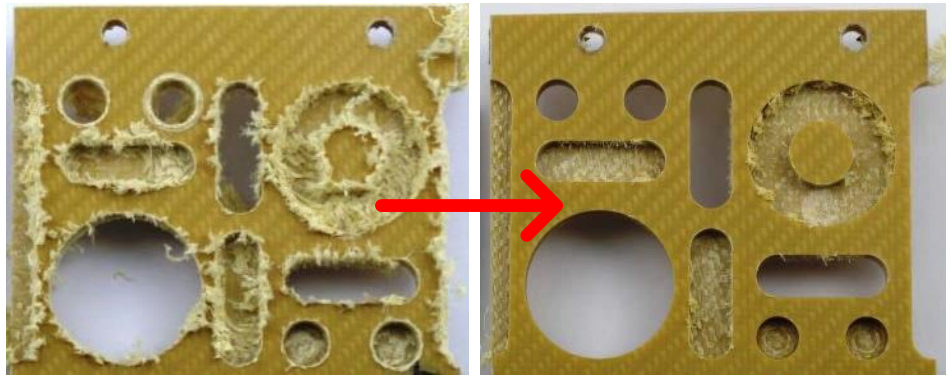
Application and benefits



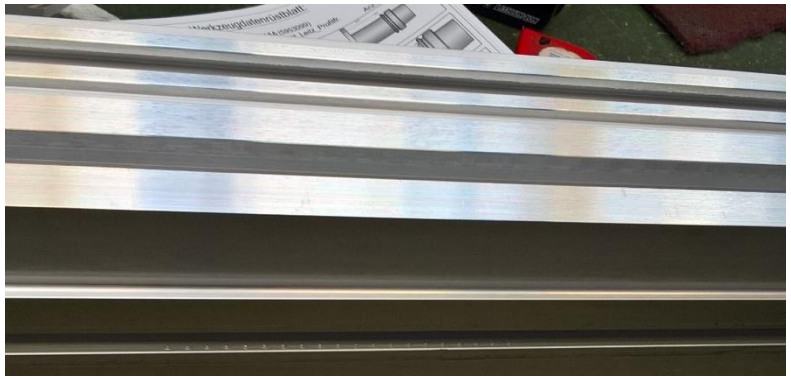
Formatting and profiling of foam / honeycomb



Technical plastics and composites



Aramid-fibre-reinforced composite



Machining Al-profiles for precision surface finish

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High Precision in Lightweight

Key takeaways

01 LIGHTWEIGHT TOOL STRUCTURES

Weight reduced tool body

High-strength aluminum

Load-oriented geometry

Functional coatings

Up to 50% weight saving

02 LIGHTWEIGHT FUNCTIONAL MATERIALS

Cutting materials

Modified, lower-density WC-Co concepts

Advanced coating and geometry

03 CUTTING LIGHTWEIGHT MATERIALS

Application focus

Precision machining of wood products and advanced lightweight materials (FRP, honeycomb, foams, …)

ESTIMATED ENVIRONMENTAL EFFECT

~3,800+ kg CO_2/year

avoided in production and through material sourcing
(production site overall)

~830 kg CO_2/year

Per toolset avoided during use
(3-shift operation; compared to steel tool body)

we care

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Solutions in new Dimensions

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PRESENTATION 4 OF 4

Stefanie Brickwede

Head of Additive Manufacturing, Deutsche Bahn · Mobility goes additive (DE)

AM & Lightweighting: huge potentials, great solutions

The Leading European Network for Additive Manufacturing in Industry and Healthcare

Lightweight in Rail with Additive Manufacturing

Stefanie Brickwede

ELN Barcelona 2026


PLASMICS
RCS Rail Components Systems
KSB
WIWEB
Universitätsklinikum Tübingen
3DLab Groningen Patient Care & Innovation
Signify myCreation
Migration of Matter
FIT Additive Manufacturing Group
angel Trains
KNORR-BREMSE
MANN+HUMMEL
ZEISS
UKM Universitätsklinikum Münster
Institut für Anaplastologie
BioMed Center Innovation gGmbH
ProMateria GMH GRUPPE
BOSCH
SNCF
VBK
Faiveley Transport A Wabtec Company
CTC
we are composites an AIRBUS company
IOI OLEOCHEMICAL
Tierklinik Lüsche GmbH
AM solutions A brand of the Rösler Group
jolke
ÖBB
NETINERA FERROVIE DELLO STATO ITALIANE GROUP
WIENER STADTWERKE
Universitätsspital Basel
MMP BINC
a.m.p.e.re alloys
GEFERTEC Generative Fertigungstechnik
POSTPROCESS Automated. Intelligent. Comprehensive.
SBB CFF FFS
ALSTOM mobility by nature
Takeda
TIZ IMPLEMENTS
PDC APP
WÜRTH ADDITIVE GROUP
stratasys
bigrep
DB
SIEMENS
blue production
CASTLAB
inspire
AeroEdge
eos
mga
PhotonAG
REINFORCE 3D
PRUSA RESEARCH by JOSEF PRUSA
materialise innovators you can count on
cirp
H&H INNOVATION H&H SMART PRODUCTS
replique Trusted parts for everyone, everywhere
AUTODESK
pro beam
3YOURMIND
TÜV SÜD Product Service
Fraunhofer IAPT
MELTIO
axenoll 3D printing for life
Guaranteed Value the future, upgrade the past
Nikon SLM SOLUTIONS
Rapid Fusion
ADDITIVE MARKING
AMPOWER
DMRC DIRECT MANUFACTURING RESEARCH CENTER
DLR
PTB Physikalisch-Technische Bundesanstalt Braunschweig und Berlin
BAM Bundesanstalt für Materialforschung und -prüfung
3D SYSTEMS
trinckle 3d printing solutions
Additive Japan Corporation
GS1 Germany
dap Digital Additive Production
RWTH AACHEN UNIVERSITY
WILDAU
LaFT Laboratorium Fertigungstechnik
Synera
UltiMaker
Neue Materialien Bayreuth
TÜVNORD
IMAD
Technische Universität Berlin
b-tu Brandenburgische Technische Universität Cottbus - Senftenberg
SKZ
TECHNISCHE UNIVERSITÄT DARMSTADT ADDITIVE MANUFACTURING CENTER
UNIVERSITY OF DERBY
3DSPARK
EXPERTANTS
VALCUN
simufact Simulating Manufacturing
Ailoys Forefront of Innovation
Qualified AM INNOVATION + COMPLIANCE
Techtra
IPI Institute for Production and Informatics
srh
Fraunhofer

RAILiability

AM cooperation of railways at a european level

Meeting during formnext open to users!

mga



- develop a joint database for printed 3D parts
- share requirements and learnings from development
- cooperate in material testing, research, development and cooperation with the industrial environment
- jointly accelerate the development of rail-AM

Train Carbodies





Conventional
7,3 kg



Lightweight
4,5 kg



Bionic
3,5 kg

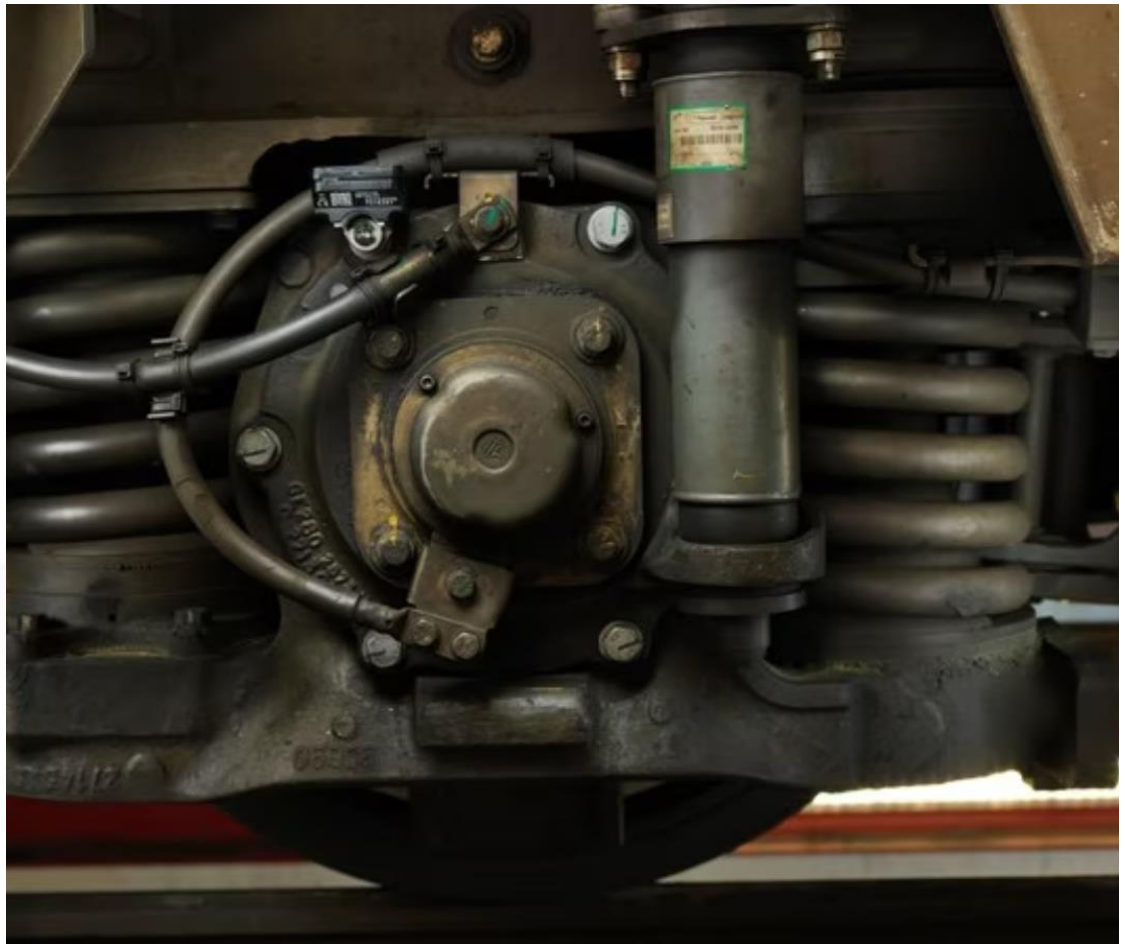
Damper Bracket: Weight reduction by 50%

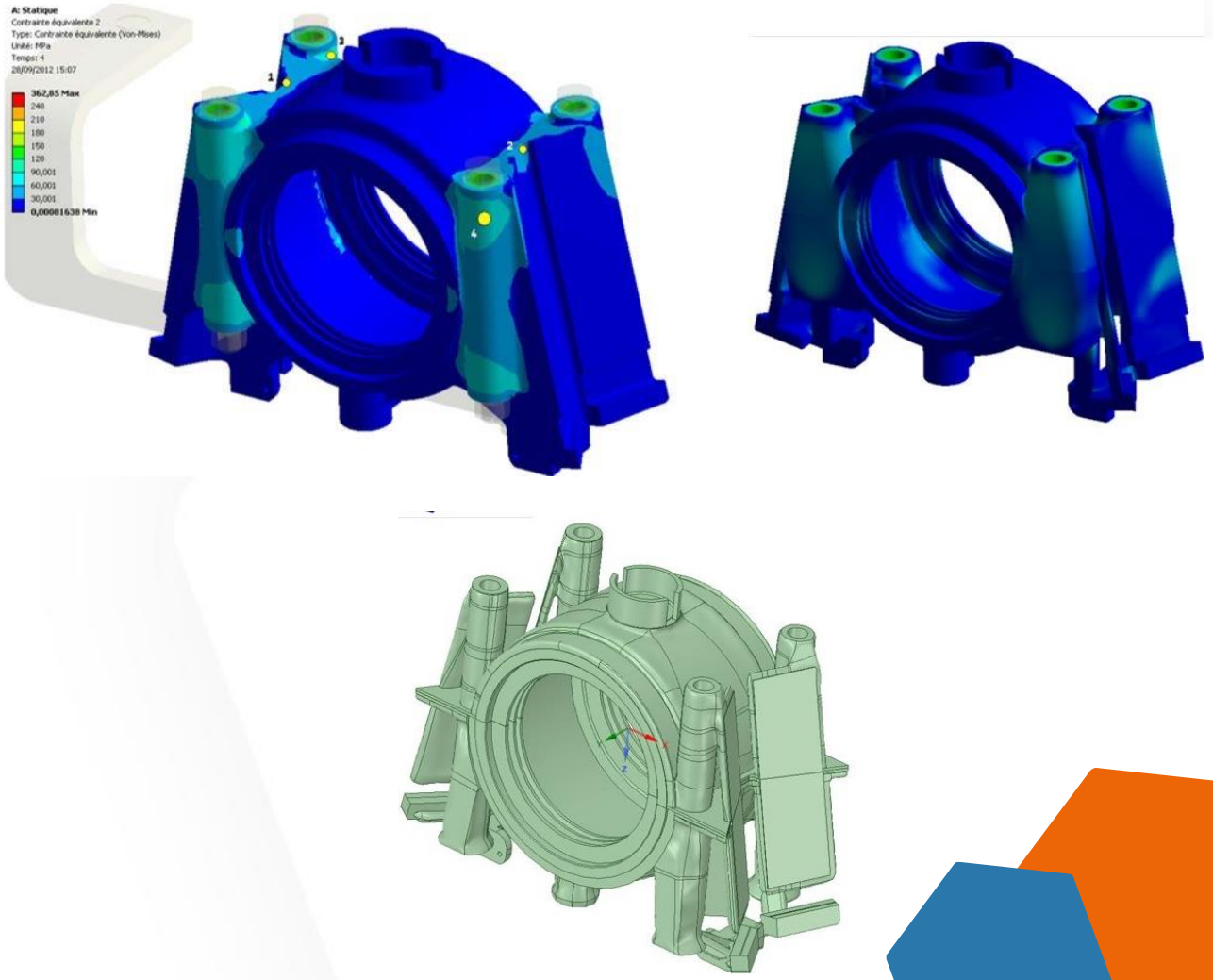






Railway axle box





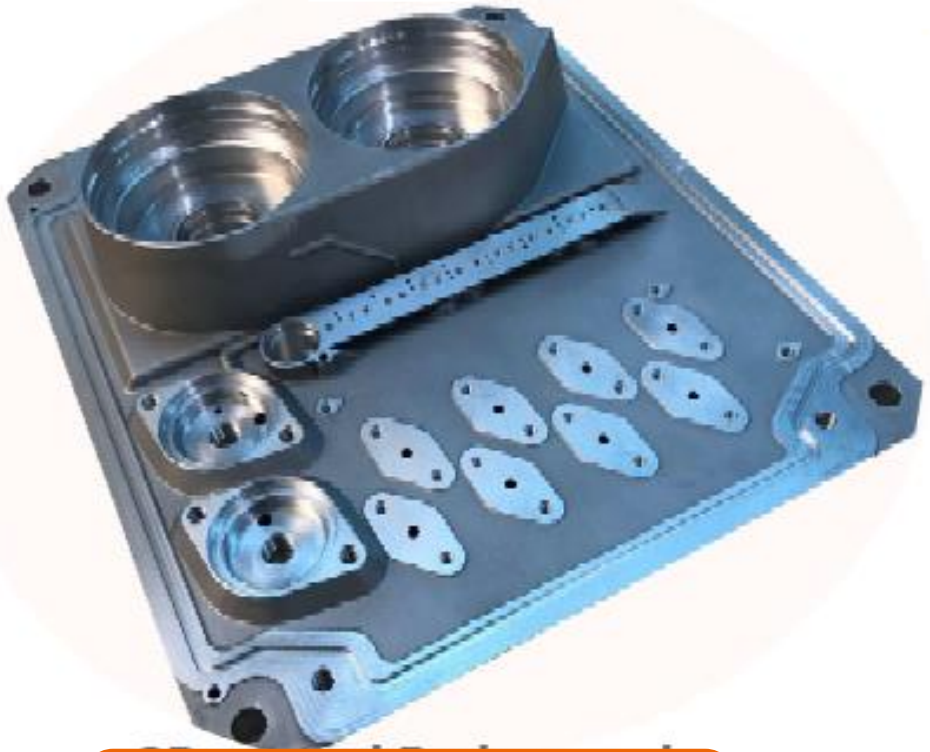
Wabtec Train Brake Panel

Conventional Brake Panel



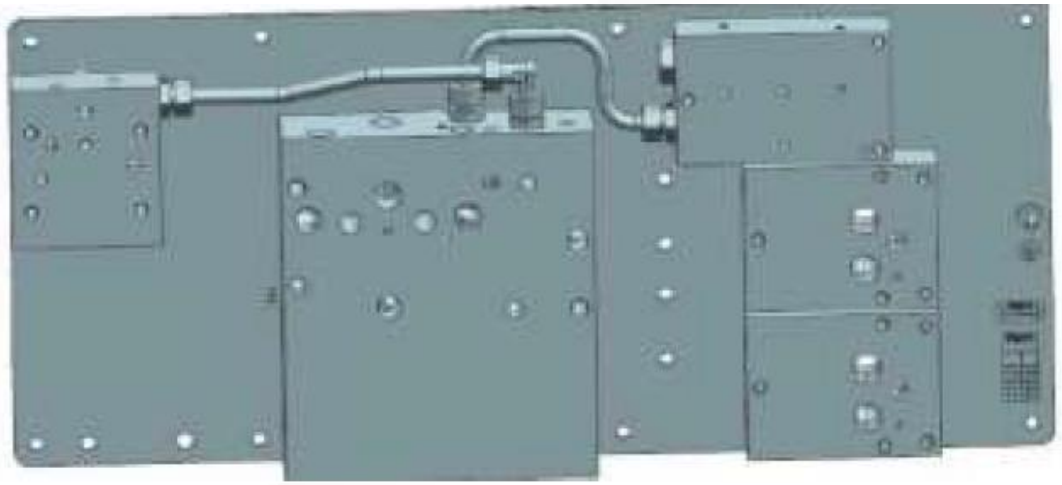
Wabtec CORPORATION

-5 kg



3d printed Brake panel

Wabtec Train Brake Panel



Conventional Brake Panel

-15 kg

3d printed Brake panel



World innovation: First fully 3D printed vehicle front running up to 125 mph (200 km/h)
Customized vehicle front design

Facts

Technology **Material extrusion**	Material **Ultem**
Development time **4 months**	Part dimensions **3.0 x 2.8 x 1.2 m**

Benefits 3D printing

- **Engineered for Additive Manufacturing**
- **No tooling** costs, no minimum order quantity
- **AM design benefits**: individual, agile, and cost-efficient
- **Fulfilled requirements**: mechanical strength, fire retardancy, and various harsh environmental conditions

→ Approach will be **transferred to other train types**



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SIEMENS

Siemens Air conveyance ejector

Old Design

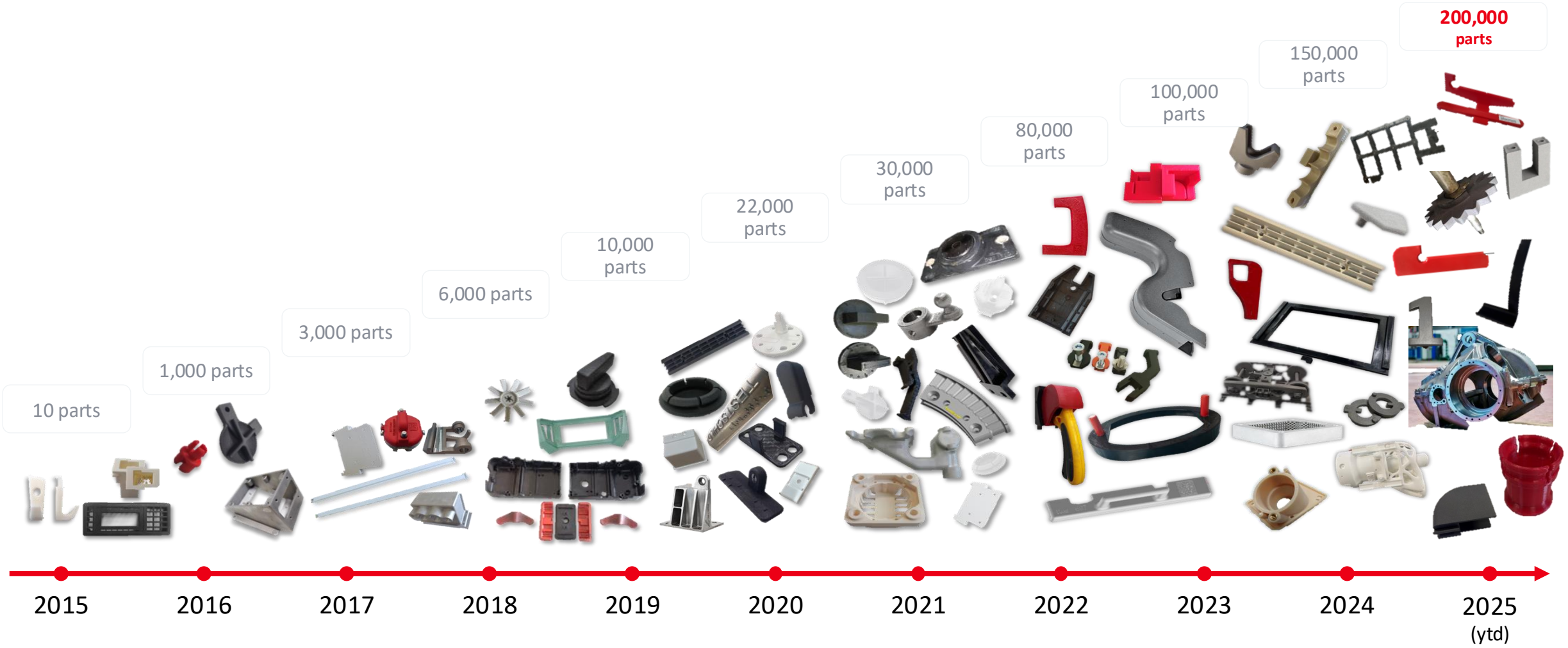


New Design

SIEMENS

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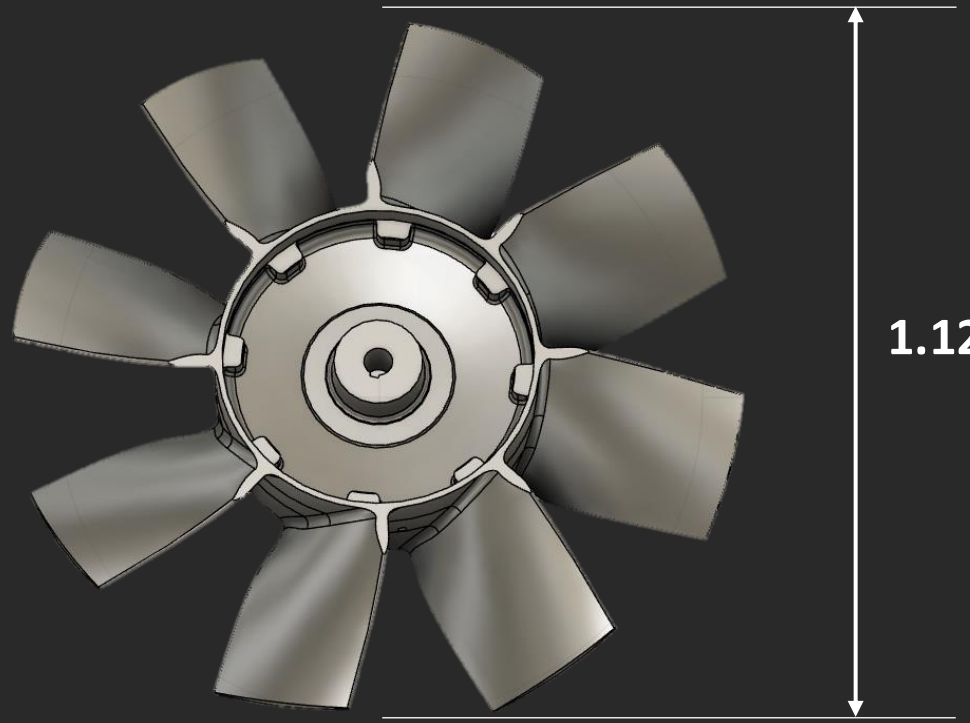
1,000 different applications | 200,000+ parts | 12 technologies
Saving effects generated in the two-digit million range

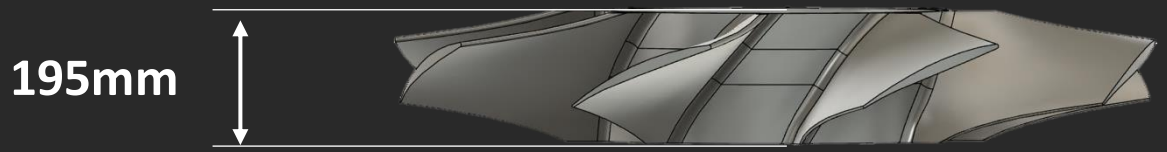


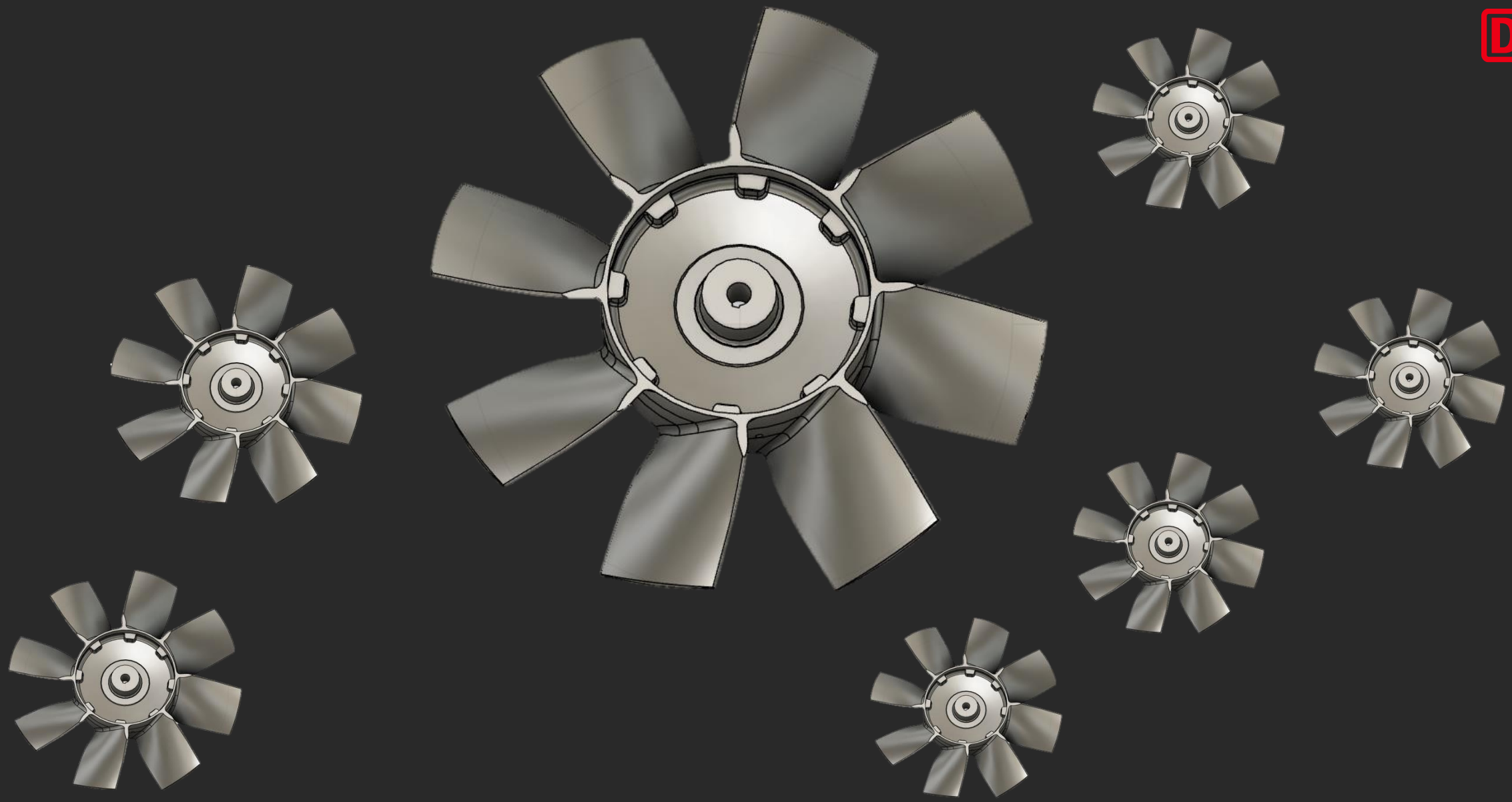
Mighty Little Helpers
Our Productivity Boosters @ DB

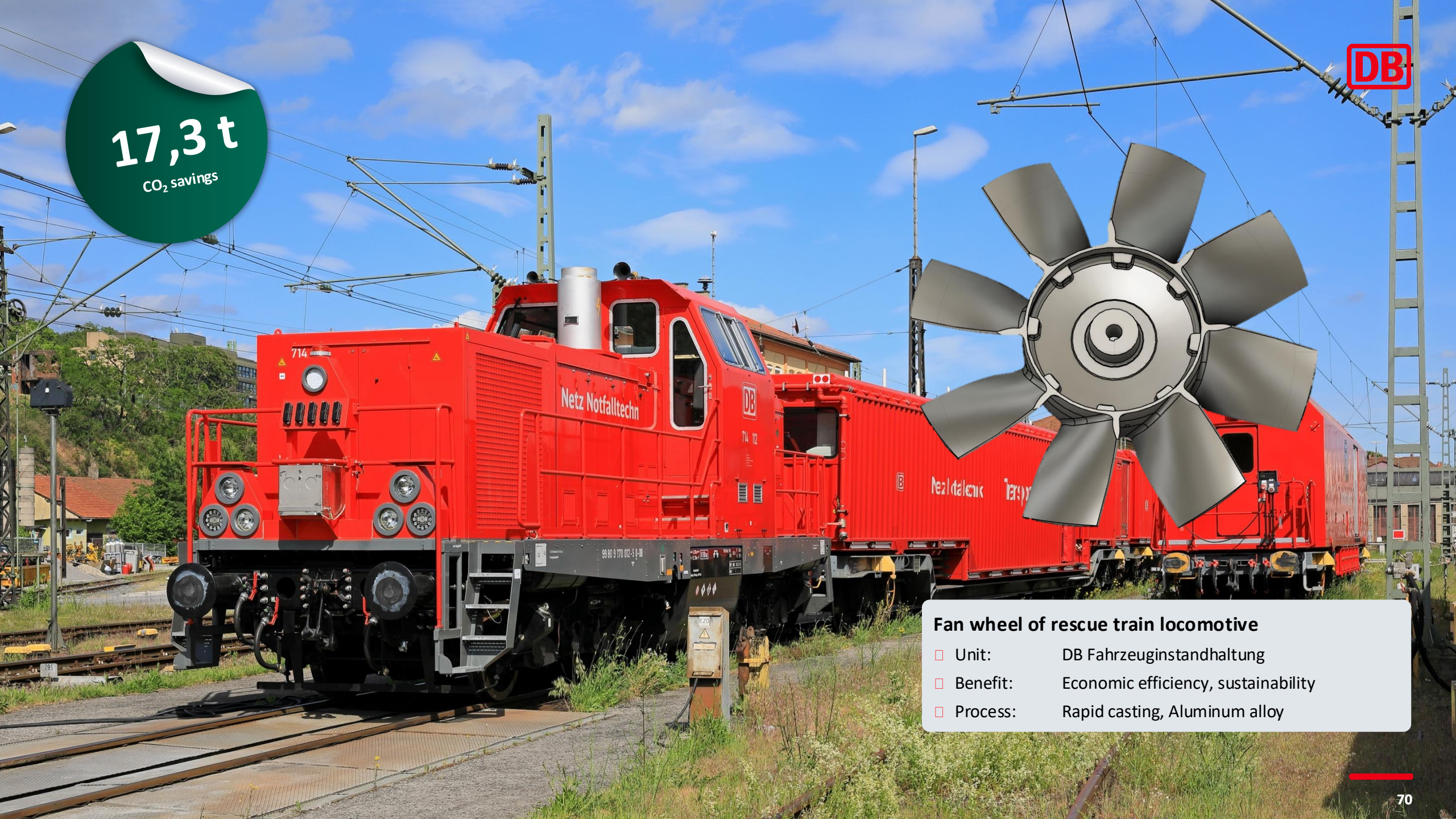



714
Netz Notfalltechn
714 102


1.125mm


195mm





Fan wheel of rescue train locomotive

- Unit: DB Fahrzeuginstandhaltung
- Benefit: Economic efficiency, sustainability
- Process: Rapid casting, Aluminum alloy

10% out of 1,8 billion



Manufacturing On Demand

Needs-based procurement of spare parts until 2030



- Actual needs
- Top-Down Analyses
- AM of suppliers

Effects based on

- **Downtime cost**
- **Capital commitment**
- **Procurement**
- **Storage costs**

Efficiency and quality-enhancing

Funded project to enhance number of printed certified parts

Calculated strength verification for AM components PBF + 316L

Digitalization of the approval process

- Derivation in FKM guideline
- Development digital platform
- Reduction of tests



Want to learn more? MGA Annual Meeting & Women in AM 2026



12.-
13.10.
2026









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DB mga



Stefanie Brickwede

Head of AM at Deutsche Bahn
& Managing Director MGA -
The leading International AM Network

+49 30 757 66111

stefanie.brickwede@mga-net.com

PANEL DISCUSSION

Railway

8 October · 09:30 – 11:00 · Main Auditorium



MODERATOR

Ignasi Gómez-Belinchón

IN MOVE cluster (ES)



Francisco Javier Vallejo

IDEKO (ES)



Jaume Casals

Refisa (ES)



Robert Schlosser

Leitz (AT)



Maximilian Denk

Leitz (AT)



Stefanie Brickwede

Mobility goes additive (DE)

DAY 2 · THURSDAY 8 OCTOBER

Coffee break

11:00 – 11:30 · Foyer next to the Main Auditorium

We resume at 11:30 with Automotive II

Visit the MAV Lightweight Expo in Rooms 3 & 4

DAY 2 · THURSDAY 8 OCTOBER

Automotive II

11:30 – 13:00 · Main Auditorium



MODERATOR

Iker Arroyo

Eurecat (ES)

SPEAKERS

Pierre Daniel BTECH (ES)

František Simančík IMMM, Slovak Academy of Sciences (SK)

Carlos Muñoz Gestamp (ES)

Herfried Lammer HEAD (AT)



PRESENTATION 1 OF 4

Pierre Daniel

Barcelona Technical Center – BTECH (ES)

Accelerating Fracture Simulation in Large Composite Structures

Accelerating Fracture Simulation in Large Composite Structures

Dr. Pierre M. Daniel

btech
Barcelona Technical Center

ELN CONFERENCE SPAIN 2026

6th conference of the European Lightweighting Network

7-8 Octobre 2026, Barcelona, Spain

A. Sánchez, Martin Fagerström, Pere Maimí

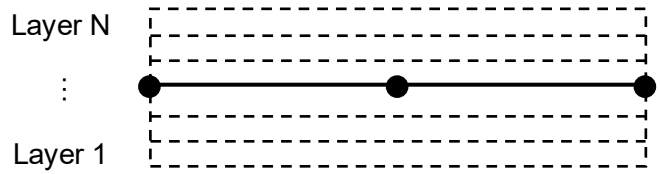
CHALMERS UNIVERSITY OF TECHNOLOGY
UdG
AMADE
ANALYSIS AND ADVANCED MATERIALS FOR STRUCTURAL DESIGN

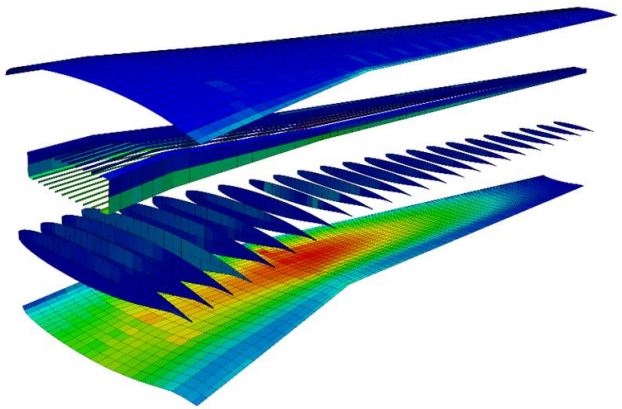
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Composite Simulation (State of the art)

Standard modelling

Simple shell



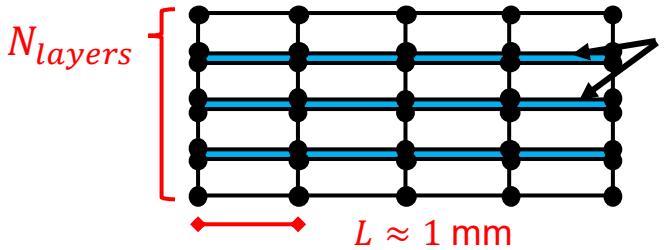


No delamination capabilities
Poor ply fracture modelling

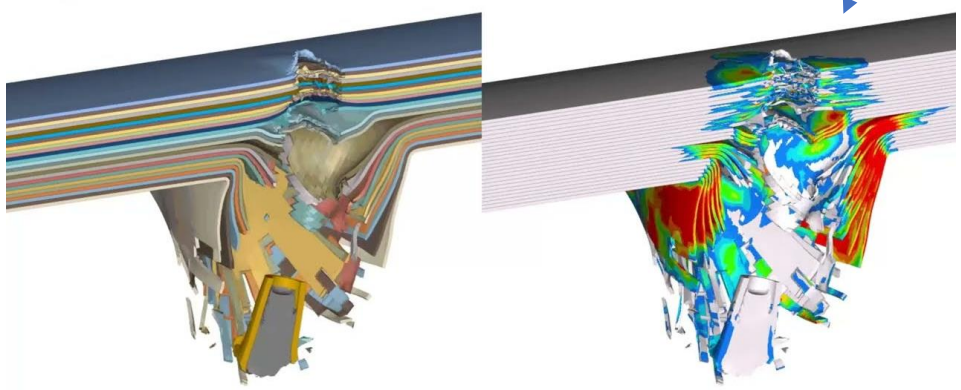
- **Inaccurate** for impacts, large deformations, damage tolerance, etc

Advanced fracture modelling

Ply-based meshing



Millions of elements



Computational cost **x50 to x1000**

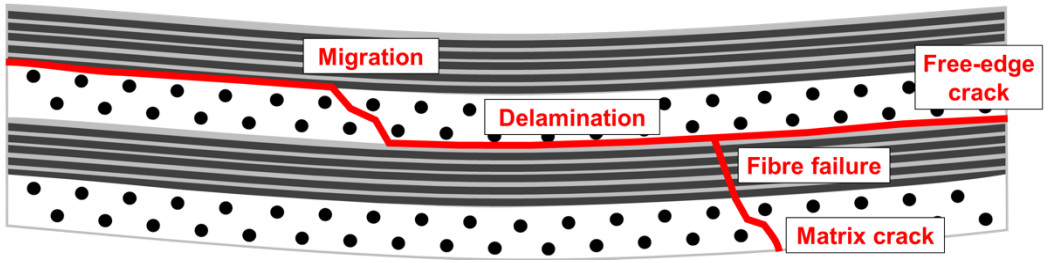
- **Inapplicable to large assemblies**

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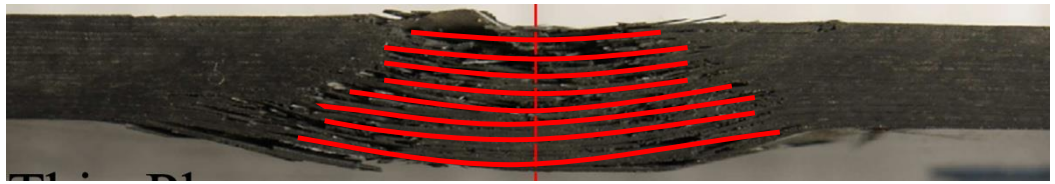
Composite Simulation (State of the art)

Why is composite modelling computationally expensive?

Intricate failure modes



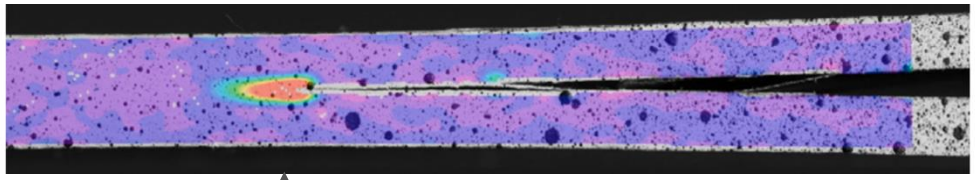
Many interactions between cracks



[A. Wagih et al., 2016]

Delamination cracks

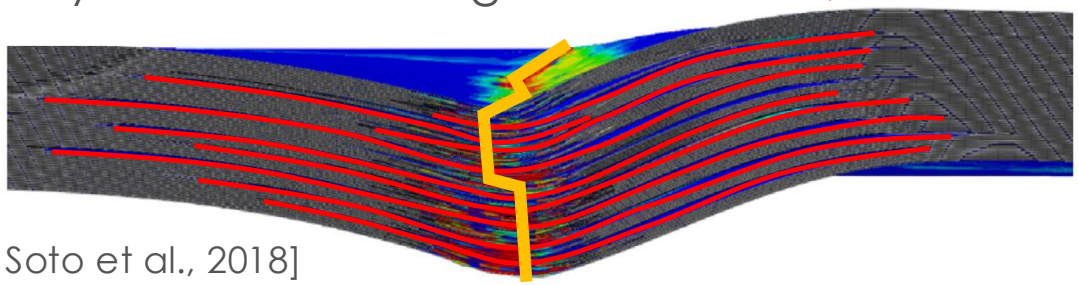
Matrix brittle behaviour (→fine discretisation)



Small Fracture Process Zone : ~0.5 mm

[D. Cardoso et al., 2025]

Ply-based modelling



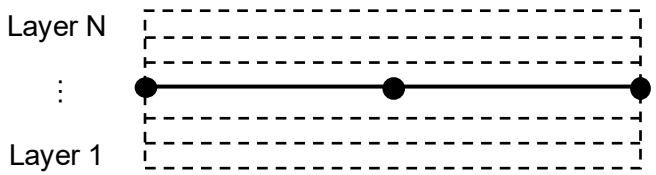
[A. Soto et al., 2018]

Delamination is the main cause

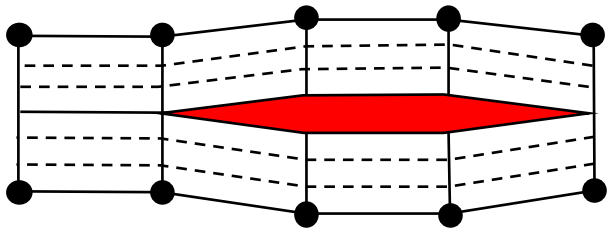
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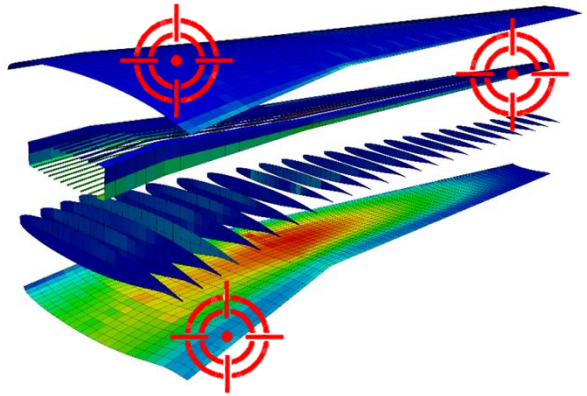
The 3 challenges of delamination

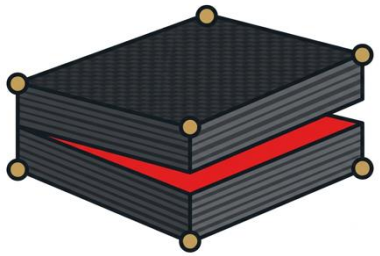
Standard modelling



Crack opening



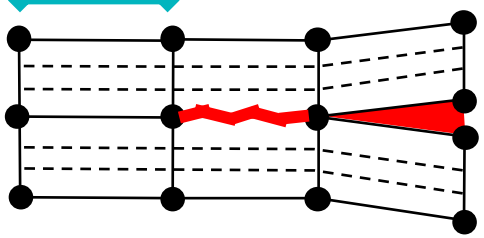


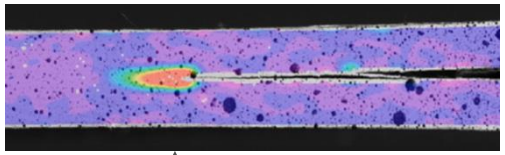


1 - Detection
How to detect delamination using standard simple shell modelling?

2 - Discretisation
How to physically introduce the crack during the simulation ?

$L \sim 5$ mm





Highly localized stress concentration ~0.5 mm

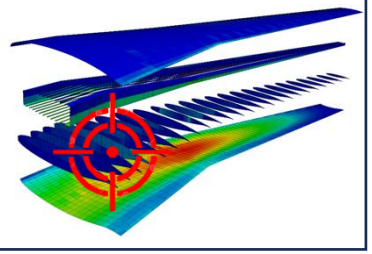
3 - Efficiency
How to model the propagation of the crack using large elements?

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The 3 challenges of delamination

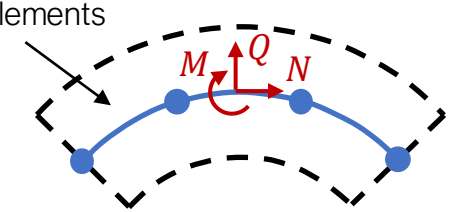
1 - Detection

How to detect delamination using standard simple shell modelling?



Simulation results
(shell forces and moments)

Shell elements

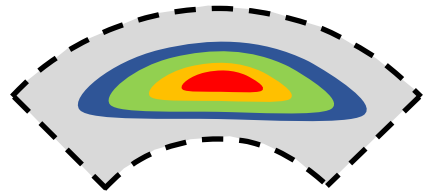


Abaqus or LS-Dyna

btech
3D stress reconstruction method

Interlaminar Shear Strength (ILSS)
Interlaminar Normal Strength (ILNS)

3D stress field:
$\sigma_{13}, \sigma_{23}, \sigma_{33}$
Delamination criterion

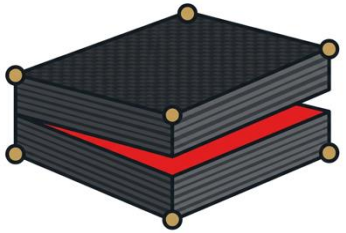


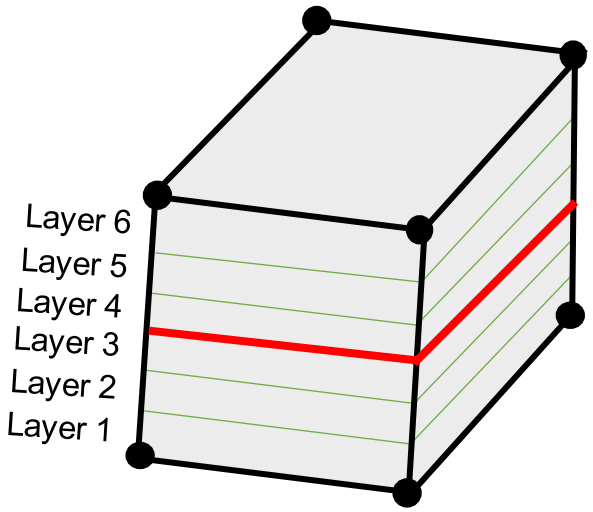
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The 3 challenges of delamination

2 - Discretisation

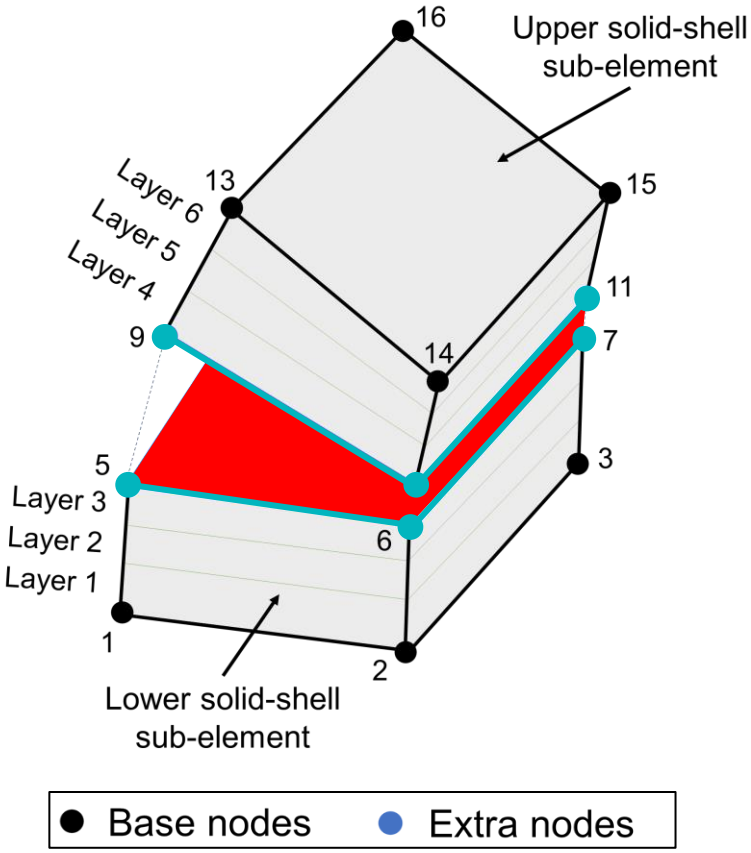
How to physically introduce the crack during the simulation ?





Delamination detected

btech
Adaptive element splitting

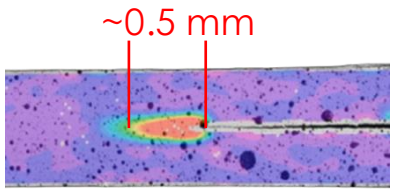


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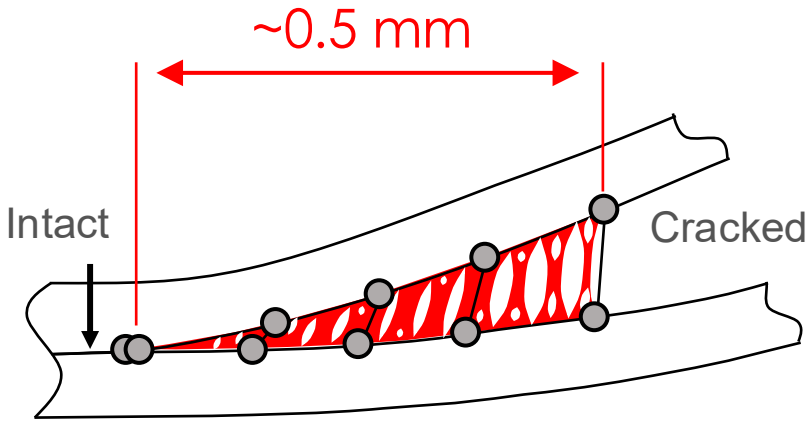
The 3 challenges of delamination

3 - Efficiency

How to model the propagation of the crack using large elements?

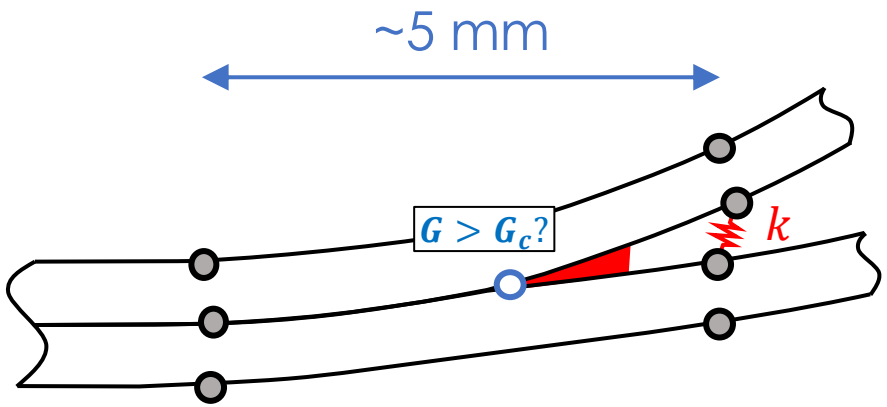


Conventional cohesive elements



- Rely on **damage mechanics**
- Represent material degradation
- Need to capture the stress concentration

New method



- Based on **fracture mechanics**
- Use energetic laws
- No size limitation

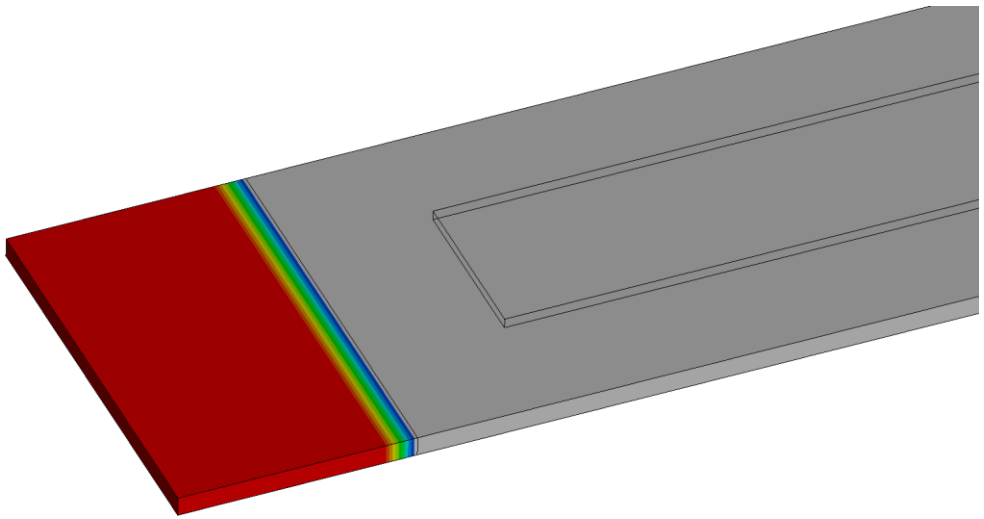
btech
Energy-based cohesive
Interface element

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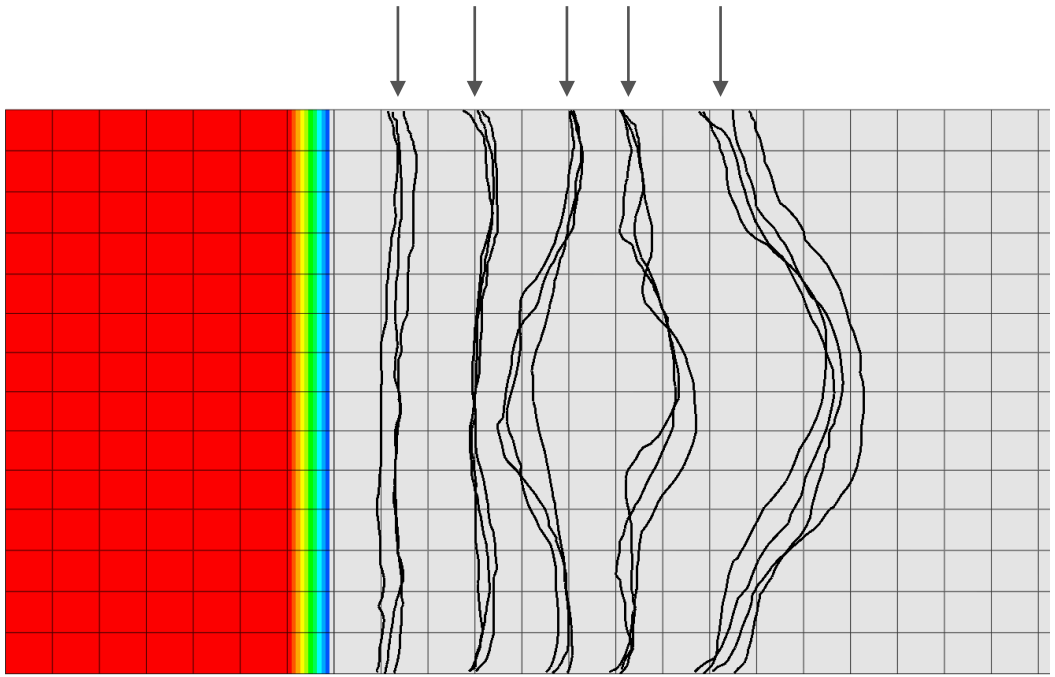
Examples

Debonding analysis

Element length: 5 mm



Experimental crack states

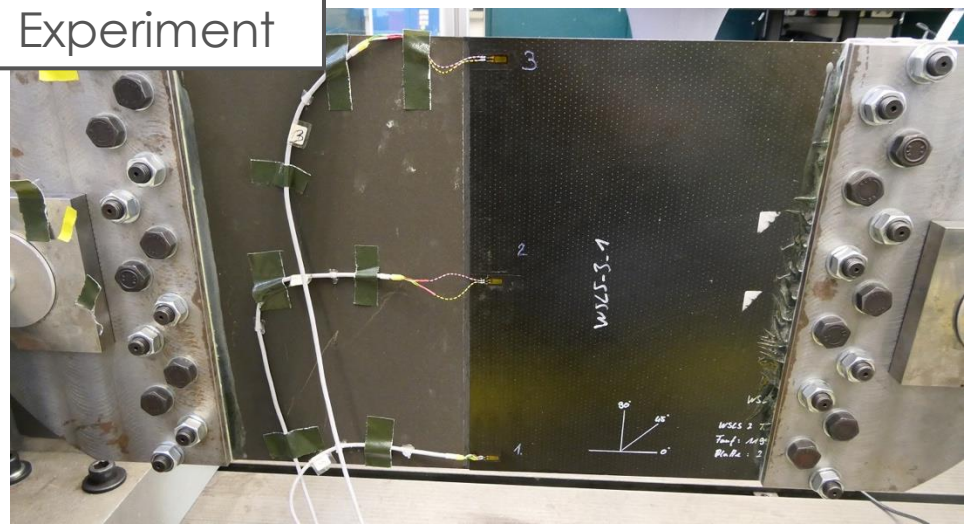


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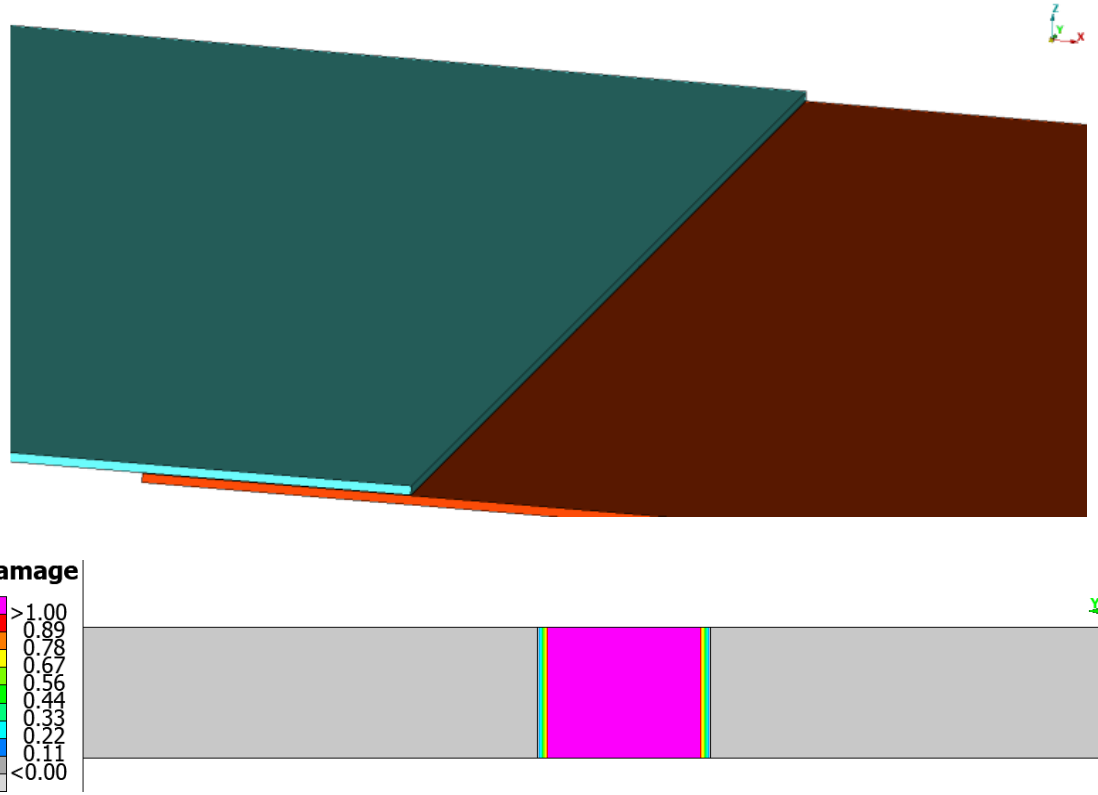
Examples

Debonding analysis

Experiment



Element length: 5 mm

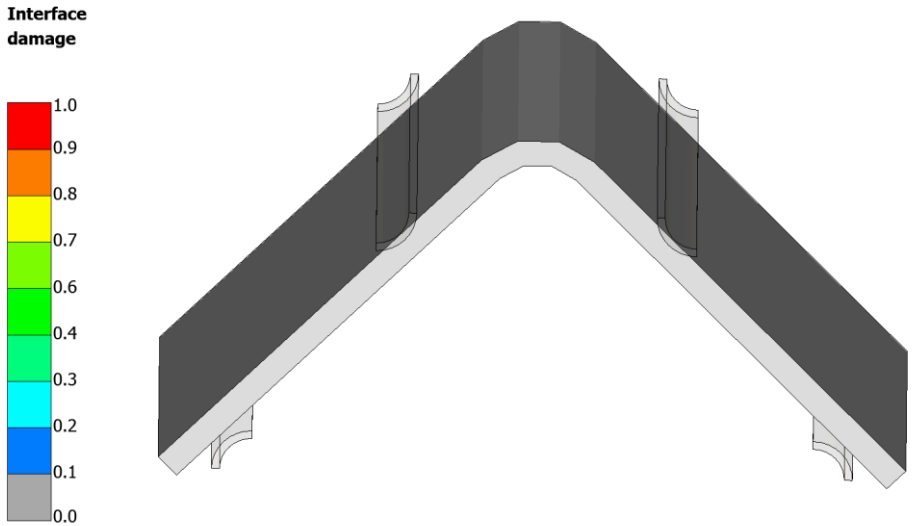


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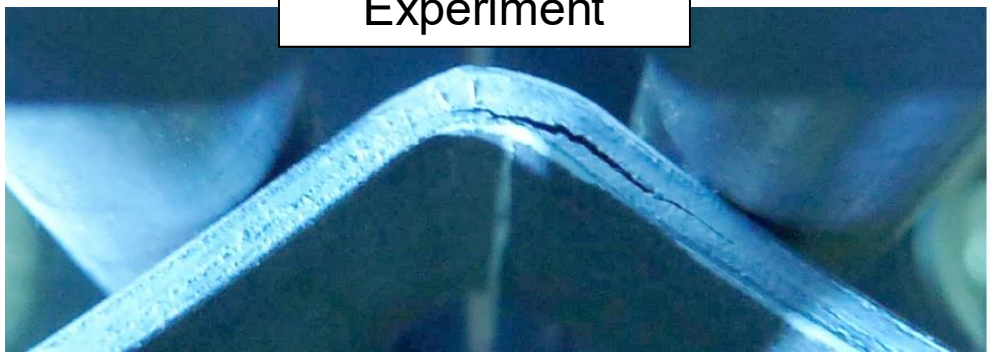
Examples

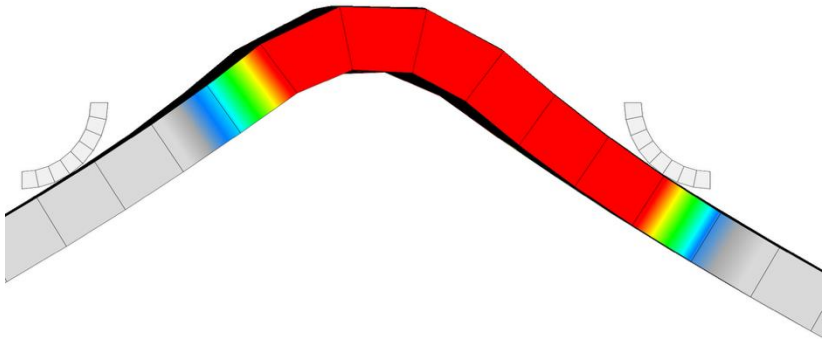
Delamination failure

L-shaped unfolding



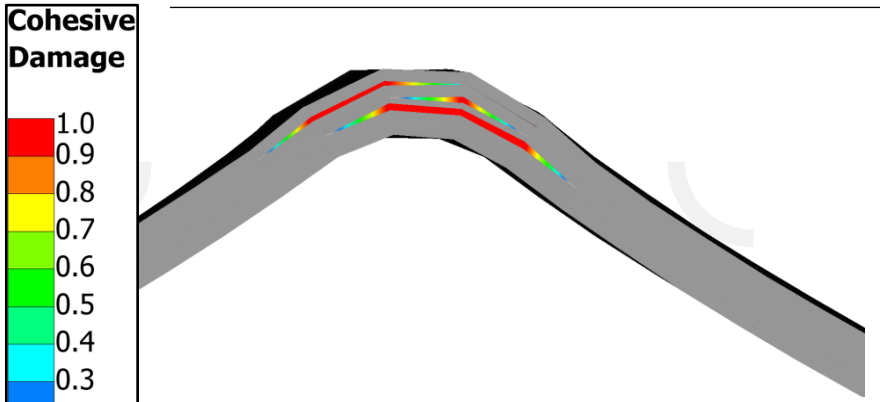
Experiment





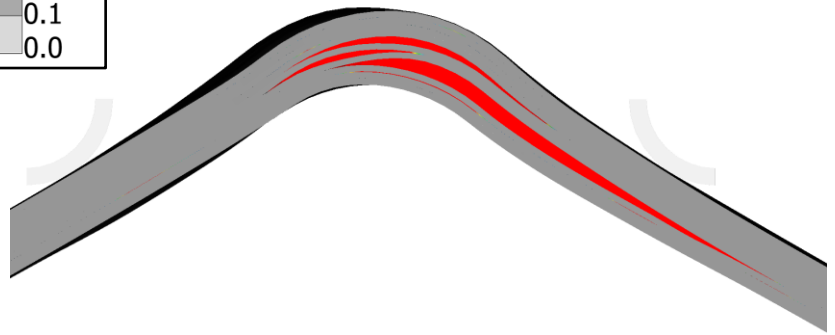
Adaptive element
2 mm

Time: 15 min 11 sec
Accurate & Fast



LS-Dyna – 2 mm
Ply-based mesh

Time: 19 min 46 sec
Loss in accuracy



LS-Dyna – 0.5 mm
Ply-based mesh

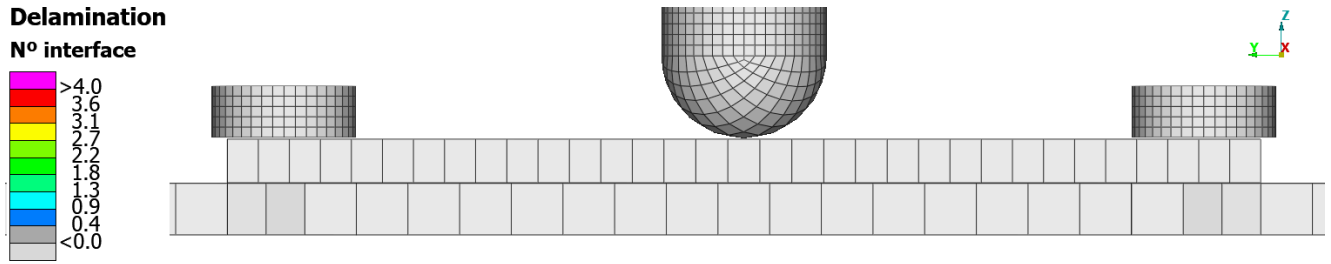
Time: 4 hours 43 min
Comput. expensive

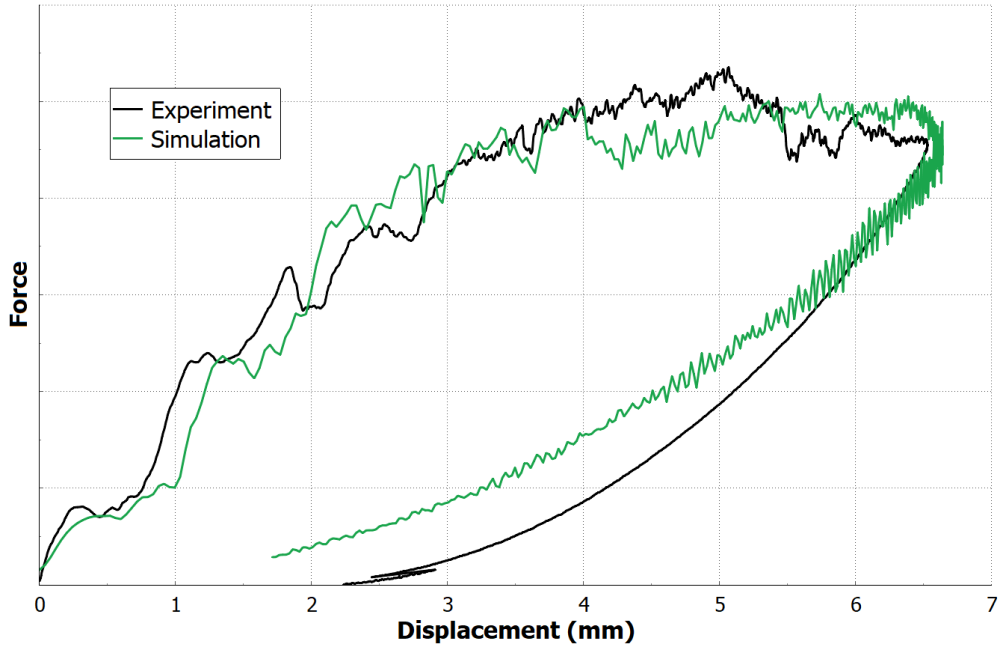
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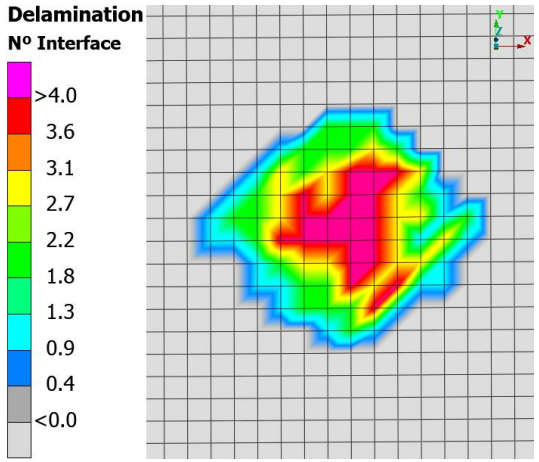
Examples

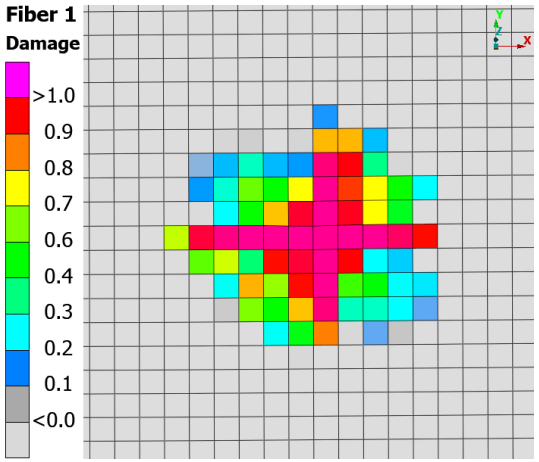
Impact analysis

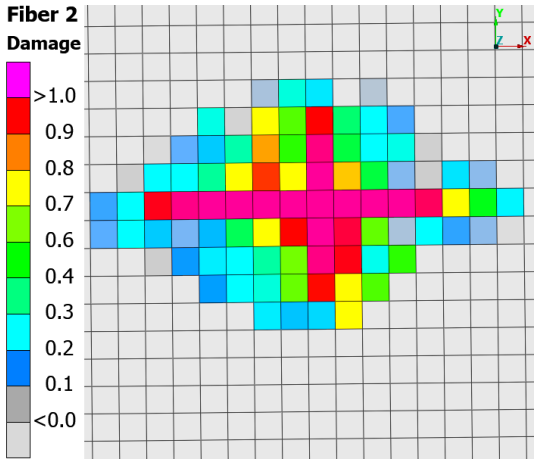
Low Velocity Impact











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Examples

Static analysis

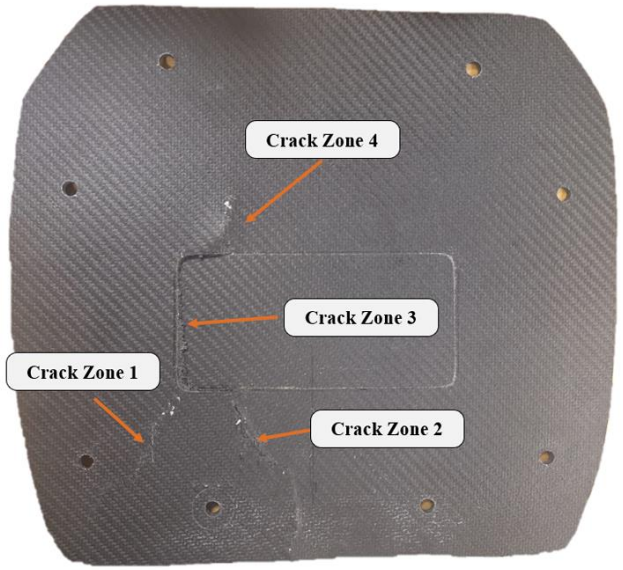
Anti-intrusion plate

Formula student vehicle

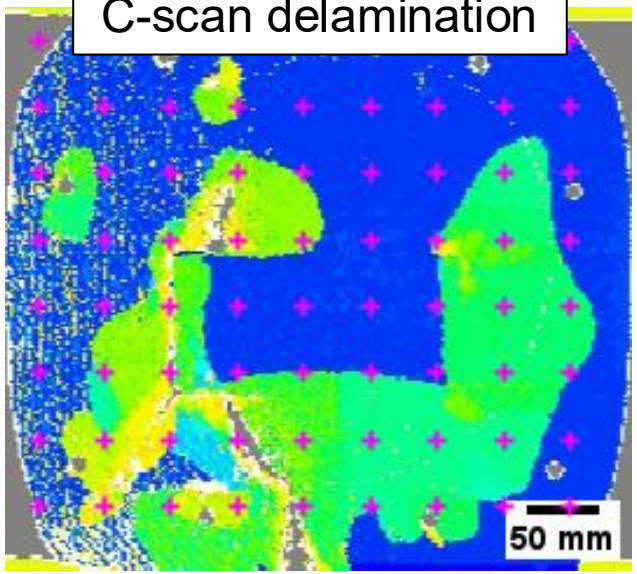


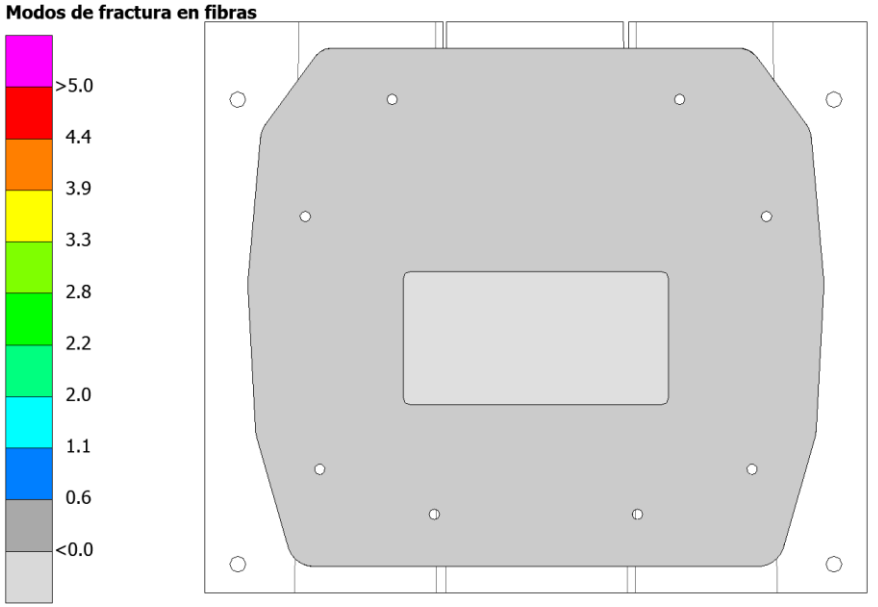
Adaptive element
4 mm

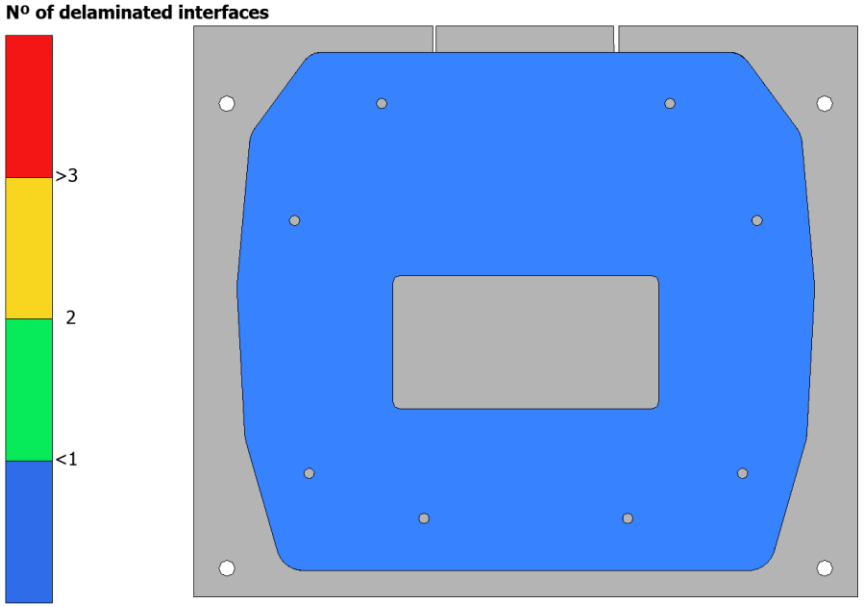
Experiment



C-scan delamination







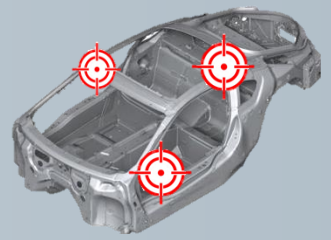
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Methods summary

3 simulation add-ons:

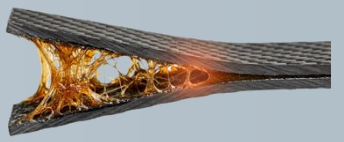
btech
3D Stress reconstruction
Post-processing tool

Delamination detection



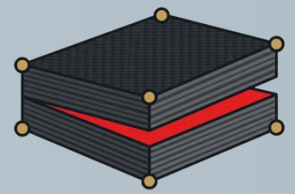
btech
Energy-based cohesive
Interface element

Debonding simulation
using large elements (5 mm)



btech
Adaptive element
User element

3-in-1
adaptive finite element



Faster computation
x50 speed

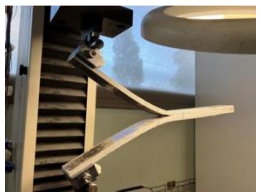
Simpler workflow
Avoid multi-layer meshing

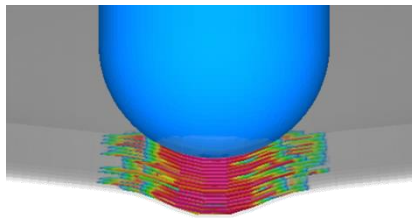
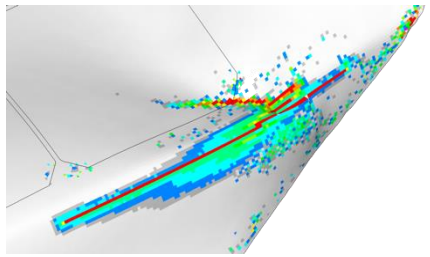
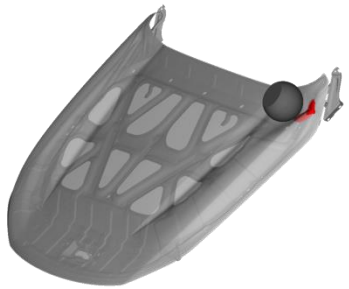
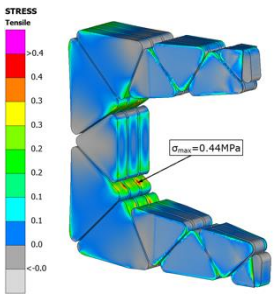
CONTACT US FOR A DEMO !
MAV Expo – Booth 4: BTech

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btech Group

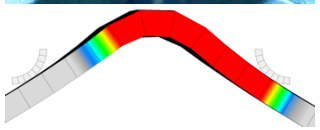
Thank you for your attention



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Automotive II

8 October · 11:30 – 13:00 · Main Auditorium

ELN CONFERENCE SPAIN 2026



PRESENTATION 2 OF 4

František Simančík

Institute of Materials and Machine Mechanics, Slovak Academy of Sciences (SK)

European Magnesium – a way for clean, competitive and sustainable lightweighting

Magnesium - Made in Europe

a way for clean, competitive and sustainable lightening

František Simančík

frantisek.simancik@savba.sk

Institute of Materials & Machine Mechanics
Slovak Academy of Sciences
Dúbravská cesta 9/ 6319, 845 13 Bratislava, SK



ELN CONFERENCE SPAIN 2026

Barcelona 8th October 2026

Typical products made of magnesium alloys

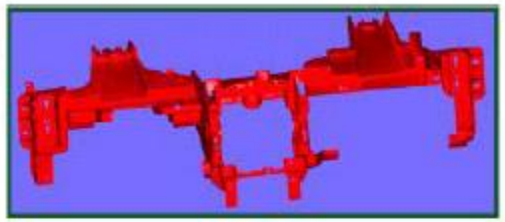


Why is magnesium good for lightening?

- **low density** (1.7 g/cm³, i.e. 30% lighter than aluminum)
- components made from Mg posses the **highest strength-to-weight** and **stiffness-to-weight ratios** compared to conventional structural materials
- it can be cast into **complex,** thin-walled components at relatively **low temperature** (~700C)
- **It does not react** with steel and graphite (increased lifetime of molds)
- is **easy to machine**,
- good **vibration damping** properties
- corrosion-resistant (if clean HP quality)

Mg alloys in automotive

Jaguar IP Cross-Car Beam



GM Front Console



Engine Accessory Mounting Bracket



Door Inner Module Aston Martin



Cam or Valve Cover



Transfer Case for 4x4 Transmission



Intake Manifold, BMW



DCX 7 Speed Transmission Case



BMW Block with Cast in Al-Si Liners



Front-End Assembly for Ford F-150 Truck



USAMP 2005: Magnesium Vision 2020: A North American Automotive Strategy for Magnesium.

Potential of Mg alloys for lightening in automotive

	Original Weight	Original Material	Mg Weight	Weight Saved
CHASSIS	*lb*		*lb*	*lb*
4 Wheels	65	Al	39	26
1A Frame Cross Member	20	steel	10	10
Engine Cradle	34.8	Al	23.7	11.1
Fuel Tank Barrier	8.7	steel	5	3.7
Brackets - Adjustable Pedal	2	steel	1	1
Brake/Accelerator	2.5	steel	2	0.5
Steering - Wheel	2.5	Al	1.5	1
Columns	4	Al	3	1
Column Brackets	2	steel	1.5	0.5
ABS Mounting Bracket	1.3	iron	0.9	0.4
INTERIOR				
Seats - Frames (4)	44	steel	16	28
Stanchions (2)	24	steel	13	11
IP - X-car beam	25	steel	15	10
Knee Bolster	10	steel	6	4
Console	8	steel	5	3
Brackets	1	steel	0.5	0.5
Glove Box Door	1	steel	0.7	0.3
POWERTRAIN				
Engine Block I 6	56	Al	33	23
Engine Block I 4	42	Al	23	19
Automatic Transmission	42	Al	30	12
Intake Manifold	22	plastic	12	10
Transfer Case	25	Al	15	10
Clutch Housing	14	Al	7	7
Oil Pan	9	Al	6	3
Engine Mounting Brackets	6	iron	3	3
Alternator Bracket	5	Al	2.5	2.5
Cam Cover (2)	7	Al	5	2
Cylinder Head Cover	7	Al	5.7	1.3
Air Intake Housings	6	plastic	4	2
Oil Pump Housing	3	Al	2	1
Power Steering Pump Bracket	1.5	Al	1.2	0.3
BODY STRUCTURE				
Door Inner Panels (4)	86	steel	39	47
Radiator Support/GOR	32	steel	12	20
Front of Dash Structure	40	steel	22	18
Lift gate Inner	22	steel	12	10
Windshield Surround (frame)	22	steel	12	10
Targa Roof Frame Opening	11	steel	6	5
Wiper Motor/support Assembly	3.5	Al	2	1.5
Mirror Housing	3	zinc	2	1
Headlight Retainer	1.5	steel	1	0.5
TOTAL	680*		**380***	300*

Steering Wheel Armature



Steering Column



Lock Housing



GM Corvette, Z06 Front Cross Member (or Cradle)



DCX Third-Row Seat Frame



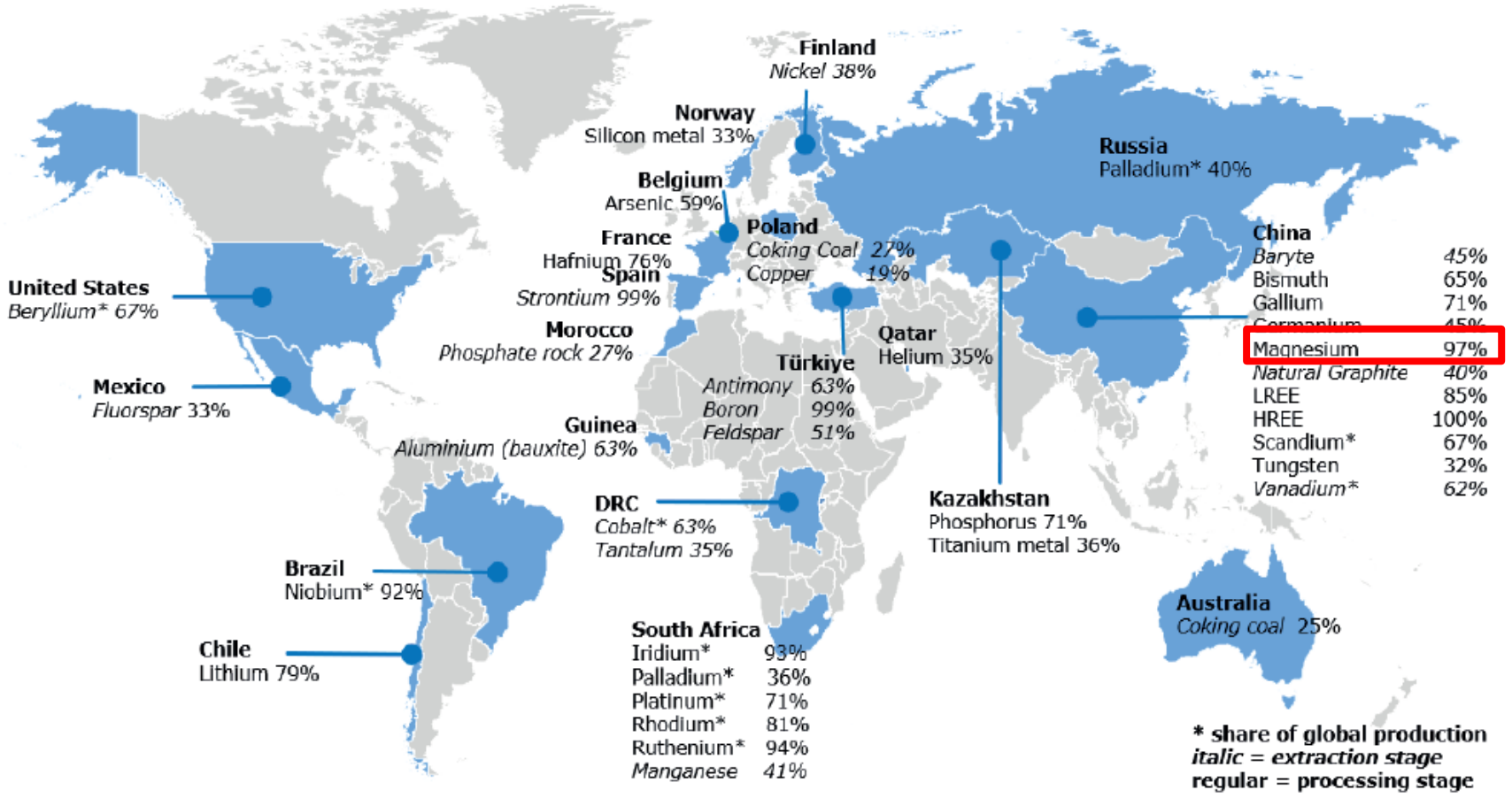
Jaguar Seat Frame



Material	typical weight	possible weight	possible weight reductions	
	kg	kg	kg	%
Steel + cast iron	973	686	287	29%
Aluminium	126	59	67	53%
Polymers/Composites	116	116	0	0%
Others	192	172	20	10%
Rubber and Glass	113	105	8	7%
Mg alloys	5	159		
Total	**1524**	**1297**	**227**	**15%**

USAMP 2005: Magnesium Vision 2020: A North American Automotive Strategy for Magnesium.

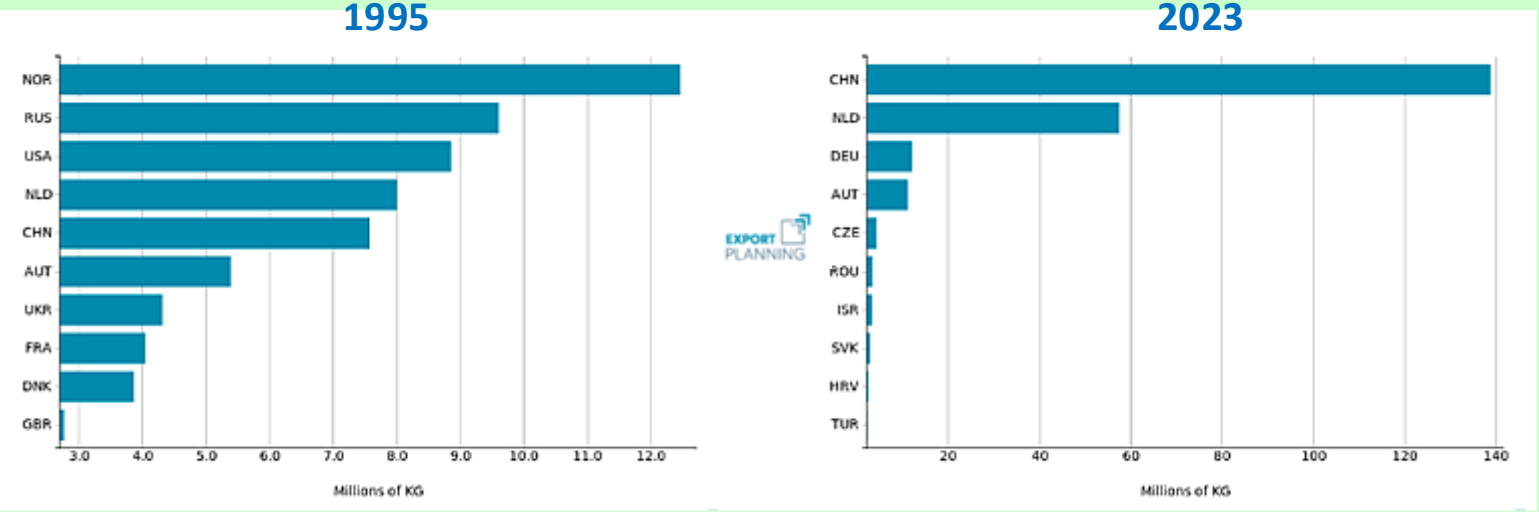
Major EU suppliers of Mg

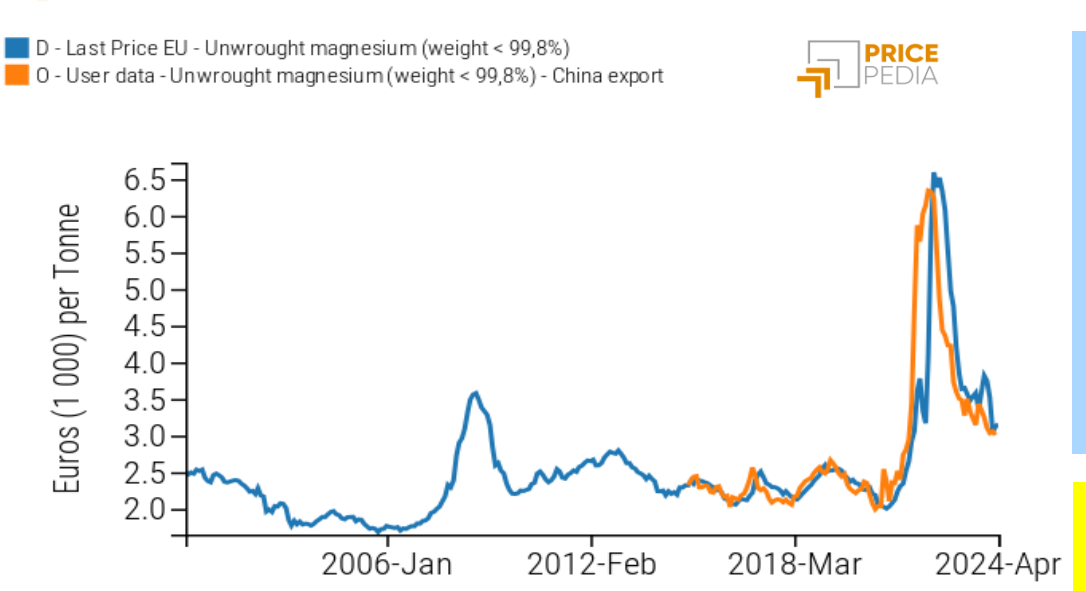


Raw materials	Stage	Main global producers		Main EU sourcing[28] countries		Import reliance[29]	EoL-RIR[30]	Selected Uses
Magnesium	Processing	China	91%	China	97%	100%	13%	Lightweight alloys for automotive, electronics, packaging or construction Desulphurisation agent in steelmaking
		United States	3%	Israel	1%			

European Commission, Study on the Critical Raw Materials for the EU 2023 – Final Report

Major EU suppliers of magnesium





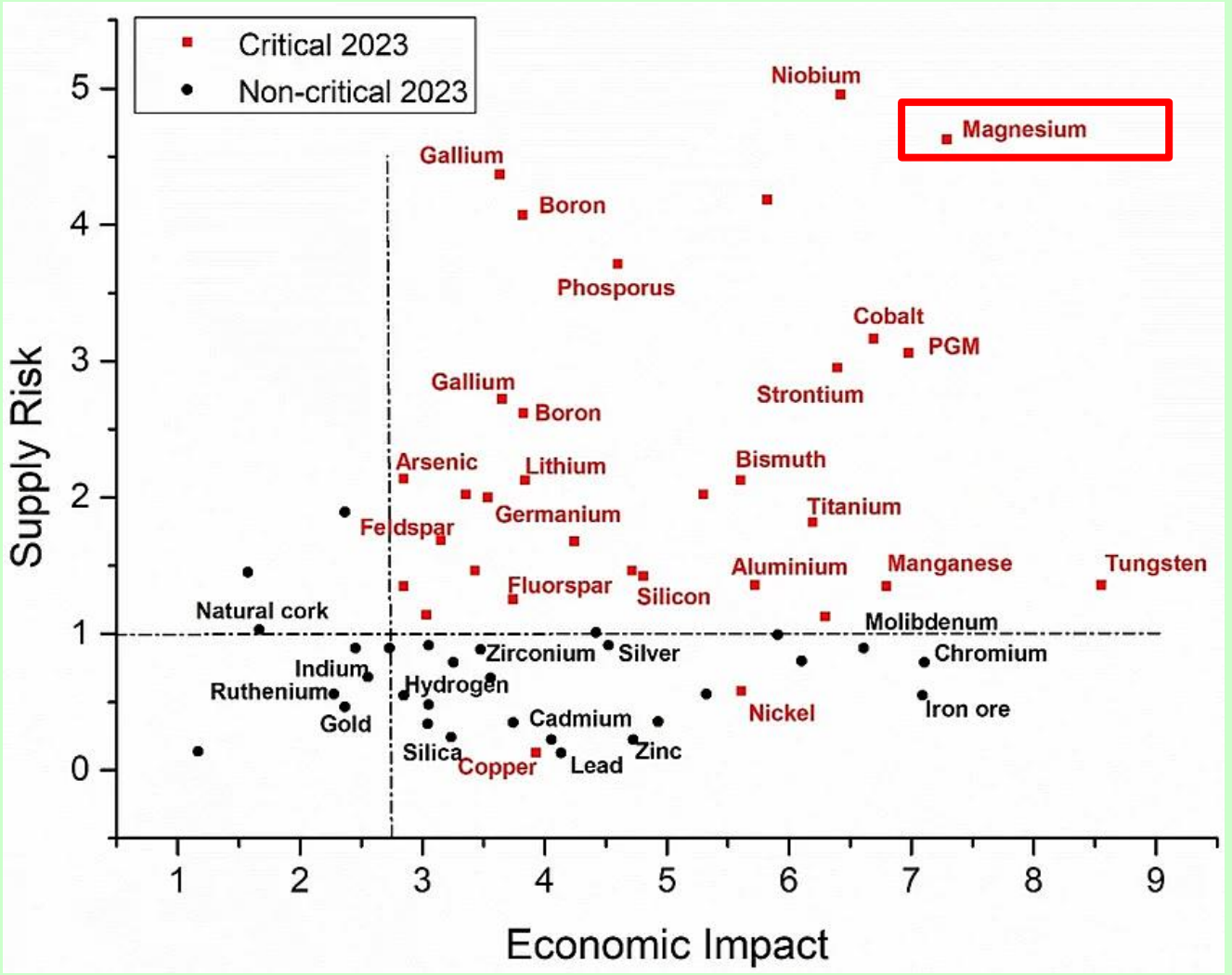


Longer transport (> 20 000 km, 40-60 days) associated high CO_2 impact

Carbon footprint from Mg production (world average): 21,3 kg CO_2 eq./kg Mg

Magnesium is critical raw material for the EU

Criticality studies	2011		2014		2017		2020		2023	
Material	SR*	EI	SR*	EI	SR	EI	SR	EI	SR	EI
Magnesium	2.6	6.5	2.5	5.5	4	7.1	3.9	6.6	4.1	7.4



European Commission, Study on the Critical Raw Materials for the EU 2023 – Final Report

Magnesium in Europe

Import	2020	2021	2022	2023	2024	average/y	%
Mg pure	87 083	101 921	119 478	78 127	89 009	95 124	51%
Mg alloy	57 633	57 693	78 682	58 686	46 487	59 836	32%
Mg powder	24 856	29 602	28 526	27 287	26 661	27 386	15%
Mg scrap	3 570	5 912	6 007	4 611	5 003	5 021	3%
Mg total	173 142	195 128	232 693	168 711	167 160	187 367	100%

Export	2020	2021	2022	2023	2024	average/y	%
Mg scrap	7 417	10 908	11 457	6 378	9 462	9 124	5%

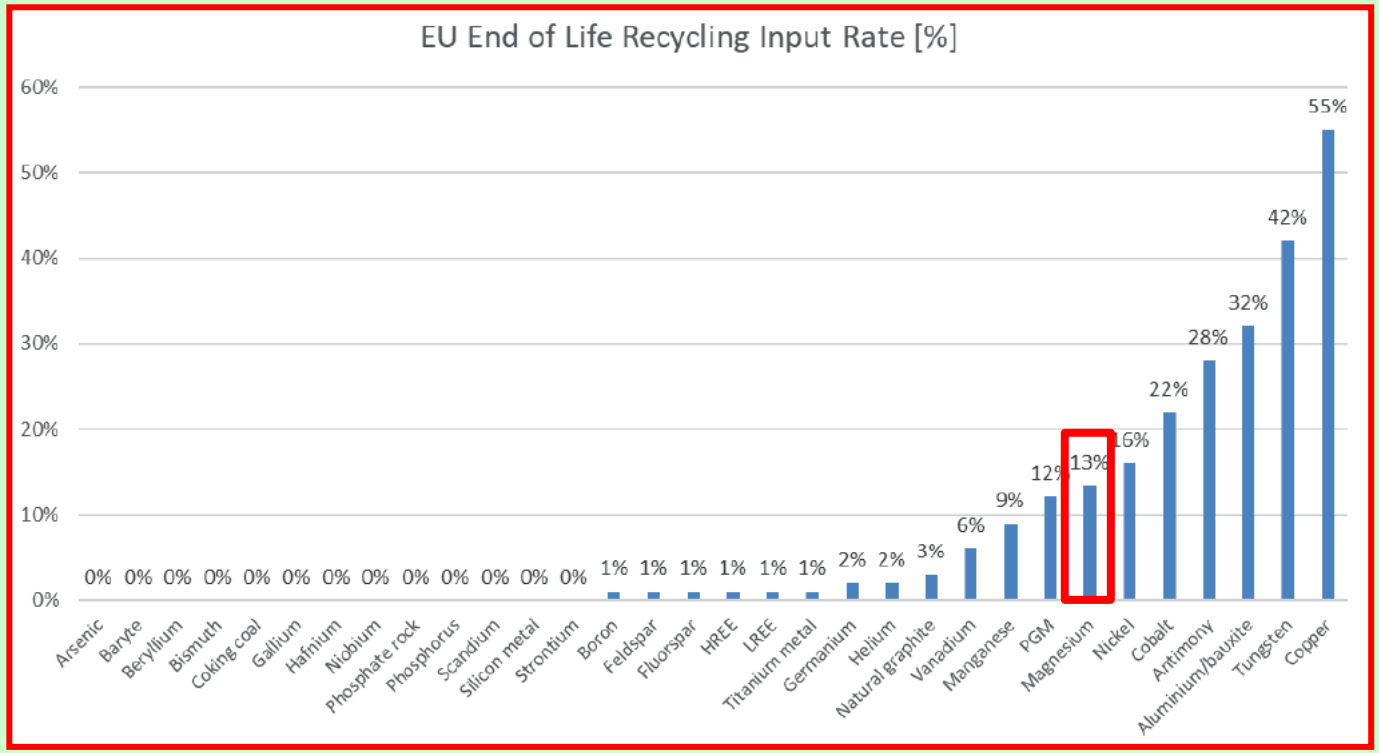
IMA, Global Magnesium Trade Flow Report 2024

Material	Application	Share	NACE sector	VA in million €
Magnesium	Transportation (automotive)	48%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	194,448
Magnesium	Packaging	23%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Magnesium	Construction	13%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Magnesium	Desulphurisation agent	12%	C24 - Manufacture of basic metals	64,561
Magnesium	Transportation (air, marine, etc.)	4%	C30 - Manufacture of other transport equipment	55,777

European Commission, Study on the Critical Raw Materials for the EU 2023 – Final Report

Magnesium recycling

Type Scrap	Description	Problems in the recycling
1	Clean scrap in large pieces	Does not present major problems
2	Clean scrap with inserts	Contains Fe, Cu and Al
3	Scrap painted or protected	Loss by fusion. Contains Fe, Si, and Ni
4	Clean chips	High surface, contains oxides
5	Oiled/wet chips	Loss by fusion, high surface, contains oxides
6	Slag and salt free foams	Contains oxides and inclusions
7	Sludge and slag with salts	Contains oxides and large inclusions
8	Residues of different grades	Contains oxides, chlorides, fluorides and inclusions



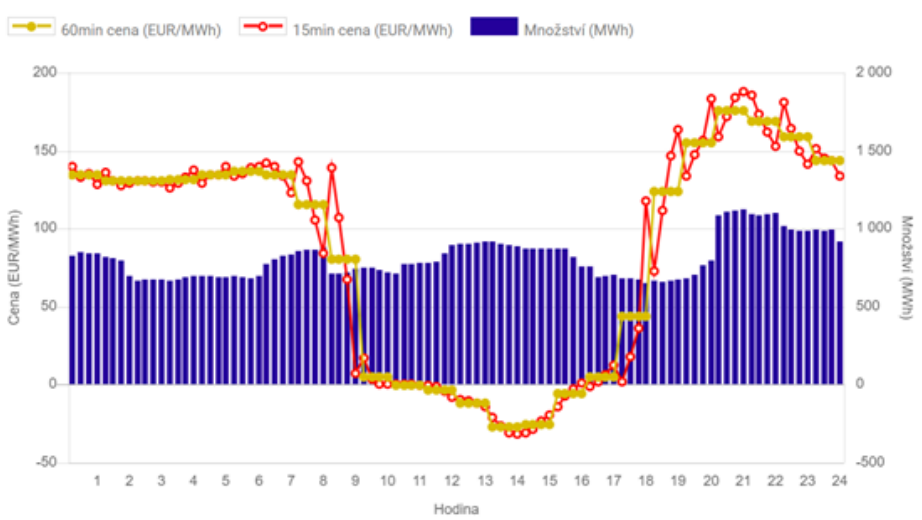


European Commission, Study on the Critical Raw Materials for the EU 2023 – Final Report

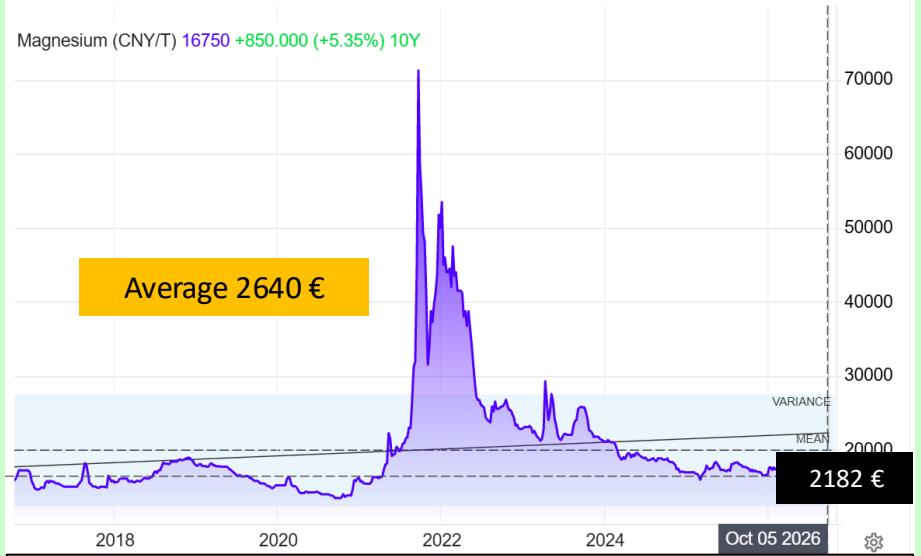
What to do? Innovative approach is urgently needed

Innovation No.2: burning roducing primary Mg from surplus electricity via interrupted electrolysis

$MgCl_{2(l)} = Mg_{(l)} + Cl_{2(g)}$ required electricity ~590 kJ/mol, i.e 6,8 kWh/kgMg



Energy price on the spot market on 25.5. 2026 (9 hours zero costs)



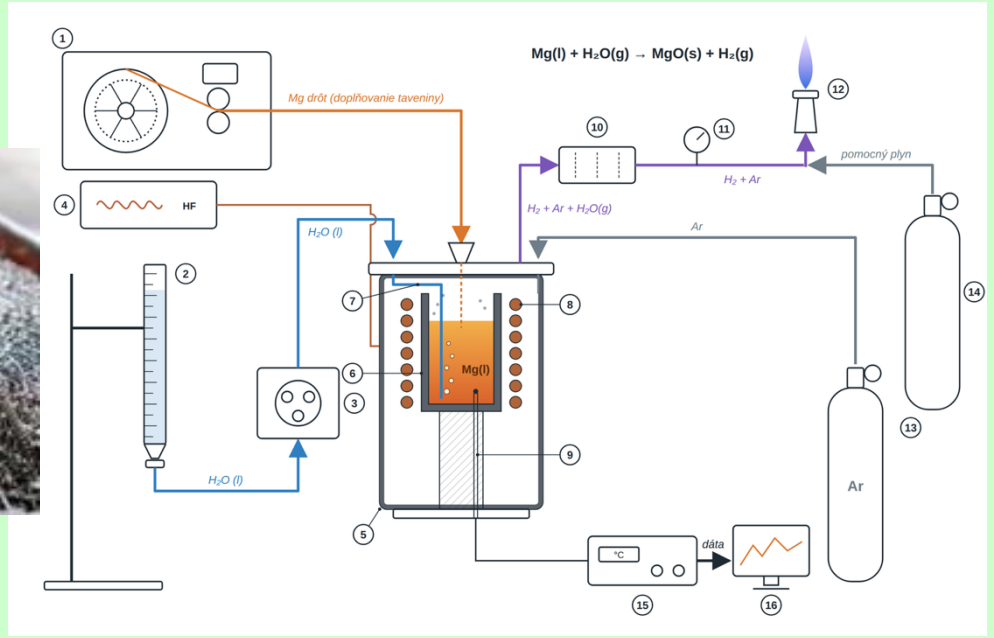
The price of primary Mg was ~ 1650 €/kg

- Electricity makes ~80 % of the Mg costs
- Based on laboratory experiments the interrupted electrolysis is possible, providing electrolyte is kept in molten state
- Laboratory production of Mg attained ~80% of theoretical value according to Faraday's law
- Realistic efficiency of electrolysis in real conditions can be ~ 60%, i.e 11,5 kWh_e is needed for 1 kg Mg
- 2182 € for 1 kg Mg is sufficient to cover electricity if 1 MWh_e < 152 €,
- Mg is significantly cheaper when it is produced using surplus electricity from RES
- the ability to interrupt electrolysis contributes significantly to grid stability
- this capability enables the expansion of further renewable energy installations
- beside this ~ 4,7 kWh / kg Mg of residual heat is produced (i.e.~ 406 kJ /mol Mg)

What to do? Innovative approach is urgently needed

Innovation No.2: producing primary Mg from scrap, that cannot be efficiently recycled via remelting or distillation







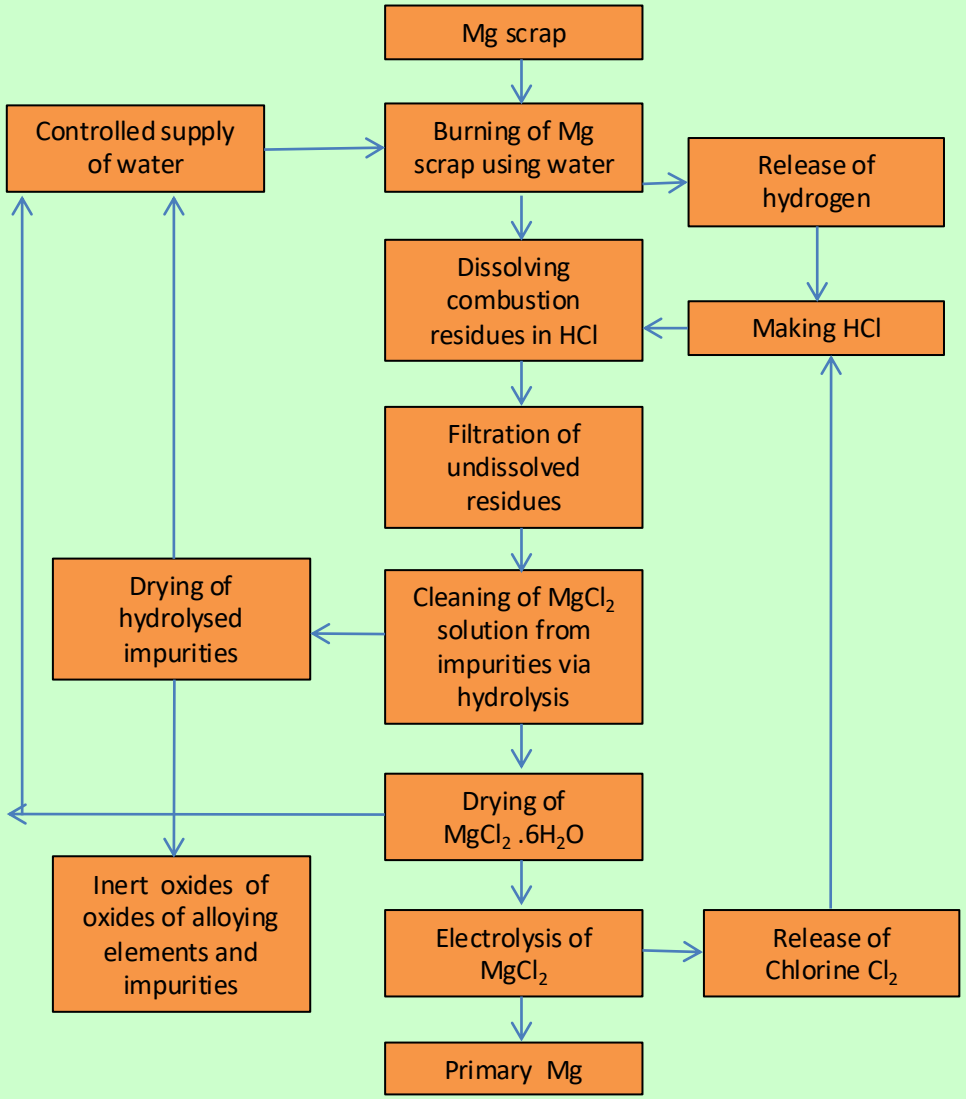
Idea:

- combustion of Mg scrap via controlled water addition:
  $Mg + H_2O = MgO + H_{2(g)}$ released heat ~382 kJ
- recycling of burning residues to new electrolyte for production of primary Mg:
  $MgO + 2HCl = MgCl_{2(a)} + H_2O$ released heat ~132 kJ
  $MgCl_2 .6H_2O = MgCl_2 + 6H_2O$ required heat ~ 148 kJ
- HCl is made from chlorine and hydrogen released in electrolysis resp. in combustion
  $H_2 + Cl_2 = 2HCl(g)$ released heat ~ 200 kJ
- Electrolysis provides additional ~ 406 kJ /mol Mg residual heat



The heat needed for recycling is much lower than heat obtained from used reactions

Concept 1: primary Mg is produced from scrap using growing surplus electricity because of RES



$Mg + H_2O = MgO + H_{2(g)}$ released heat ~382 kJ

$MgO + 2HCl = MgCl_{2(a)} + H_2O$ released heat ~132 kJ

$H_2 + Cl_2 = 2HCl(g)$ released heat ~ 200 kJ



$MgCl_2 .6H_2O = MgCl_2 + 6H_2O$ required heat ~ 148 kJ

$MgCl_{2(l)} = Mg_{(l)} + Cl_{2(g)}$ required electricity ~590 kJ

- the process generates **zero emissions**
- water, chlorine, hydrogen and Mg operate in a closed cycle (**no added material needed**)
- released reaction heat significantly exceeds the process heat requirements (**no additional heat needed**)
- the only input required is electricity for electrolysis—ideally **surplus energy from RES** (grid stabilization is benefitial)

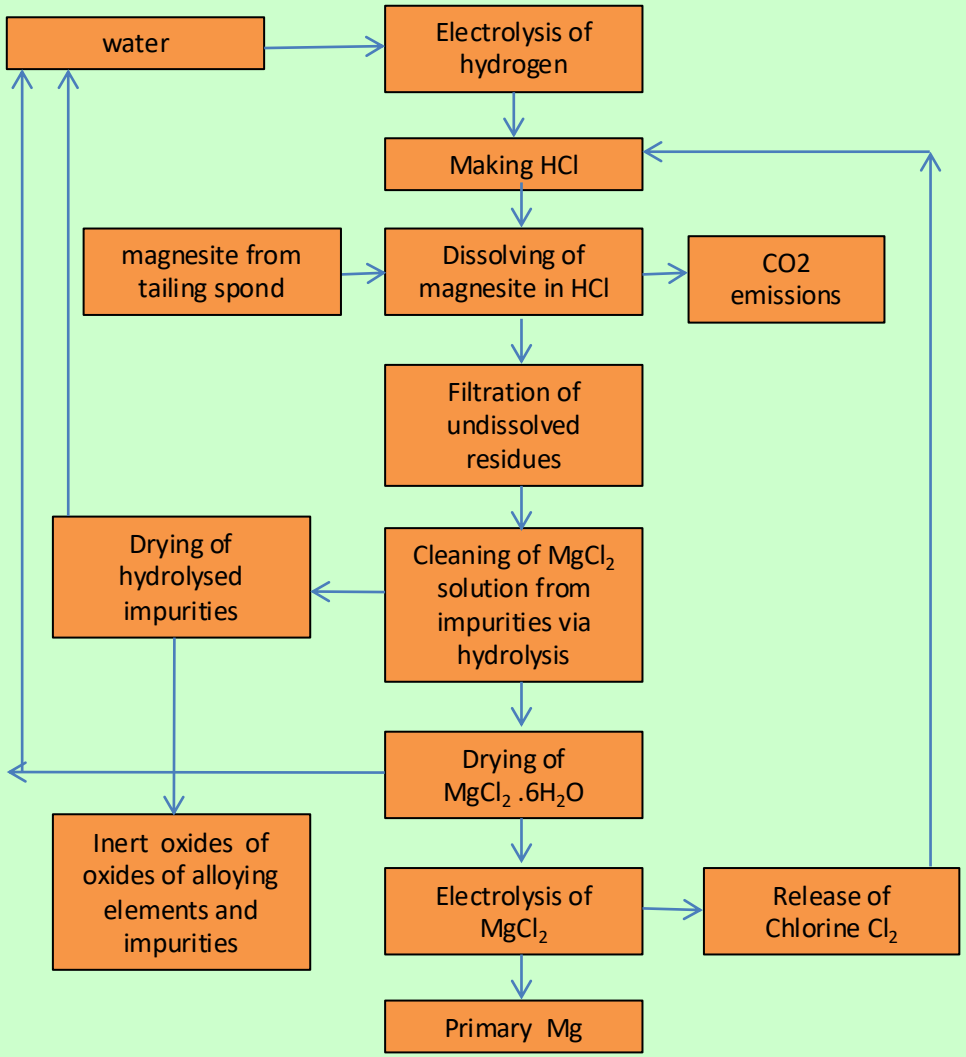
Concept 2: primary Mg is produced from magnesite using the same process





- Electrolyte $MgCl_2$ is prepared by dissolving magnesite $MgCO_3$ in HCl:
  $MgCO_3 + 2HCl = MgCl_{2(a)} + H_2O + CO_2$ released heat ~74 kJ
- Other processing steps are similar to previous concept
- There is sufficient magnesite in Europe (resources in Jelsava Slovakia exceed 250 mil tons). This is sufficient for production of ~ 80 mil tons magnesium
- As much as 4 million tons of fine magnesite powder / dust—a residue from MgO production—are even stored here in the tailings pond. This amount is sufficient for production of ~ 3,3 mil tons Mg
- When magnesite is used as a feedstock for magnesium production, only 1,8 kg of CO_2 is released per 1 kg of Mg - significantly less than the current global average (21 kg CO_2/ 1kg Mg)

Concept 2: primary Mg is produced from magnesite using the same process



$2H_2O = 2H_2 + O_2$ required electricity 290 kJ/mol H_2

$H_2 + Cl_2 = 2HCl(g)$ released heat ~ 200 kJ

$MgCO_3 + 2HCl = MgCl_{2(a)} + H_2O + CO_2$ released heat ~74 kJ

$MgCl_2 .6H_2O = MgCl_2 + 6H_2O$ required heat ~ 148 kJ

$MgCl_{2(l)} = Mg_{(l)} + Cl_{2(g)}$ required electricity ~590 kJ

- the process generates **low emissions** (1,8 kg of CO_2 is released per 1 kg of Mg)
- Chlorine and Mg operate in a closed cycle, water is necessary for production of hydrogen
- released reaction heat exceeds the process heat requirements
- the only input required is **electricity for electrolysis of Mg and hydrogen** - ideally surplus energy from RES

Investment support available

Public co-financing to a CRMA strategic project:

- EIB Project Finance up to €2B/year (strategic projects)
- EIT RawMaterials up to €2,5M pre project (pilot stage raw material projects)
- EU Innovation Fund up to €700M – 2026 call (pilot demonstration, strategic project)

Why not give it a try?





Acknowledgement:

Co-workers :

Robert Adamčík, Karol Iždinský, Michal Kuriš, Peter Oslanec, Ľubomír Pavlík, Ján Poničan, Matej Štepánek et al.

Supported by the EU through the Recovery and Resilience Plan of the Slovak Republic under project 09I04-03-V02-00058: "Research into the potential use of metallic magnesium as a multifunctional and fully recyclable energy storage medium (Magrestor)," conducted by the Institute of Materials and Machine Mechanics of the Slovak Academy of Sciences in collaboration with the Faculty of Chemical and Food Technology and the Faculty of Mechanical Engineering of the Slovak University of Technology in Bratislava.



PRESENTATION 4 OF 4

Herfried Lammer

Chief Innovation Officer, HEAD Sport GmbH (AT)

Highly innovative lightweight sporting goods as a technology platform for automotive

High innovative lightweight sporting goods as technology platform for automotive and aerospace

October 8th

Herfried Lammer,

Different types of light weight mobility☺



Performance with recycled products



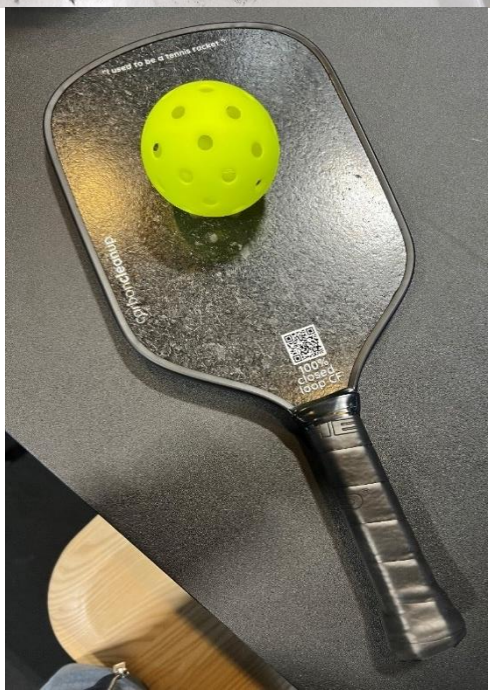


Performance with Recycled CF









From Racket to racket

Characteristics of innovation:

- Tennis rackets, due to their requirements and shape are built from ~100% UD carbon fiber prepregs
- Due to a flat hitting surface, Paddel and Pickleball are produced with a different technology and have different mechanical specifications
- Recycled fibers, from Tennis rackets or other sources can be processed in a kind of SMC/BMC process and can fulfill the KPI

Customer benefit:

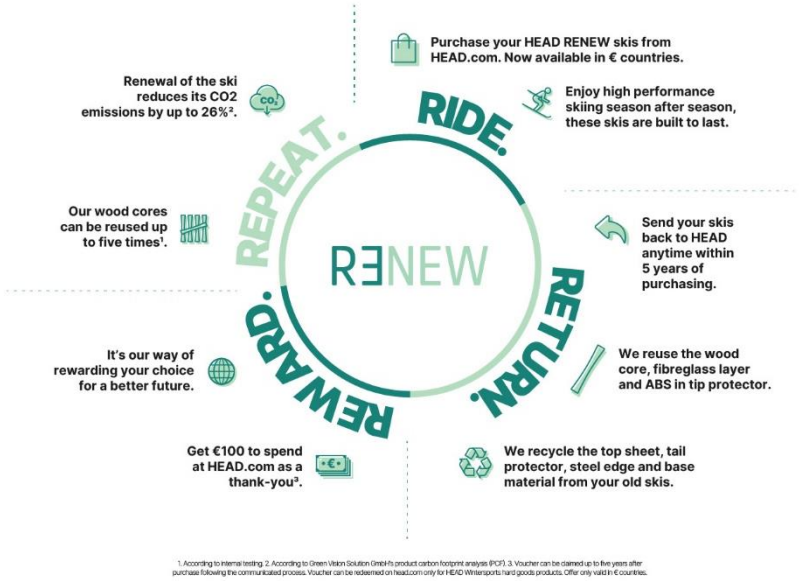
Challenges

- Quality of recycling fibers for new process
- Isotropic properties especially at thin layers

Solution

- SMC/BMC Process adaption

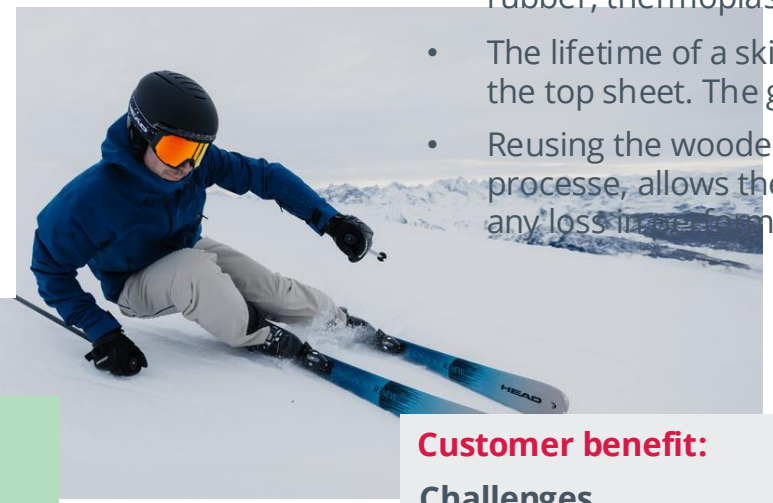
Performance with Recycled GF



Can we use recycled Glass fibers in a ski?

Characteristics of innovation:

- A ski is a complex composite part, combining wood, glass fibres, metal, rubber, thermoplastic materials
- The lifetime of a ski is often limited by the steel edge, the racing base or the top sheet. The glass fibers can withstand much longer use periods
- Reusing the wooden core and the glass fibers, without shredding or other processe, allows the the CO2 saving production of a renewed ski without any loss in performance





Customer benefit:

Challenges

- Process development of separating and remanufacturing of a ski
- NDT of composite parts

Solution

- These skis are made from materials that can be renewed and recycled up to 5 times, with 26% less carbon footprint for one cycle.

Performance with short rCF











Where can we use short rCf and improve performance?

Characteristics of innovation:

- Ski bindings have partly injection molded parts, highly filled with glass fibers
- Temperature range, impact, UV are significant loads
- Ecoluxe compounds from recyclyed short fibers from shredding have been developed together with Carbon Cleanup GmbH to fulfill all specifications

Customer benefit:

Challenges

- Demanding specification
- Lightweight

Solution

- First parts on touring bindings have been replaced with short rCF material

Summary

Sporting goods are high performance lightweight products in serial production and fast product cycles.

They are an ideal plattform to develop new sustainable lightweight technologies and transfer them.

For recycling, challenges exist – beyond technologies there are logistics and emotions.


HEAD

PANEL DISCUSSION

Automotive II

8 October · 11:30 – 13:00 · Main Auditorium



MODERATOR

Iker Arroyo

Eurecat (ES)



Pierre Daniel

BTECH (ES)



František Simančík

IMMM, Slovak Academy of Sciences (SK)



Carlos Muñoz

Gestamp (ES)



Herfried Lammer

HEAD (AT)

DAY 2 · THURSDAY 8 OCTOBER

Lunch

13:00 – 14:00 · Foyer next to the Main Auditorium

We resume at 14:00 with Defence, Security and Dual-Use Technologies

Visit the MAV Lightweight Expo in Rooms 3 & 4

DAY 2 · THURSDAY 8 OCTOBER

Defence, Security and Dual-Use Technologies

14:00 – 15:30 · Main Auditorium



MODERATOR

Stephany Rivero

AeroS Ecosystem (ES)

SPEAKERS

Thomas Hipke Fraunhofer IWU (DE)

Manuel García 2M Engineering (ES)

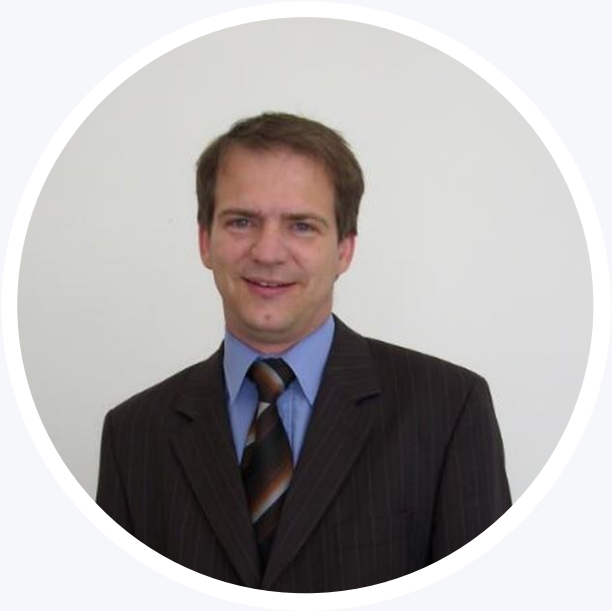
Samanta Simon Airbus GeoTech (ES)

Stanislav Landa Danish Technological Institute (DK)

Defence, Security and Dual-Use Technologies

8 October · 14:00 – 15:30 · Main Auditorium

ELN CONFERENCE SPAIN 2026

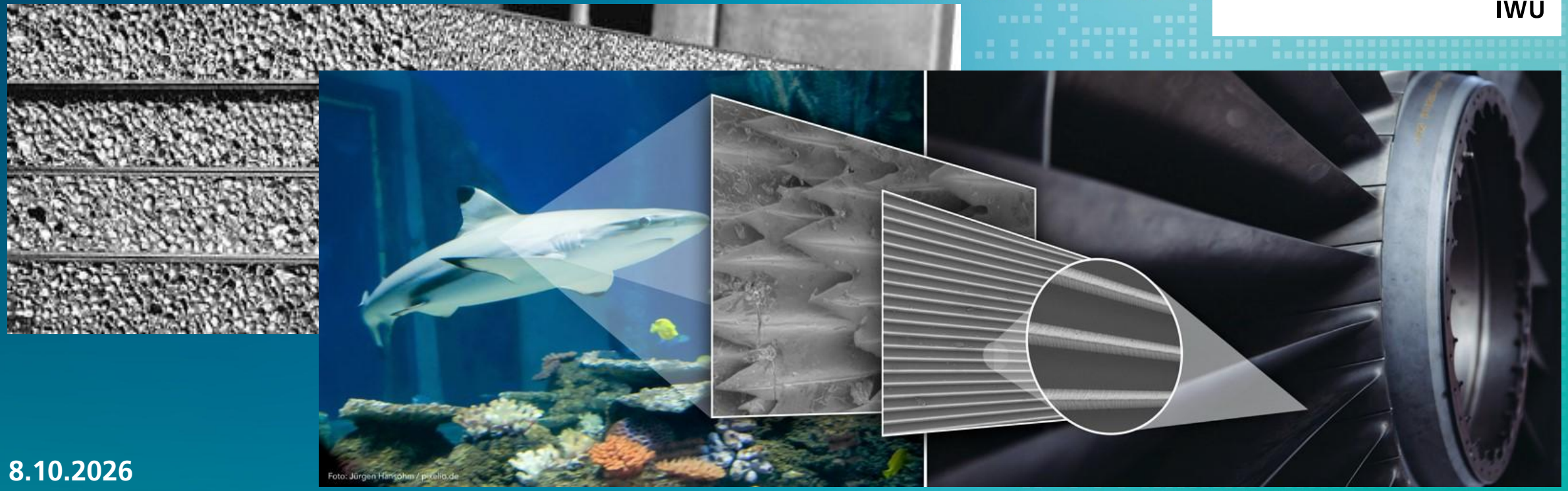


PRESENTATION 1 OF 4

Thomas Hipke

Head of Division, Fraunhofer IWU (DE)

Defence systems, new developments at Fraunhofer IWU



8.10.2026

New developments in defense industry at Fraunhofer IWU

Fraunhofer IWU

Our network of research and industry partners

Networks

INDUSTRIEVEREIN SACHSEN 1828

WGP Wissenschaftliche Gesellschaft für Produktionstechnik

EFB

IRP

euspen

ACOD Automotive Cluster Ostdeutschland e.V.

VDI

VDW

eu ROBOTICS

MITTELDEUTSCHES INSTITUT FÜR SICHERHEITS-INDUSTRIE

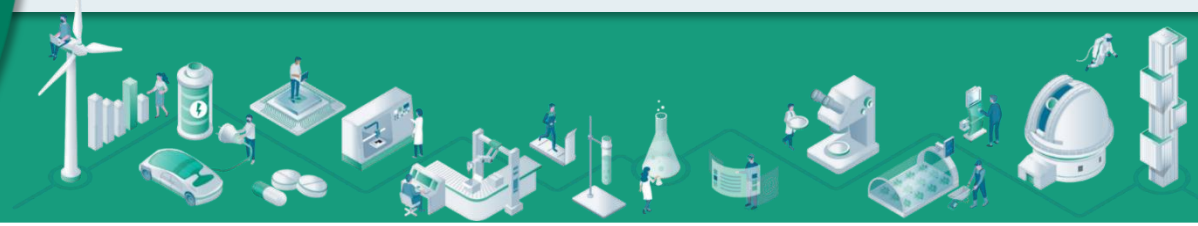
VE.MAS innovativ

ENERGY- AND RESOURCE-EFFICIENT PRODUCTION

SECOND LIFE AND CIRCULARITY

DIGITALISATION AND FUNCTIONAL INTEGRATION

SUSTAINABLE MOBILITY AND MANUFACTURING



Affiliated universities

TECHNISCHE UNIVERSITÄT CHEMNITZ

HTWK Hochschule für Technik, Wirtschaft und Kultur Leipzig (FH)

Technische Universität Dresden

WHZ Westsächsische Hochschule Zwickau

HOCHSCHULE MITTWEIDA University of Applied Sciences

HTWD

Hochschule Zittau/Görlitz University of Applied Sciences

Industry

- Mechanical and Plant Engineering
- Automotive and supplier industries
- Electrical and Energy Engineering
- Aerospace

Public funding bodies

European Union

SACHSEN

Bundesministerium für Forschung, Technologie und Raumfahrt

Fraunhofer IWU

Fraunhofer Research Divisions and Networks

Focus on Defence and Production



Defence, Prevention and Security

12 Fraunhofer Institutes

Areas of activity (selection):

- Systems and technologies for use on land, in the air, at sea, in space and in cyberspace
- Information gathering, reconnaissance, decision support
- Resilience and protection of critical infrastructure

Production

12 Fraunhofer Institutes



Areas of expertise (selection):

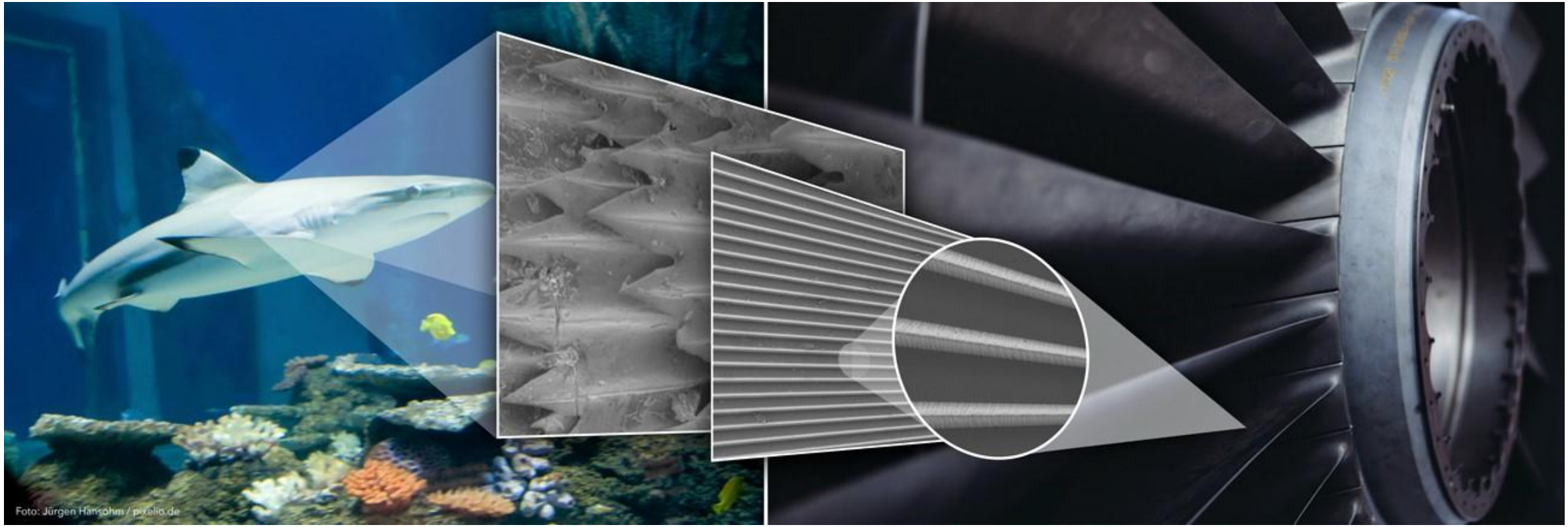
- Production techniques and process technologies
- Production machinery and plant
- Production control, automation and measurement technology
- Logistics and supply chain management

→ **Pooling expertise through networks and partnerships is essential**

MITTELDEUTSCHES INSTITUT FÜR SICHERHEITS-INDUSTRIE

High-performance products and new materials

Functional surfaces for industrial applications



- A microstructure inspired by shark skin for improved flow characteristics by reducing wall shear stress
- Benefits: Increased efficiency, noise reduction, energy savings, etc.

[source: https://infothek.bmk.gv.at/hightech-haifischhaut-aus-der-steiermark-soll-flugzeuge-effizienter-fliegen-lassen/]

bilasurf

Fraunhofer IWU



Drones

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High-performance products and new materials

Development of an autonomous multicopter cargo drone

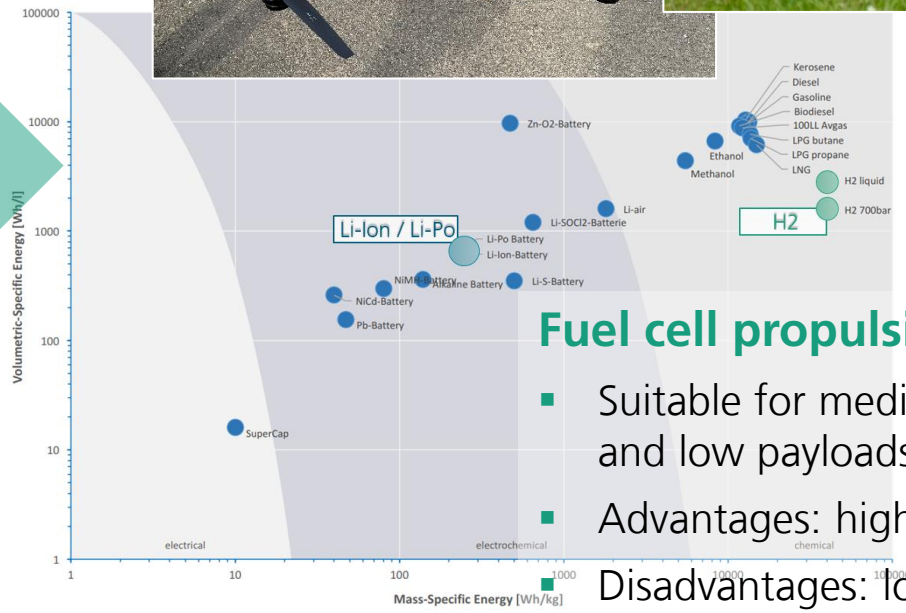
Our current research projects:

- **Level 4 autonomy**
- **Advanced control systems,** including collision avoidance, automatic route planning and sensor fusion
- Power supply via an **air-cooled fuel cell stack**
- **Energy management system** utilising flight characteristics and energy consumption simulation
- **Lightweight and modular load-bearing structure** using a shape memory alloy









Fuel cell propulsion

- Suitable for medium flight durations (>100 min) and low payloads (<6 kg)
- Advantages: high energy density
- Disadvantages: low fuel cell efficiency, no volatile energy release

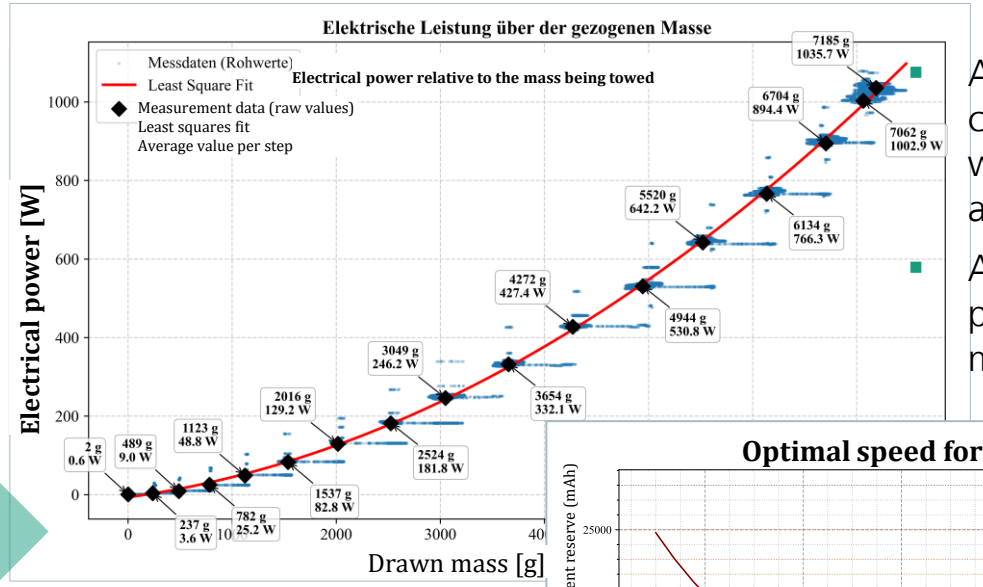
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High-performance products and new materials

Development of an autonomous multicopter cargo drone

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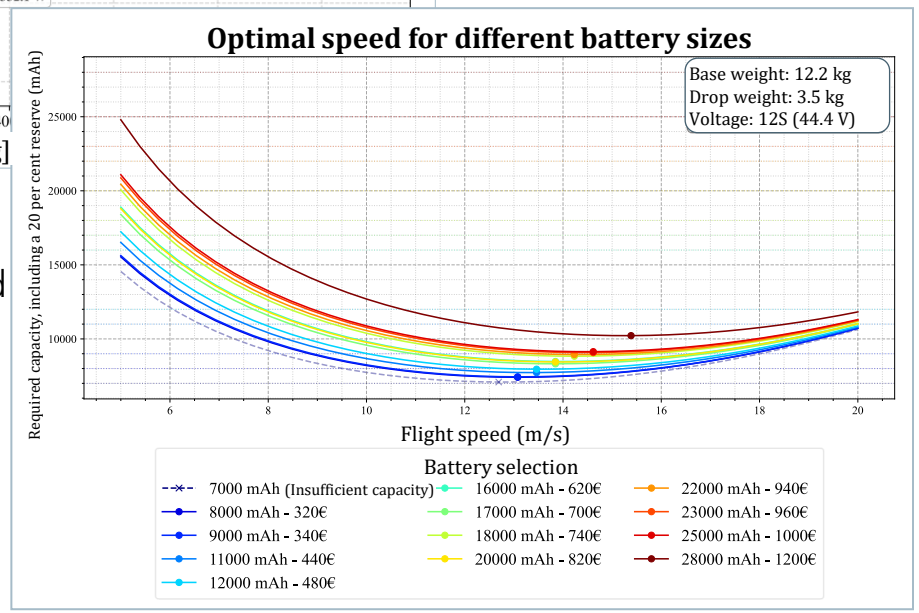
- **Level 4 autonomy**
- **Advanced control systems,** including collision avoidance, automatic route planning and sensor fusion
- Power supply via an **air-cooled fuel cell stack**
- **Energy management system** utilising flight characteristics and energy consumption simulation
- **Lightweight and modular load-bearing structure** using a shape memory alloy



Advance online energy consumption forecast, taking weather conditions into account

Analysis of complete propulsion systems (servo, motor, propeller)

- Design of the energy supply system with regard to mission duration, distance and weigh
- Design of optimal buffer systems for fuel cell operation



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Lightweight drives for UAV

Publication in DRONES 01/2025



- Flytime with Payload:

  35 – 45 min
- V_{max}: 60 km/h
- Weight: 3,2 kg



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High-performance products and new materials

Shape-memory alloys for small-scale actuators

Published in Drones Magazine

Small actuators based on shape memory alloys (SMA)

- **How SMAs work:** following what appears to be plastic deformation, the material returns to its original shape when heated to a specific temperature
- **Advantages in small actuators:** high power density with minimal installation space, electromagnetic safety, silent operation, low wear due to a small number of mechanical components, sensors included

→ Development of a specialised locking and unlocking actuator system for UAVs is possible



TECHNIK

TEXT: BENJAMIN JOHN
ABBILDUNGEN: FRAUNHOFER IWU

SMARTES MATERIAL

Formgedächtnislegierung: Eine Verriegelung für den Grabbit G7 von Vectorbirds

Antriebe auf Basis von Formgedächtnislegierungen finden sich bereits in unterschiedlichsten Anwendungen wie Smartphone-Kameras oder Automotive-Ventilen. Am Fraunhofer-Institut für Werkzeugmaschinen und Umformtechnik IWU wurden nun zusammen mit Vectorbirds airborne systems innovative Kleinantriebe für UAS-Anwendungen entwickelt. Diese nutzen die besonderen Materialeigenschaften aus, um bei minimalem Bauraum und Gewicht große Stellwege zu realisieren.

Die als Formgedächtnislegierungen bezeichneten Materialien besitzen die außergewöhnliche Eigenschaft, nach einer scheinbaren plastischen Verformung durch Erhitzen auf eine kritische Temperatur wieder ihre ursprüngliche Gestalt anzunehmen. Dieser Effekt eröffnet zahlreiche Anwendungsmöglichkeiten in der Aktorik. Denn im Vergleich zu konventionellen Antrieben bieten formgedächtnisbasierte Systeme entscheidende Vorteile: eine höhere Leistungsdichte, elektromagnetische Unbedenklichkeit, attraktive Wirtschaftlichkeit, geräuschlose Arbeitsweise und einfache Integration in kompakte Bauräume. Da sie zudem aus wenigen mechanischen Komponenten bestehen, ist der Verschleiß minimal. Dank des sogenannten intrinsischen Sensor-Effekts fungieren diese Materialien nicht nur als Aktoren, sondern auch als Sensoren, was sie in die Lage versetzt, Informationen über äußere Lasten, Stellwege und Temperaturen zu liefern. Das Ergebnis sind kompakte, technisch im Grunde simple, aber dennoch hochfunktionale Leichtbau-Aktoren.

TECHNISCHE DATEN

BAURAUM:	45 X 14 X 10 MM³
GEWICHT:	3 G
HUB:	> 2 MM
AKTIVIERUNGSGESCHWINDIGKEIT:	100 MS
BETRIEBSTEMPERATUR:	-20 °C BIS 65 °C
LEBENSDAUER:	> 100.000 ZYKLEN/BEWEGUNGEN

VOLL ZERLEGBAR

Langlebigkeit, Zuverlässigkeit, kompakte Abmessungen und geringes Gewicht machen derartige Kleinantriebe als Komponenten für Bau und Betrieb von UAS interessant. So kommen zum Beispiel seit Kurzem einige von ihnen in der Grabbit G7 von Vectorbirds zum Einsatz. Dabei handelt es sich um eine Drohne, die insbesondere mit Blick auf Überwachungsmissionen sowie den Search & Rescue-Betrieb konzipiert wurde und vor allem bei Behörden und Organisationen mit Sicherheitsaufgaben oder auch dem Militär zur Anwendung kommt. Sie lässt sich ohne den Einsatz von Werkzeug in ihre einzelnen Komponenten zerlegen. Die Antriebseinheit ist zusammenklappbar, die Landeinheit ist demontierbar. Ein schneller Aufbau vor Ort sowie ein verlässlicher Betrieb setzen jedoch ein zuverlässiges Verriegelungssystem voraus, um die Einzelkomponenten sicher zu montieren. Hier kommen die formgedächtnis-basierten Kleinantriebe ins Spiel, die dank ihrer kompakten Bauweise nicht nur das Gesamtgewicht der Drohne gering halten, sondern auch eine effektive Verriegelung der Module gewährleisten.

Die in Zusammenarbeit mit dem Fraunhofer IWU entwickelte Aktorik dient dazu, den Batterieschlitten der Drohne zu verriegeln und ein unbeabsichtigtes Lösen während des Betriebs zu verhindern. Das Ganze besteht im Wesentlichen aus einem federbelasteten Schieber und einem Formgedächtnisdraht aus Nickel-Titan. Im kalten Zustand wird der nur 76 Mikrometer dicke Draht durch die Federkraft vorgespannt. Bei elektrischer Erwärmung kontrahiert der Formgedächtnisdraht, da er in seine lastfreie Ursprungsform zurückkehren möchte und zieht so den Schieber zurück. Sobald der Draht abkühlt, bewegt die Rückstellfeder den Schieber in die Ausgangsposition und spannt den Draht erneut vor.

Durch die V-förmige Anordnung des Drahts wird eine Kraft-Weg-Übersetzung ermöglicht. Auf diese Weise erzeugt der Draht bei einer Dehnung von nur 3 Prozent einen Hub von 2 Millimeter. Da die Stellzeit für das Einfahren der Aktorik direkt von der Heizleistung abhängt, können problemlos Reaktionszeiten von 100 Millisekunden erreicht werden.

Formgedächtnisaktoren sind in Hinblick auf Stellweg, Bauraum, Kraftbereich und Lebensdauer einfach zu skalieren. Längere Drähte ermöglichen mehr Stellweg, dickere Querschnitte bieten größere Kraft

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FACEBOOK:	@FRAUNHOFERIWU
INSTAGRAM:	@FRAUNHOFER.IWU
YOUTUBE:	/FRAUNHOFERIWU
LINKEDIN:	@FRAUNHOFERIWU

VECTORBIRDS AIRBORNE SYSTEMS IM NETZ

WEBSITE:	WWW.VECTORBIRDS.COM
FACEBOOK:	@VECTORBIRDS
INSTAGRAM:	@VECTORBIRDS.DE
LINKEDIN:	@VECTORBIRDS

Im kalten Zustand wird der dünne Nickel-Titan-Draht von der Feder gedehnt ...

... bei Stromfluss kontrahiert der Draht und drückt die Feder gut sichtbar zusammen

INFO

Dieser Beitrag entstand mit freundlicher Unterstützung aus dem Fraunhofer-Institut für Werkzeugmaschinen und Umformtechnik (IWU). Autor Dipl.-Ing. Benjamin John beschäftigt sich im Rahmen seiner Forschung intensiv mit der Entwicklung und Anwendung der Formgedächtnistechnik, zum Beispiel Stellantriebe für Leichtbauanwendungen wie Drohnen.

Bei der Batterieverriegelung der Grabbit G7 setzt man bei Hersteller Vectorbirds mittlerweile auf einen Aktoren, dessen Wirkung auf Formgedächtnistechnologie basiert

Foto: Drones Magazin

56

57

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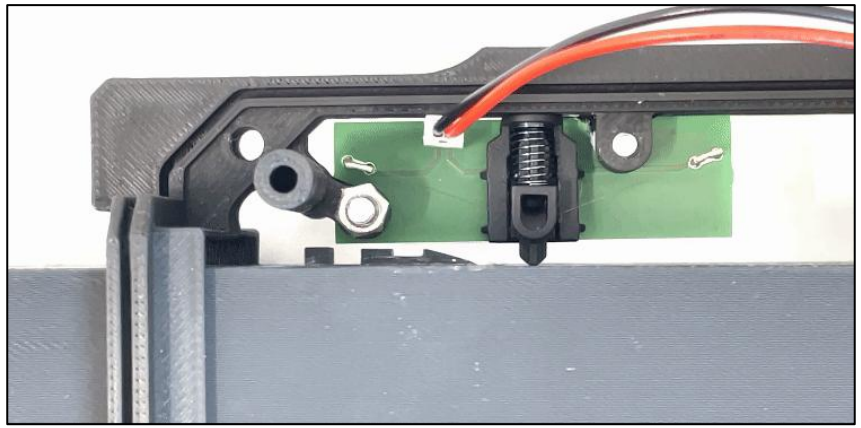
vectorbirds AIRBORNE SYSTEMS

Fraunhofer IWU

Application Development

Reference Project: Compact lightweight drives for quadcopters





Battery slide lock in the Grabbit G7 quadcopter

- Lightweight design due to 76-micrometer thin actuator wire
- Easy integration into compact installation spaces
- Electromagnetic compatibility
- Easy scalability for a wide range of applications

Technische Daten

Stroke:	> 2	mm
Activation time:	0,1	s
Dimensions:	56 x 14 x 10	mm^3
Operating temperature:	-20 – 65	°C
Weight:	4	g
Lifetime:	> 10.000	Cycles

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Fraunhofer IWU

Fraunhofer-Institut für Werkzeug-maschinen und Umformtechnik IWU

Additive Manufacturing for Defence Applications – Project References

Functionalization Technologies

Technologies and research priorities

Research Priorities

Automated application/integration of functions on/in components

Data & power line | Actuators | Sensors | Pneumatic | Hydraulic

Product features and new manufacturing/structural concepts

Wearables | Morphing | Robotic | Consumerelectronics

Technologies



WEAM

Wires and strands with thermoplastics and thermosets



FEAM

Optical and piezoelectric fibers with polymers



Jet Dispensing

Electrically conductive pastes and inks with local sintering



AuCA

Automatic cable laying, Build harnesses on components



PDM

Functional material with paste-like, biogenic materials



TEAM

Capillaries and tubes with polymers

Method



Switchable/ adaptive stiffness

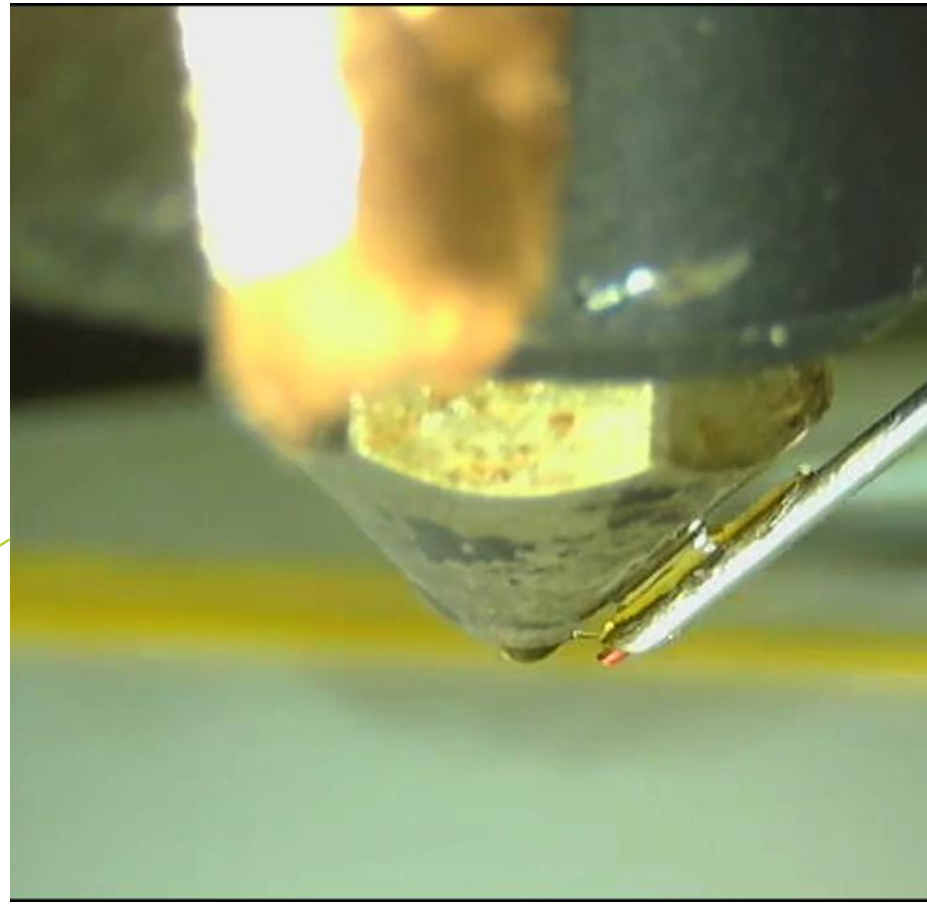
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Functionalization Technologies

WEAM – Wire Encapsulating Additive Manufacturing

A technology for applying a wide variety of functions to various components and materials.

ALLOY	+	DIAMETER	+	STRUCTURE LAYOUT	=	FUNCTION	+	POLYMER
Copper		0,05 mm		Meander		Sensor		Adhesion to semi-finished products
Iron-chromium-aluminum		0,2 mm		Comb		Heating		
Nickel-titanium		⋮		Spiral		Antenna		Requirements for the entire component
⋮		0,8 mm		Straight		Aktuator (Coil)		
				⋮		Power Supply		
						⋮		



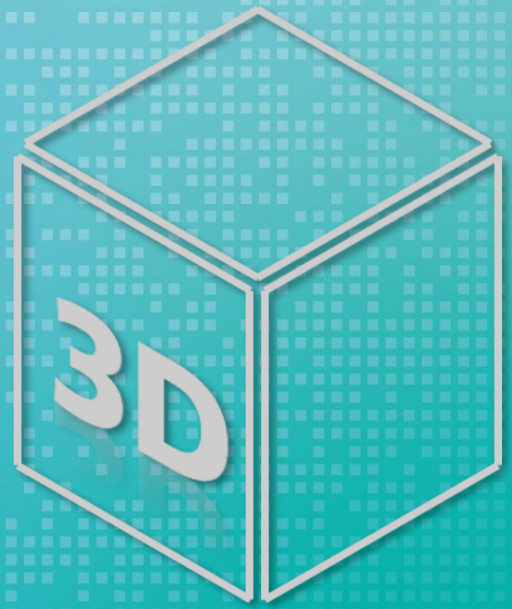
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Apply any function anywhere - on demand

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Industrial project:
AM for special high strength parts in armored vehicles



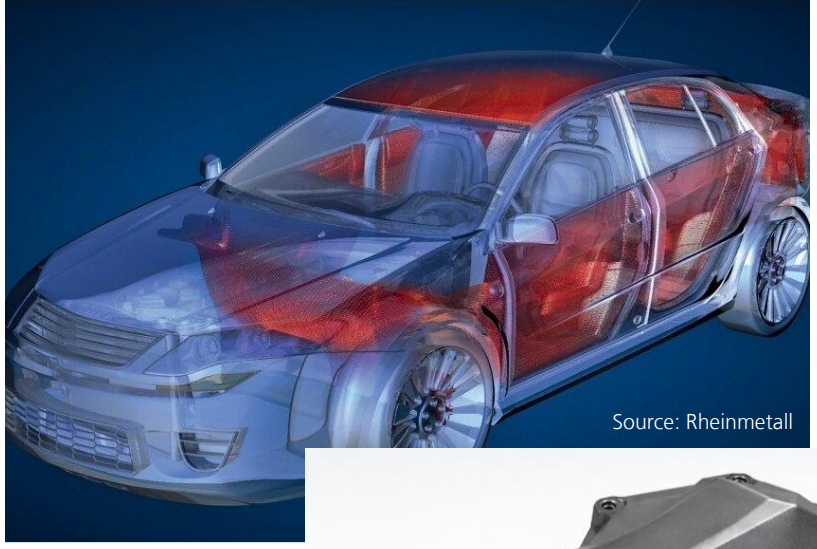
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Vehicle Armor

Ballistical Tests

Project reference

- Customer: Manufacturer of special-purpose armored vehicles
- Requirement: Additively manufactured armor components for protection of “ballistic holes” (panel gaps, cut-outs, joints, etc.)
- Target properties comparable to 22MnB5 press-hardened steel
- Step 1: Verify whether the martensitic hot-work steel 1.2709 meets the requirements
- Additive manufacturing of test plates for ballistic impact tests using LPBF with 1.2709 at Fraunhofer IWU
- Conducting ballistic impact tests at the customer’s site
- Step 2: Alternative use of case-hardening steels 20MnCr5 or 16MnCr5 with even higher hardness potential (already qualified for LPBF at IWU)
- Step 3: Qualify conventional armor steel for LPBF manufacturing


Source: Rheinmetall

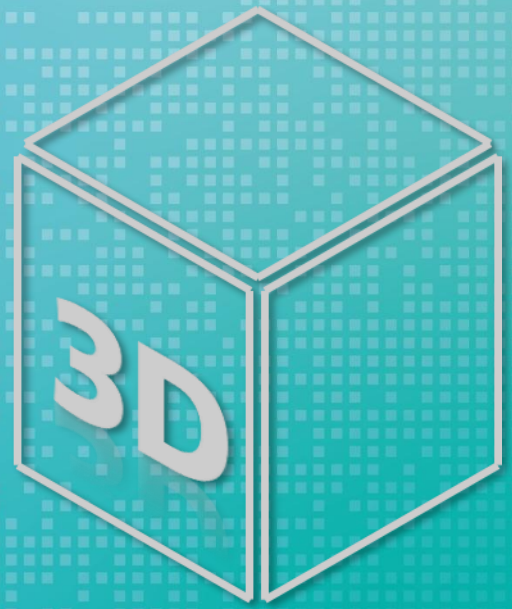




Source: Welp Group

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Study for NATO:
Impact of Additive Manufacturing on military supply chains



- Informationsklassifizierung -

Additive Manufacturing in NATO supply chains

Strategic Study

Project reference

- Customer: NATO Support and Procurement Agency NSPA
- Requirement: Review of potential benefits and risks of incorporating AM (3D Printing) into current NATO Codification System (NCS)
- How can defense supply chains best work with rapidly developing AM
- Case study “Foxhound” armored vehicle: 33% of 4,199 specific NSN items (NATO Stock Number) found viable for AM, 50 % within 10 years
- Assessment of forward deployable AM facilities (ISO containers equipped with 3D printers) and connected risks
- Assessment of legal implications (patent infringements, intellectual property protection, product liability)
- Options to identify AM items in the NCS (pre- and post-codification)
- Major conclusions: use validated Manufacturing Data Sets (MDS) for AM, uniform IP and data licensing agreements (legal framework), item data repository or access system, establish Freedom to Operate process



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Incremental forming

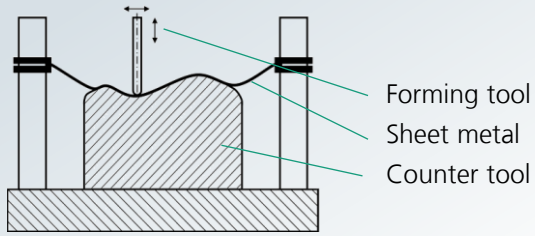
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Incremental Sheet Metal Forming

Flexible. Precise. Cost-Efficient.

How does it work

- **stepwise, local forming with a CNC-controlled tool**



Your benefits at a glance

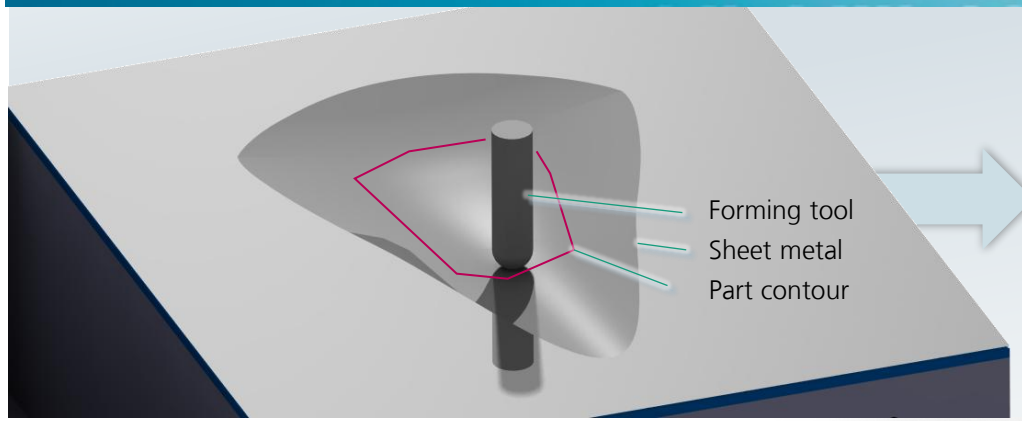
Low tooling costs
No dedicated tooling

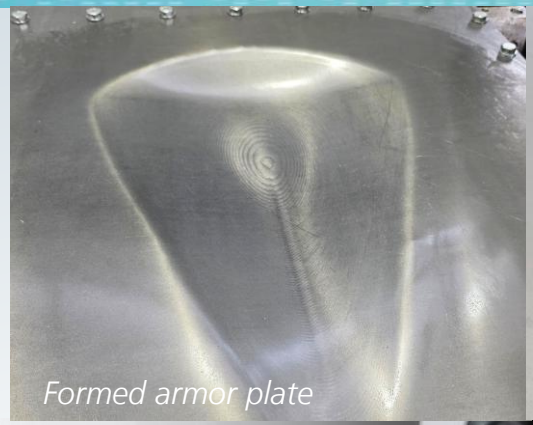
Short time-to-market
From CAD to part in hours

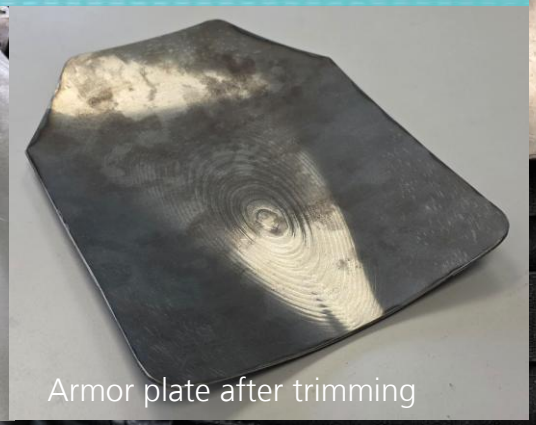
Flexibility
Complex geoemtries and individualization

Cost-efficient for smalll volumes
Prototypes and small seriess

From CAD to component in less than 1 hour







- **custom-fitted upper-body armor plate made of 2.5 mm thick C45 steel**

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FORM THE FUTURE
Fraunhofer IWU

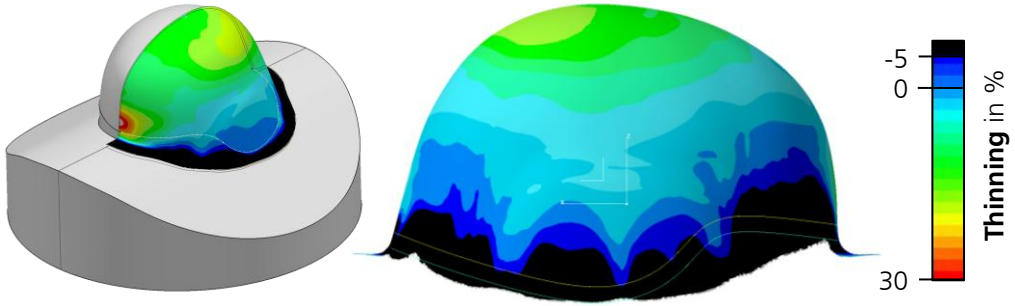
PERSONAL PROTECTIVE EQUIPMENT

PROCESS DESIGN AND PROTOTYPING

Application: press-hardened helmet

Development of single-stroke press hardening process

A VIRTUAL PROCESS DESIGN



B TOOLING AND PROTOTYPING





in cooperation with

WELP GROUP

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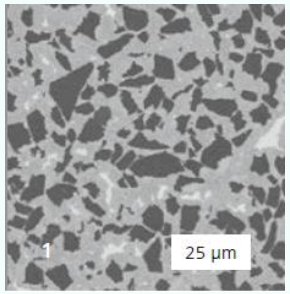
Machining of ceramics

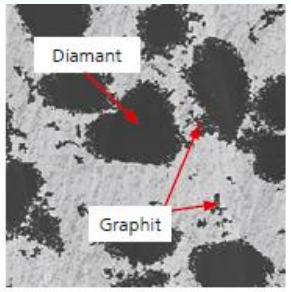
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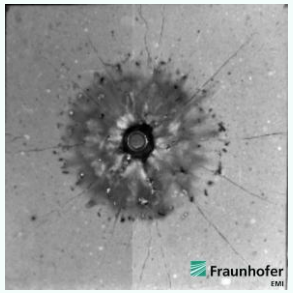
Development and Machining of High-Performance Ceramics for Protective Applications

IKTS

Ceramic Manufacturing





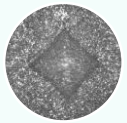




Ceramic Manufacturing in Various Shapes



System Assembly



Characterization for Data Sheet



Preparation and Follow-up for the Shotting Test

Application Example





IWU

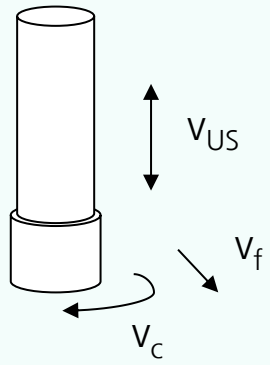
Ceramic Cutting

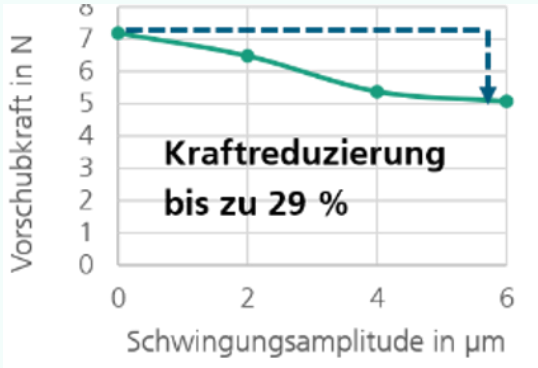
Ultrasonic-Assisted Machining

Reduced force, self-sharpening effect, increased productivity



Axial Vibration





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Aluminium foams

Lightweight design and energy absorption in defense applications

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Metal foams – Properties









light

bending-resistant

energy absorbing

recyclable

shielding

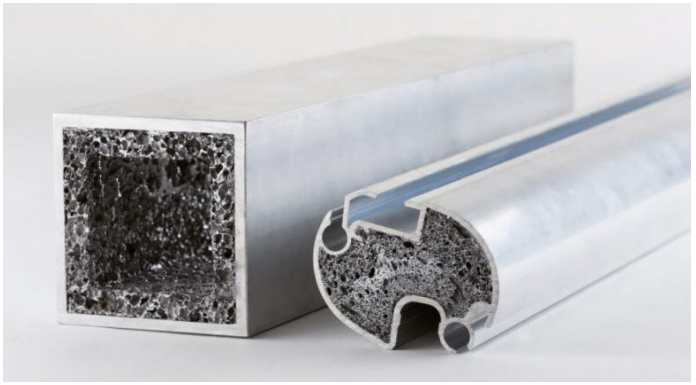
temperature resistant

sandwich panels





crash elements Audi Q7



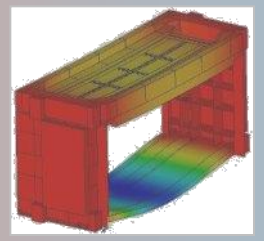
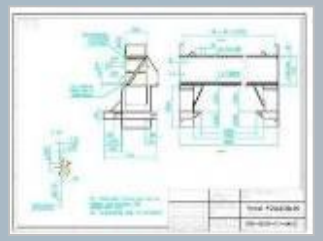
foamed profiles

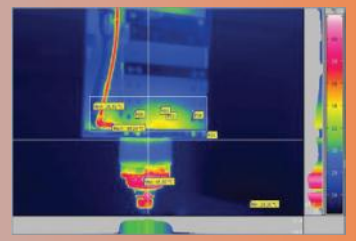
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Powdermetallurgical Metal Foam production

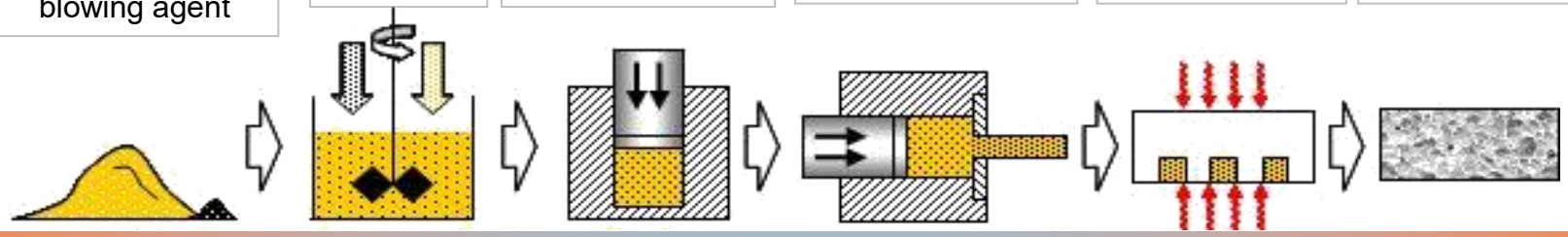
Idea → Plan → Simulation → Design → Manufacturing → Property analysis





metal powder + blowing agent → mixing → compacting → extrusion → foaming → cooling



Lightweight construction with metal foam

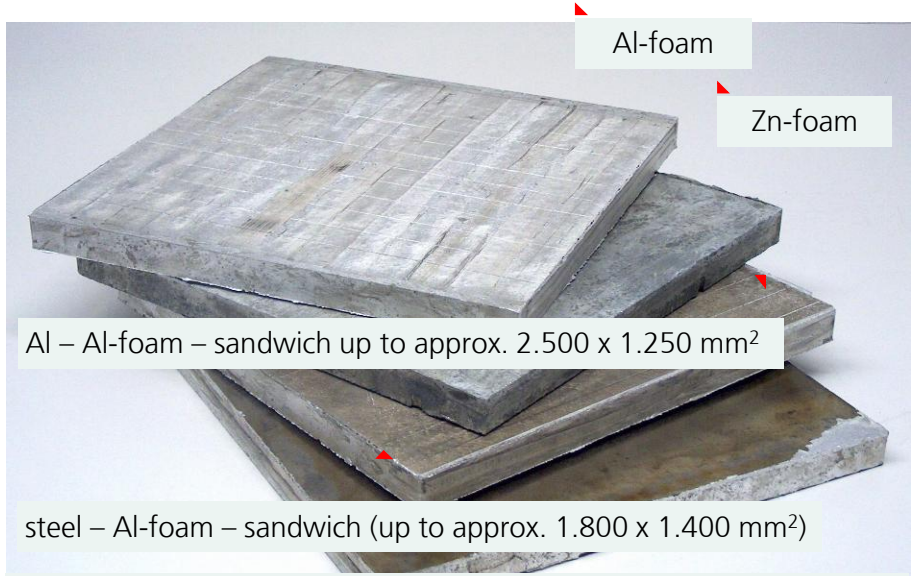


3-D molded parts

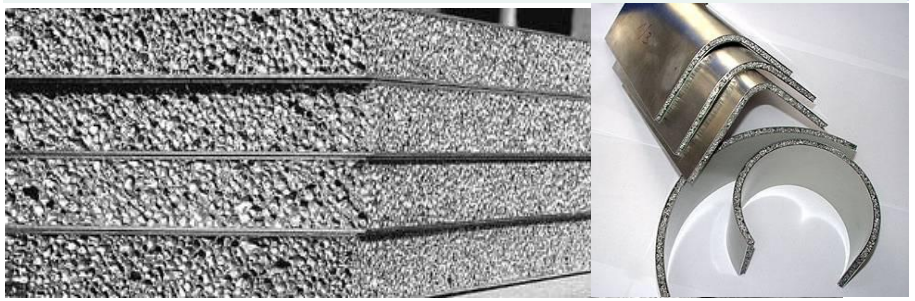




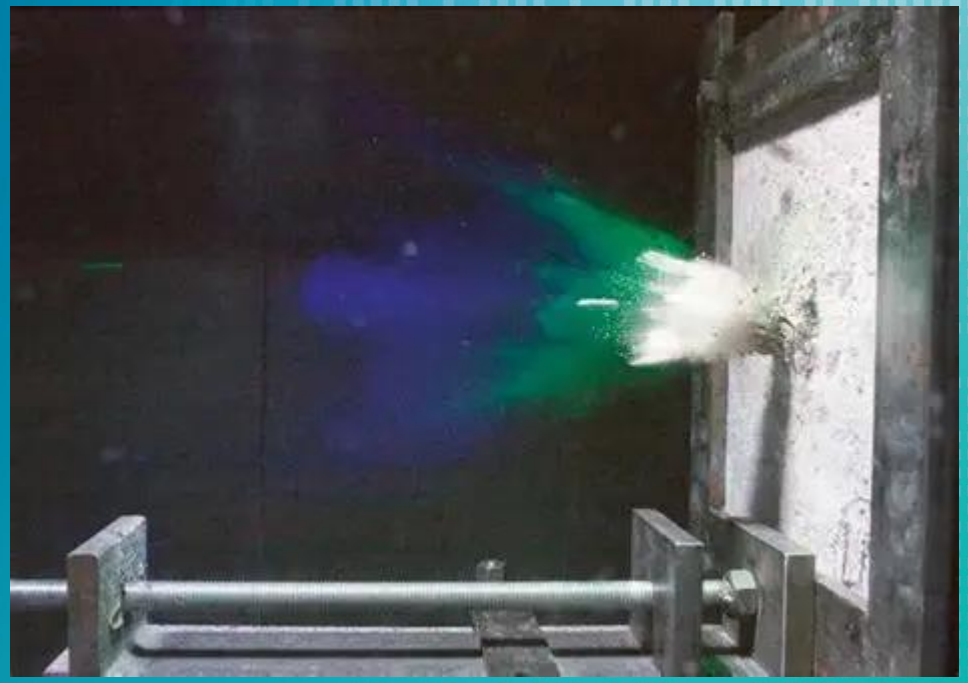
foamed steel profiles



metal foam- and sandwich panels with metal foam



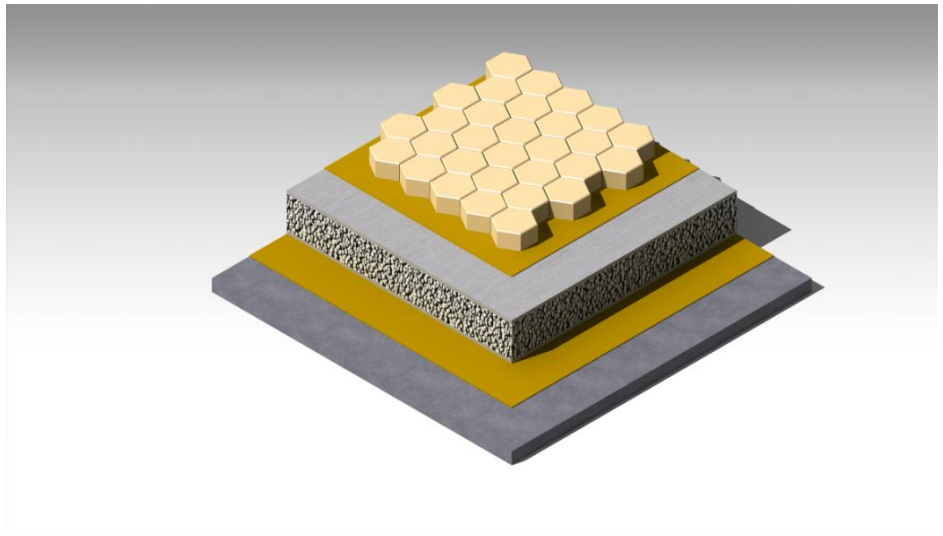
Impact

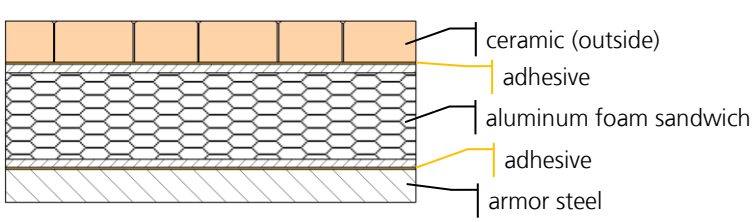


Security Concepts using metallic foams

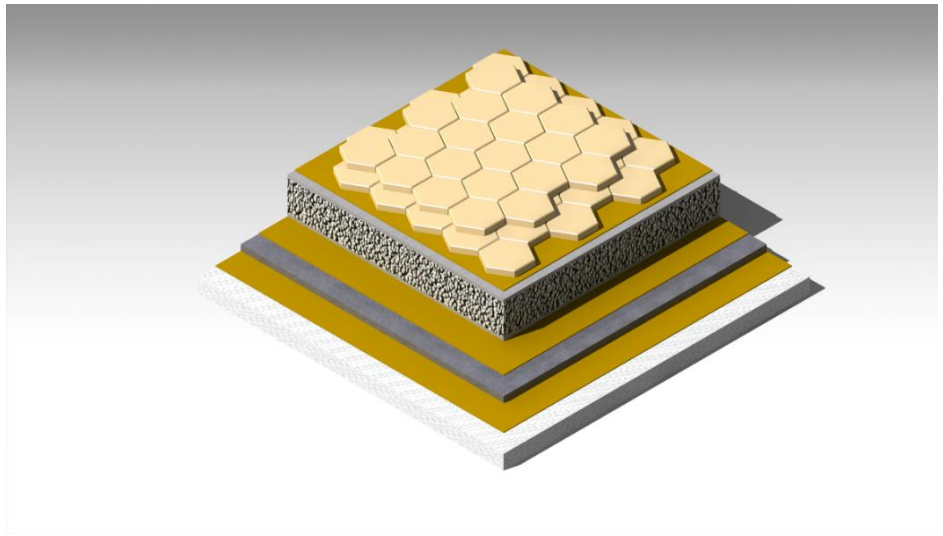
overview wall designs from the study

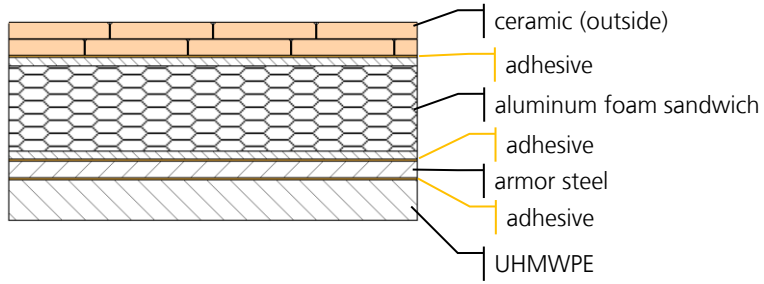
Impact – variant 1





variant 2



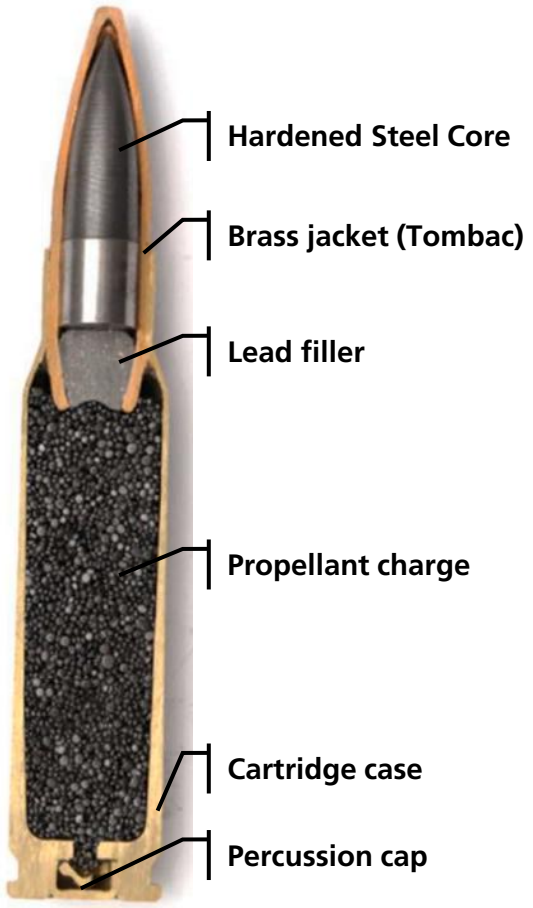


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Security Concepts using metallic foams

use case - VPAM 9 - combined with blast loading

Klassen		Waffenart (Beispiele)	Patrone	Munition und Geschoss		
VPAM	EN 1063 EN1522/23			Kaliber	Art	Masse [g] Härte [HRC]
VPAM 1	B 1			.22 lr	L/RN	2,6 ± 0,1
VPAM 2	-			9 mm Luger	FMJ/RN/SC verzinnt	8,0 ± 0,1
VPAM 3	B 2			9 mm Luger	FMJ/RN/SC verzinnt	8,0 ± 0,1
VPAM 4	B 3			.357 Mag.	FMJ/CB/SC	10,2 ± 0,1
	B 4			.44 Rem. Mag.	FMJ[1]/FN/SC	15,6 ± 0,1
VPAM 5	-			.357 Mag.	FMs/CB	7,1 ± 0,1
VPAM 6	-			7,62 x 39	FMJ/PB/FeC	8,0 ± 0,1 Kern 3,6
VPAM 7	B 5			.223 Rem. (5,56 x 45)	FMJ/PB/SCP	4,0 ± 0,1
	B 6			.308 Win. (7,62 x 51)	FMJ/PB/SC	9,55 ± 0,1
VPAM 8	-			7,62 x 39	FMJ/PB/HCI	7,7 ± 0,1 Kern 4,1 Härte 65
VPAM 9	B 7			.308 Win. (7,62 x 51)	FMJ/PB/HC	9,45 g ± 0,1 Kern 4,6 Härte 60
VPAM 10	-			7,62 x 54 R	FMJ/PB/HCI	10,4 ± 0,1 Kern 5,3 Härte 63
VPAM 11	-			.308 Win. (7,62 x 51)	FMJ/PB/WC	8,4 g ± 0,1 Kern 5,9
VPAM 12	-			.308 Win. (7,62 x 51)	FMJ/PB/WC	12,7 ± 0,1 Kern 5,58 [Härte 1330 HV 10]
VPAM 13	-			.50 Browning	FMJ/PB/HC	43,0 ± 0,5 Kern 35,0 Härte 55 ± 2
VPAM 14	-			14,5 x 114	FMJ/PB/HCI	63,4 ± 0,5



Caliber 7.62 x 51 FMJ AP

total weight: 24 g
projectile weight: 9.2 g
hard core weight: 4 g

projectile velocity at impact: 840 m/s

projectile energy at impact: 3242 J

recommended thickness RHA (rolled homogeneous armor) for protection:

14.5 mm

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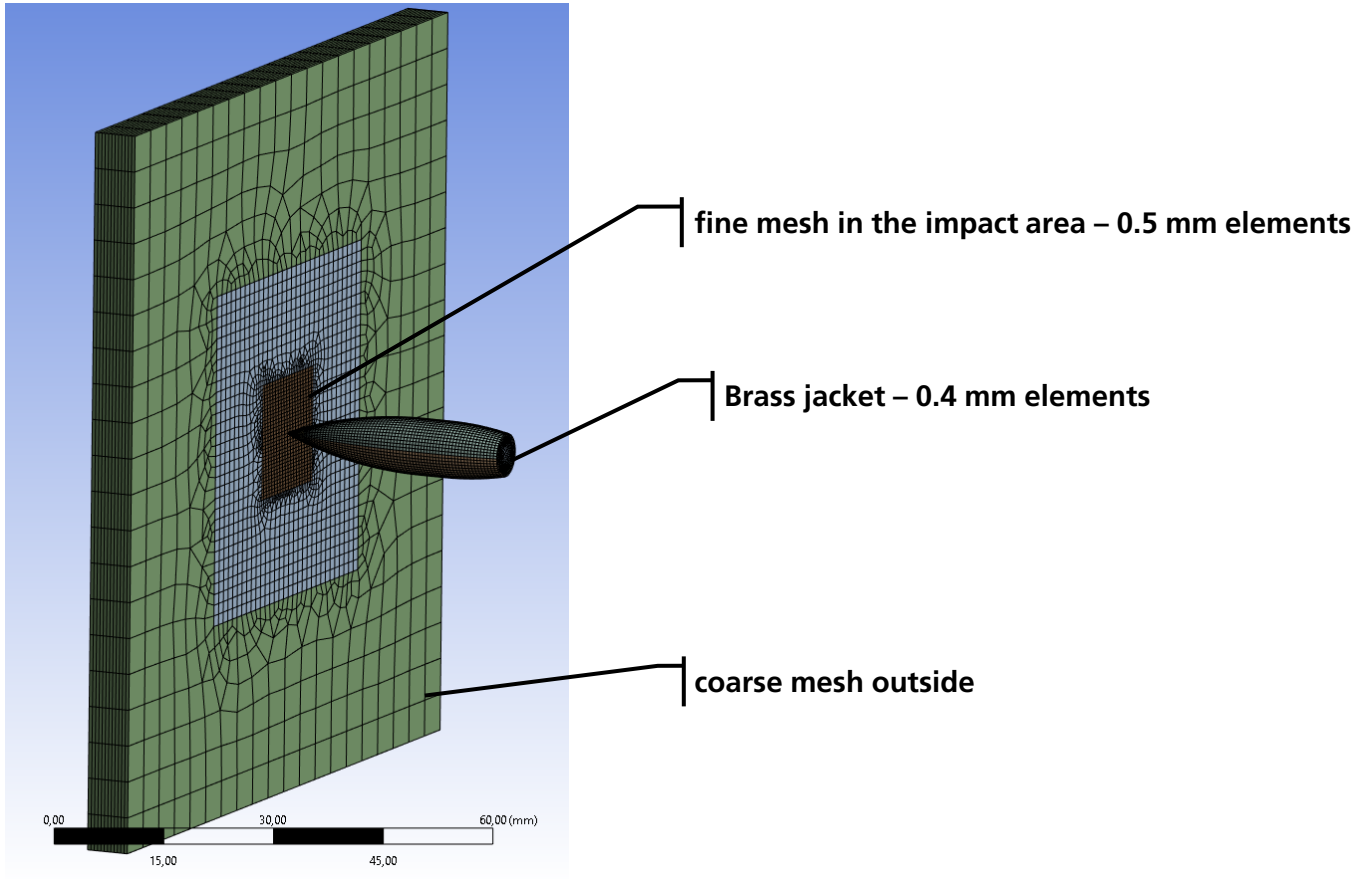
Security Concepts using metallic foams

simulation model – armor

Simulation software – ANSYS Workbench and LS-Dyna

projectile velocity at impact: 840 m/s

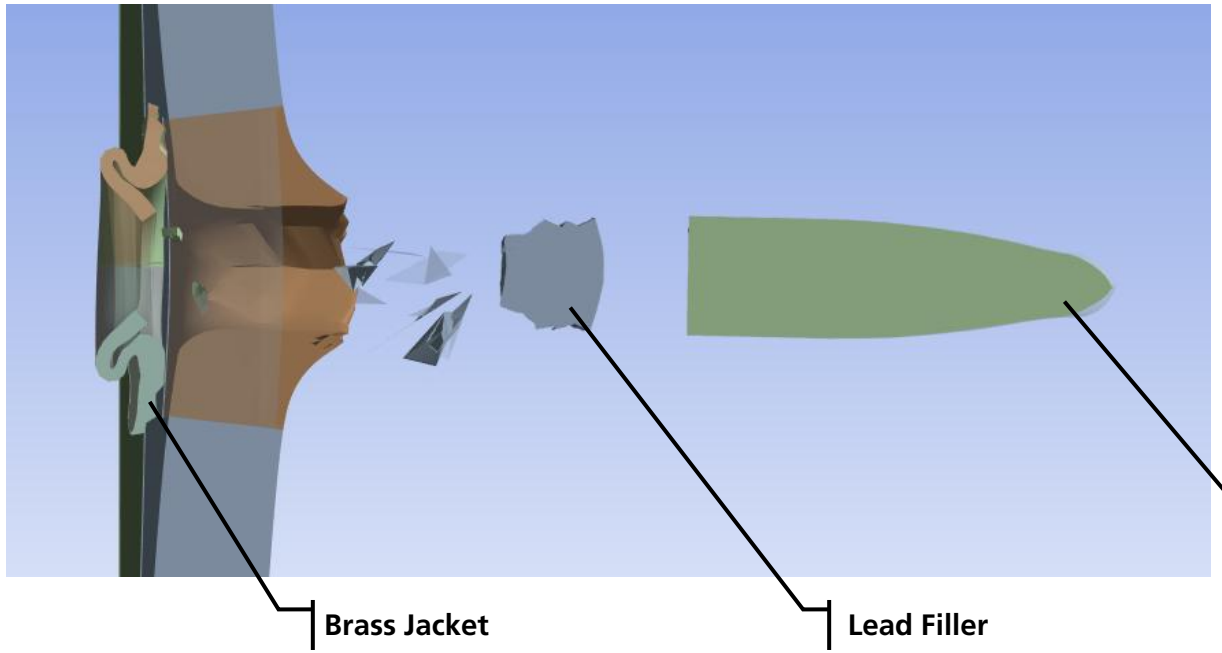
fixed support on the outside of the armor



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Security Concepts using metallic foams

simulation results – armored steel only

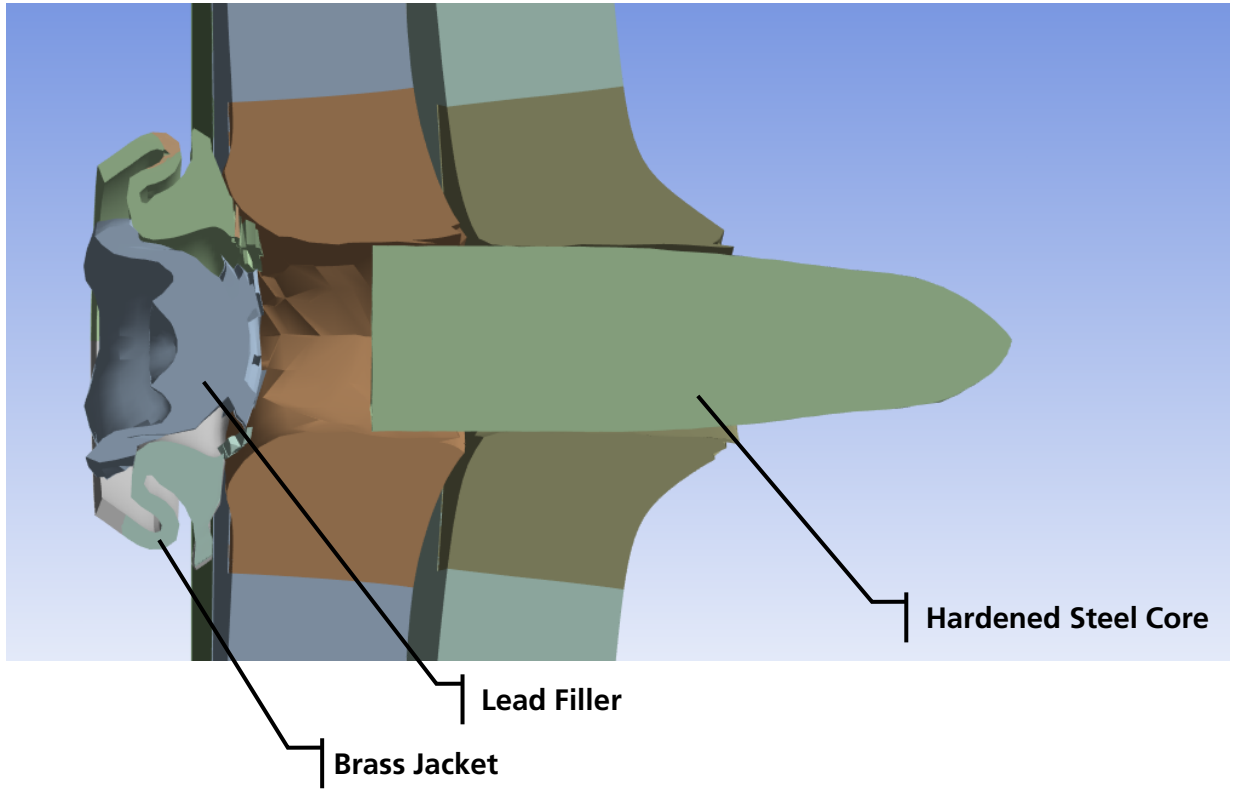


armored steel:	Armox 500T
armored steel thickness:	6 mm
impact angle:	0°
projectile velocity at impact:	840 m/s
result:	**plate perforation projectile intact**
projectile velocity after perforation:	**630 m/s**

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Security Concepts using metallic foams

simulation results – armored steel only

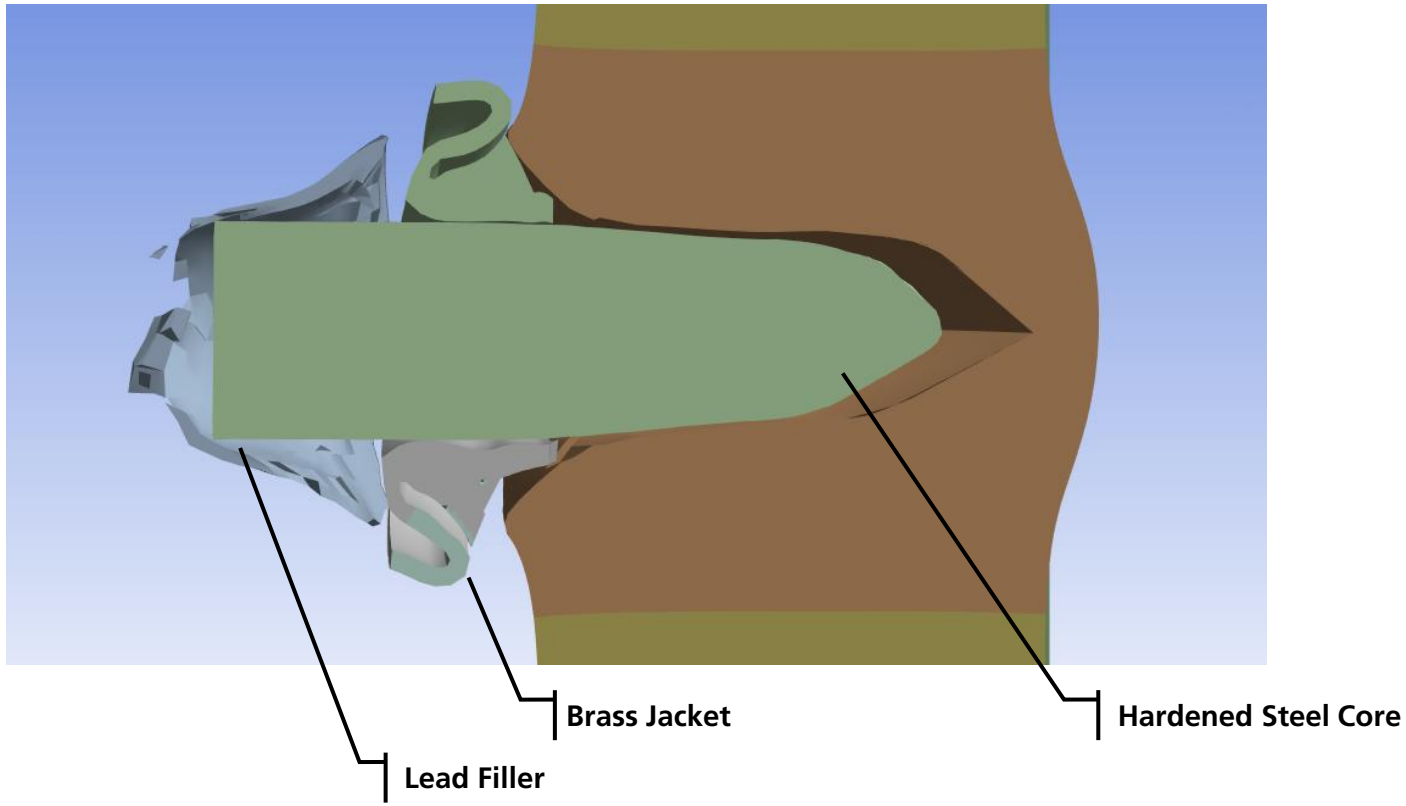


armored steel:	Armox 500T
armored steel thickness:	2x6 mm
impact angle:	0°
projectile velocity at impact:	840 m/s
result:	**plate perforation projectile intact**
projectile velocity after perforation:	**138 m/s**

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Security Concepts using metallic foams

simulation results – armored steel only



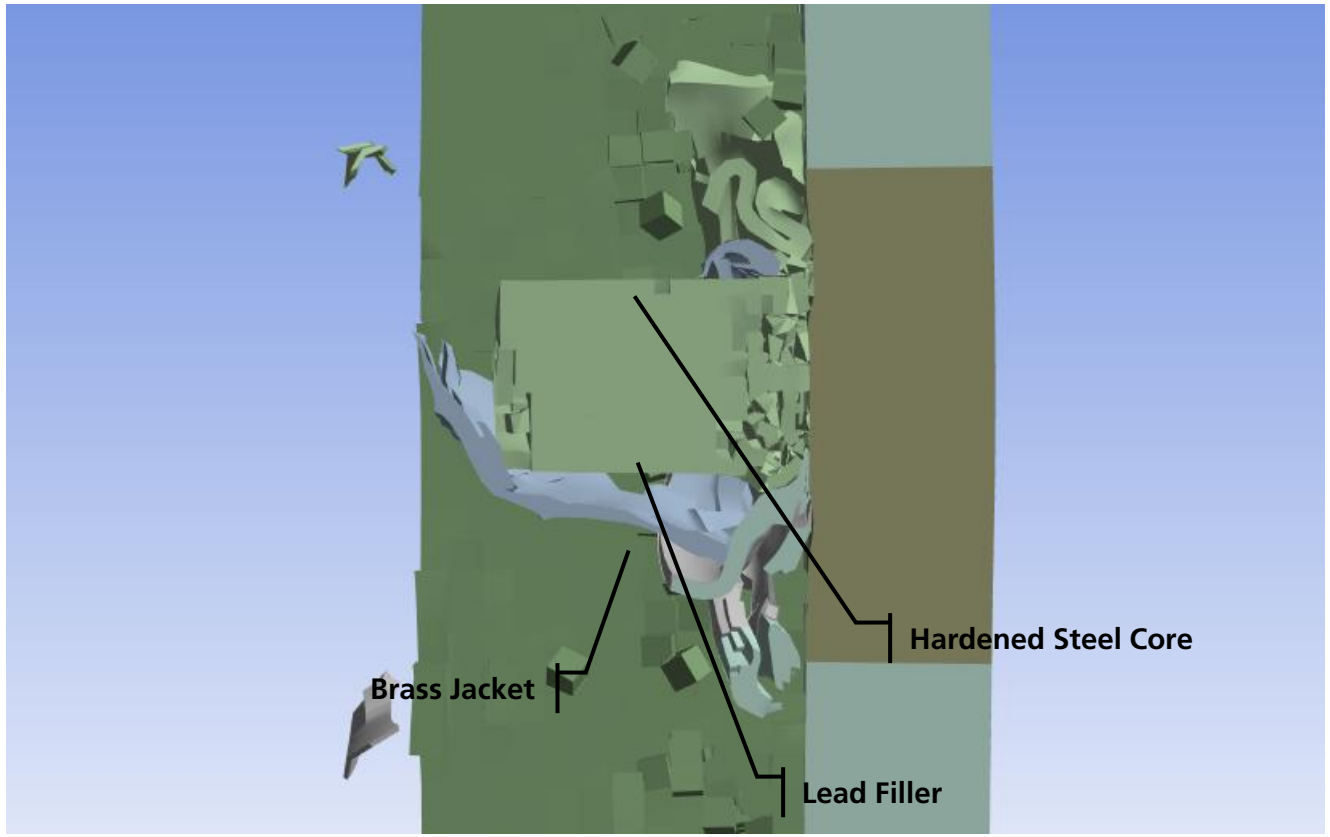
armored steel:	Armox 500T
armored steel thickness:	14.5 mm
impact angle:	0°
projectile velocity at impact:	840 m/s
result:	**no perforation** **projectile intact**
inside plate deformation:	**1.43 mm**
projectile velocity after perforation:	-

area weight: 113,83 kg/m²

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Security Concepts using metallic foams

simulation results – armored steel + ceramics



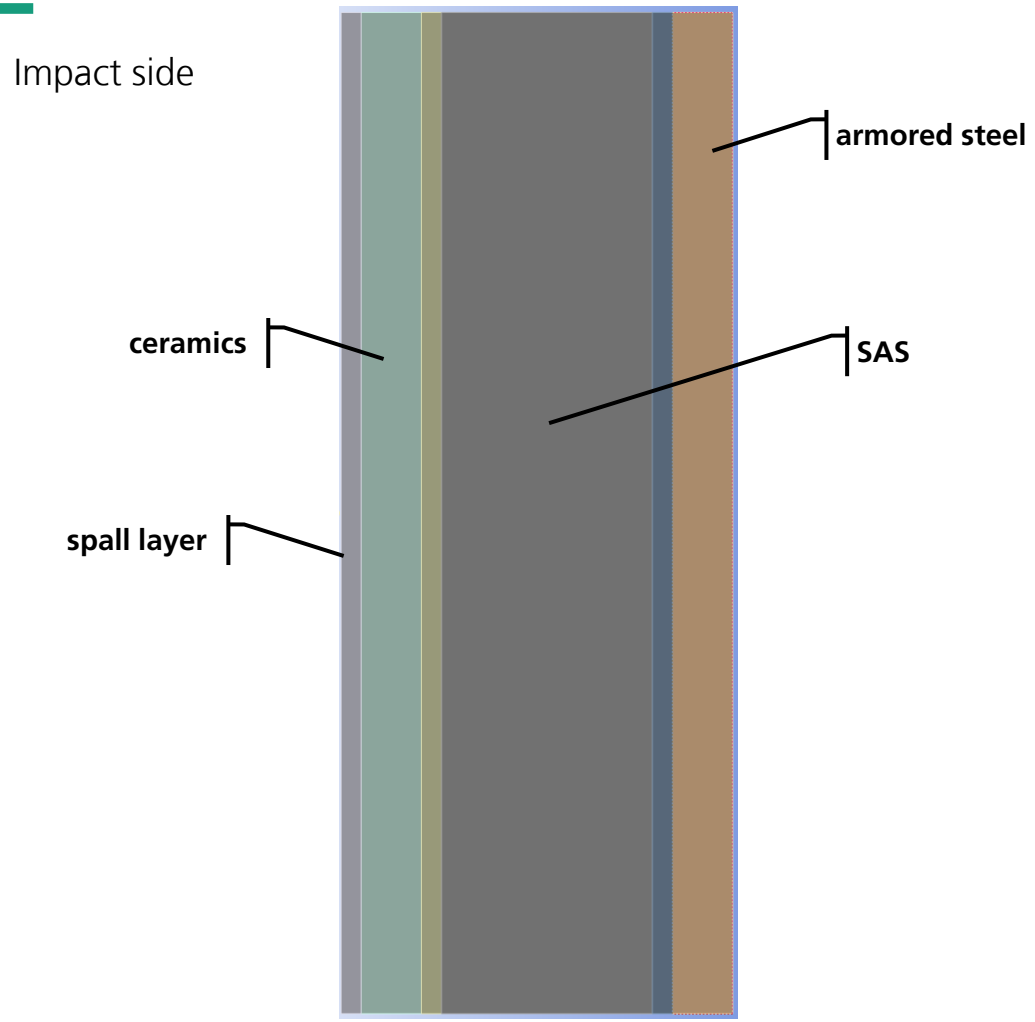
armored steel:	Armox 500T
armored steel thickness:	6 mm
ceramics:	Al_2O_3
ceramics thickness:	12 mm
impact angle:	0°
projectile velocity at impact:	840 m/s
result:	**no perforation** **projectile shatterd**
inside plate deformation:	**0.4 mm**
projectile velocity after perforation:	-

area weight: 92.7 kg/m²

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Security Concepts using metallic foams

simulation results – new security concepts V1



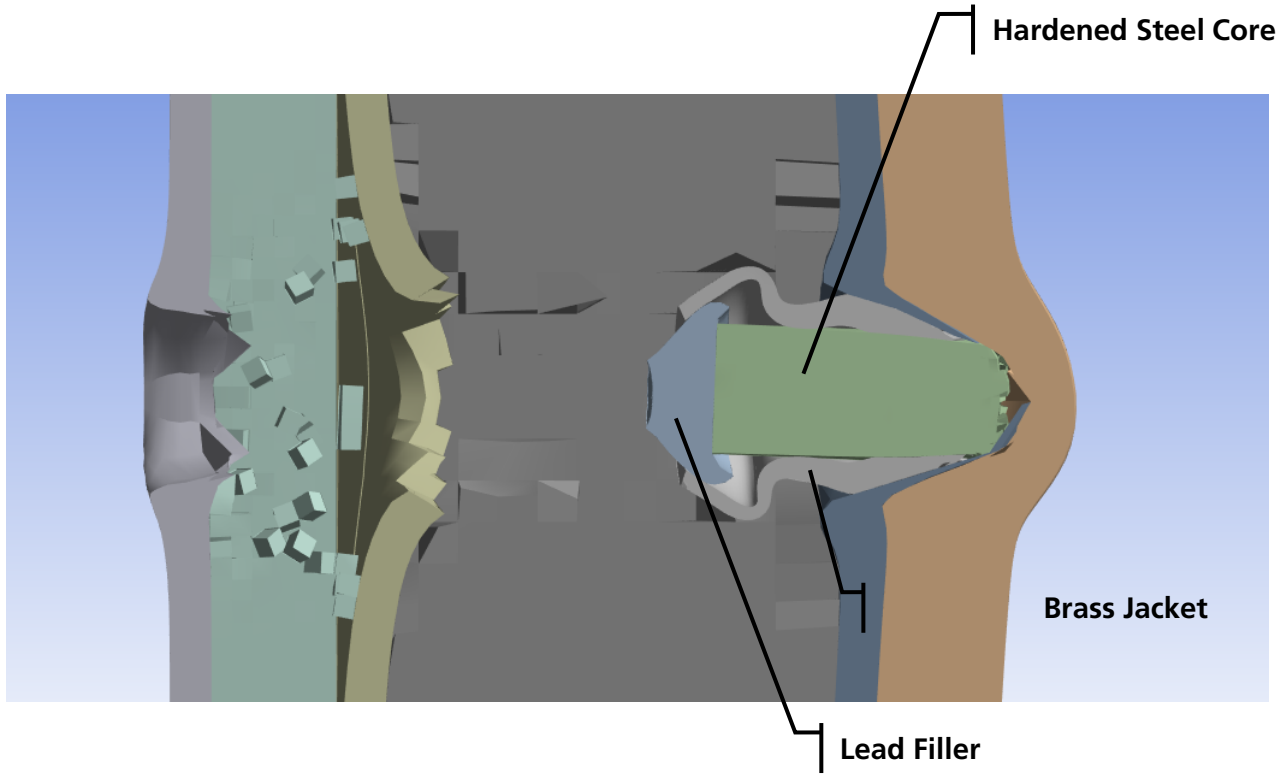
spall layer:	Aluminium – 2mm
ceramics:	Al_2O_3 – 6 mm
SAS (aluminum foam sandwich)	steel-foam-steel – 2-21-2
armored steel:	Armox 500T – 6 mm
total thickness:	39 mm
impact angle:	0°
projectile velocity at impact:	840 m/s

area weight: 127.6 kg/m²

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Security Concepts using metallic foams

simulation results – new security concepts V1



spall layer:	Aluminium – 2mm
ceramics:	Al_2O_3 – 6 mm
SAS (aluminum foam sandwich)	steel-foam-steel – 2-21-2
armored steel:	Armox 500T – 6 mm
total thickness:	39 mm
impact angle:	0°
projectile velocity at impact:	840 m/s
result:	**no perforation** **projectile partly eroded**
inside plate deformation:	**4.6 mm**
projectile velocity after perforation:	-

area weight: 127.6 kg/m²

Sandwich support is not sufficient for the ceramics → thicker cover layer recomended

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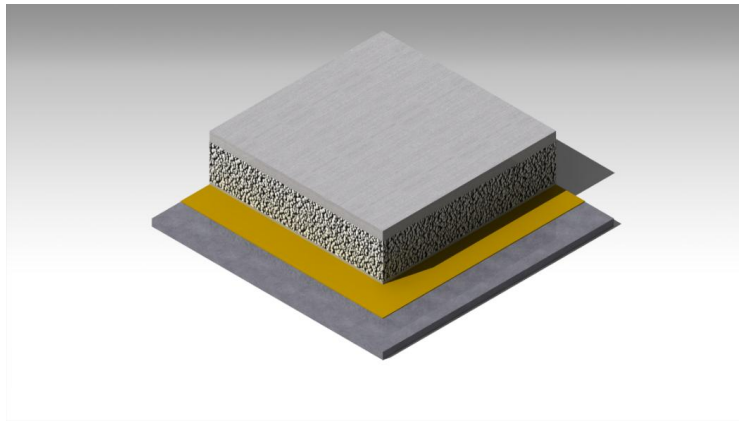
Blast

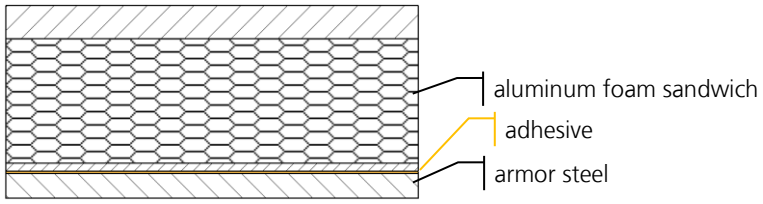


Security Concepts using metallic foams

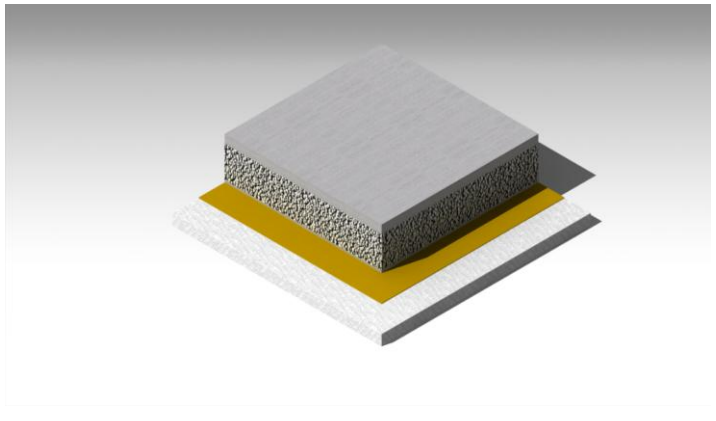
overview wall designs form the study

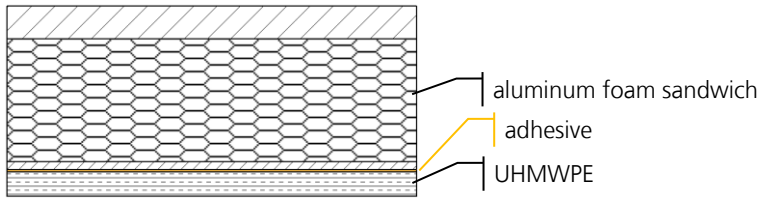
Blast – variant 1 (favorite)



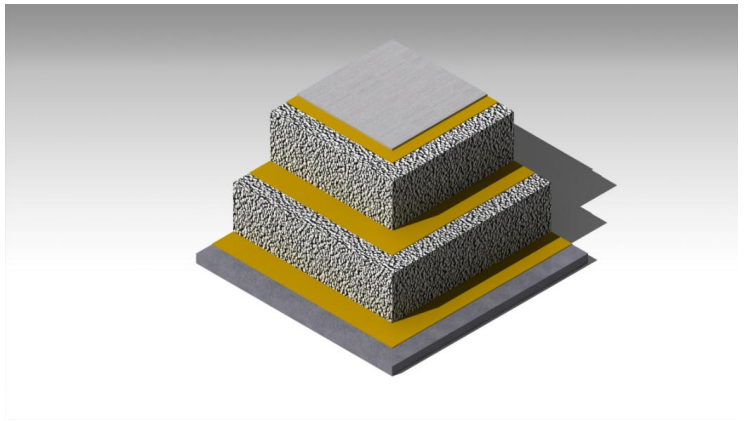


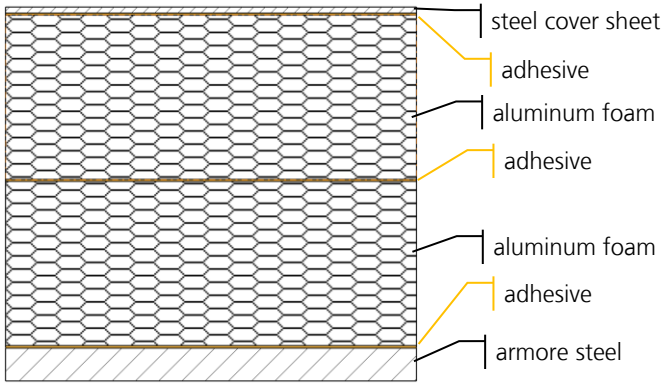
variant 2





variant 3





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- Informationsklassifizierung -

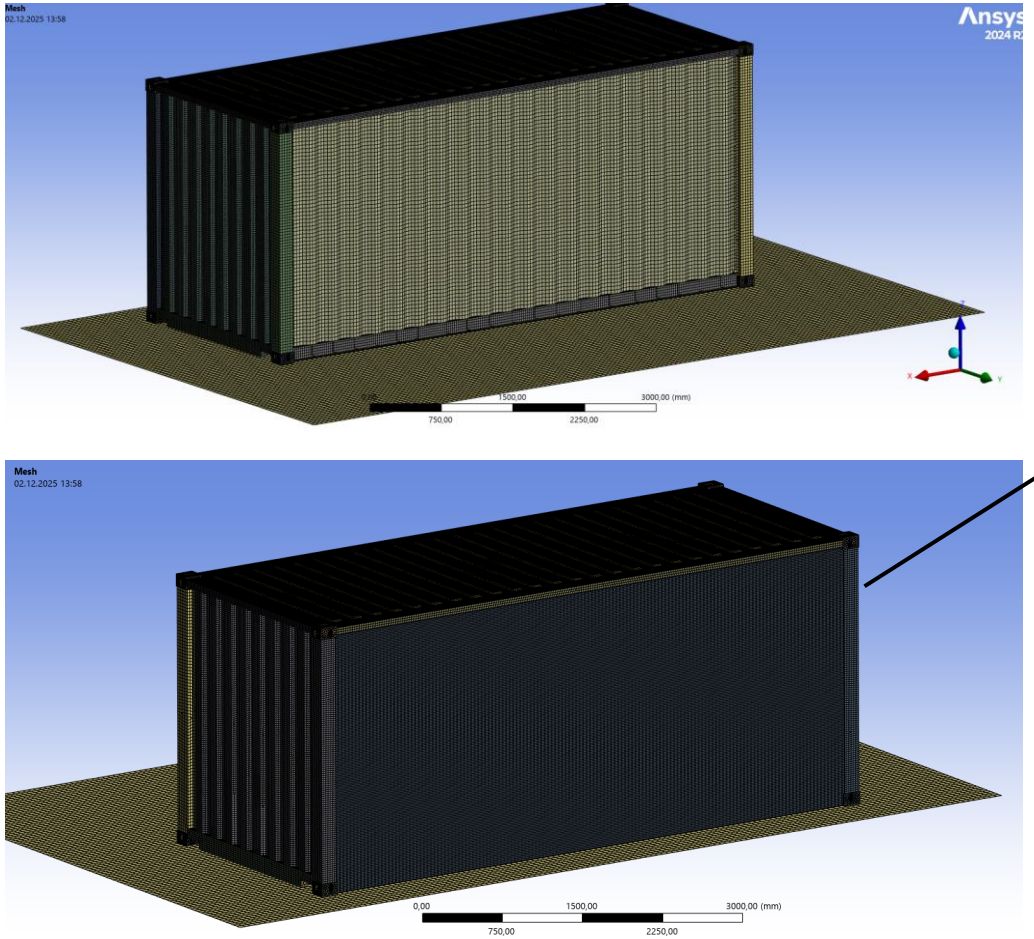
Security Concepts using metallic foams

simulation model – armor

Simulation software – ANSYS Workbench and LS-Dyna

load: 3 kg TNT, 1 or 3 m distance to explosion center

5 t additional mass
frictional support on the bottom



fine mesh in the impact area – 20 mm elements

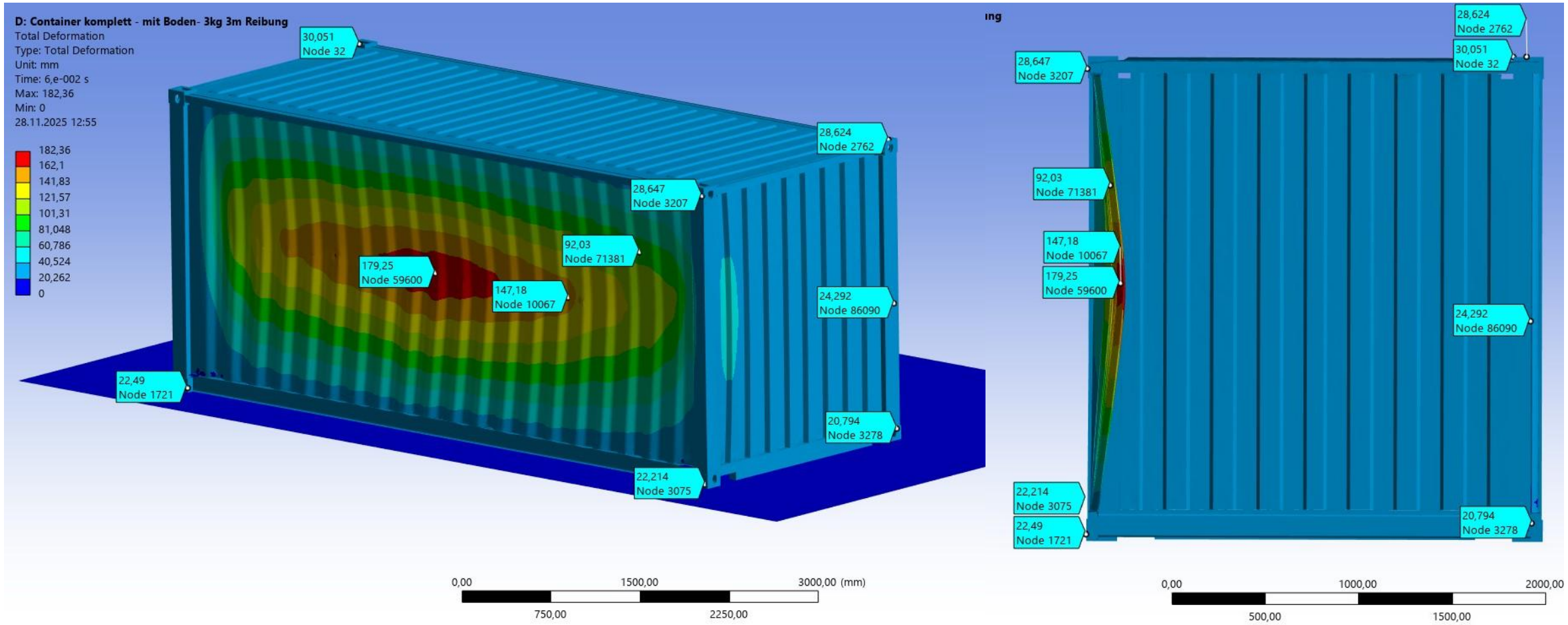
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- Informationsklassifizierung -

Security Concepts using metallic foams

simulation results – blast – state of the art, **3 kg TNT at 3 m**

max. pressure at pressure wave impact: 15 bar

max. deflection:	159 mm
container displacement:	22 mm



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Blast protection

Useable in privat or official or military use











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- Informationsklassifizierung -

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PRESENTATION 2 OF 4

Manuel García

General Manager, 2M Engineering (ES)

From Automotive to Defence: Transferring Lightweight Engineering Capabilities

ELN CONFERENCE 2026 · DEFENSE & SECURITY

FROM AUTOMOTIVE TO DEFENSE

2M Engineering
& PRODUCT DEVELOPMENT

Transferring Lightweight Engineering Capabilities

AUTOMOTIVE → AEROSPACE → DEFENSE

Lightweight structures · Advanced materials · Functional integration

Manuel García
Co-Founder & General Manager · 2M Engineering

Barcelona · 8 October 2026

WE DIDN'T START IN DEFENSE.

Our engineering DNA comes from **Automotive.**



OUR BUSINESS UNITS

PRODUCT DEVELOPMENT
Engineering · CAD · Simulation

PROTO LAB
Prototyping · Additive · CNC

JIGS & TOOLS
Fixtures · Tooling · Industrialization

TECHNICAL ENCLOSURES
Lightweight · EMC · Thermal

WWW.2MENGINEERING.TECH

2M Engineering
& PRODUCT DEVELOPMENT

AUTOMOTIVE: ENGINEERING AGAINST A SPECIFICATION

A highly defined framework drives the engineering solution.

STANDARDS

OEM standards · ISO · VDA · UNECE

MATERIAL

Specified grade · additives · approvals

GEOMETRY

CAD · package · interfaces · thickness

TOLERANCES

GD&T · dimensional targets · gap & flush

VALIDATION

Mechanical · thermal · ageing · environmental

QUALITY

APQP · PPAP · traceability · capability

INDUSTRIALIZATION

Cycle time · process · volumes · takt time

COST

Target price · tooling investment · piece cost

THE REQUIREMENT FRAMEWORK → DEFINES THE SOLUTION SPACE

2M Engineering
& PRODUCT DEVELOPMENT

DEFENSE: ENGINEERING FOR AN ADVANTAGE

Different requirements. Same objective: gain an operational advantage.

01

LIGHTER

Less mass

Payload · Autonomy

02

FASTER

Higher speed

Response · Deployment

03

STRONGER

More robust

Durability · Survivability

04

FURTHER

More range

Operational reach

05

SMARTER

More function

EMC · Thermal · Integration

LIGHTWEIGHT ENGINEERING → OPERATIONAL ADVANTAGE

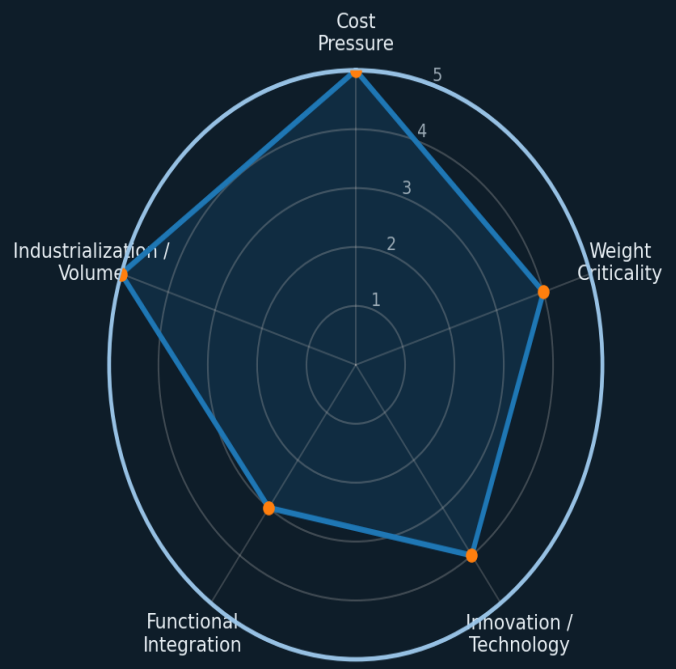
The question is not only "What does it weigh?" — but "What advantage does it enable?"

2M Engineering
& PRODUCT DEVELOPMENT

DIFFERENT INDUSTRIES. DIFFERENT PRIORITIES

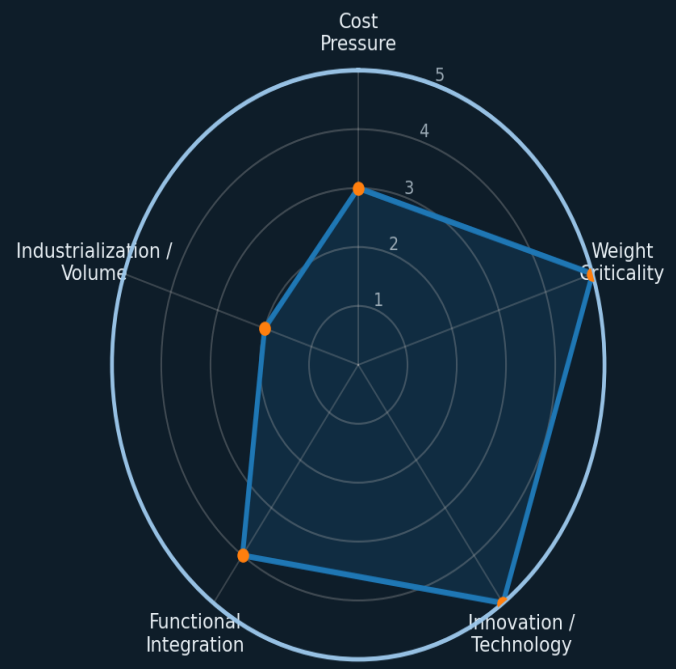
Same engineering capabilities. Different focus.

AUTOMOTIVE



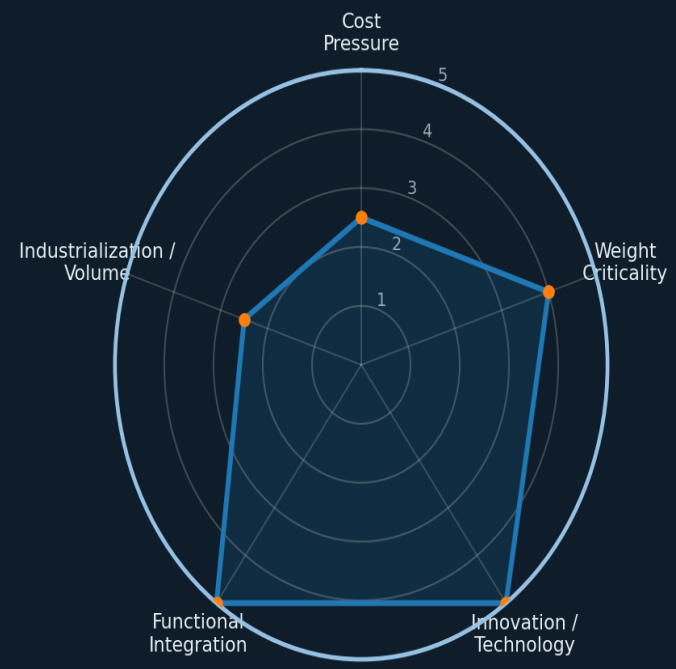
Cost + Industrialization

AEROSPACE



Weight + Technology

DEFENSE



Technology + Functional Integration

Conceptual comparison based on 2M Engineering's cross-sector experience · Scale 1–5

2M Engineering
& PRODUCT DEVELOPMENT

SO, WHAT CAN WE TRANSFER?

Engineering know-how that can cross industries.

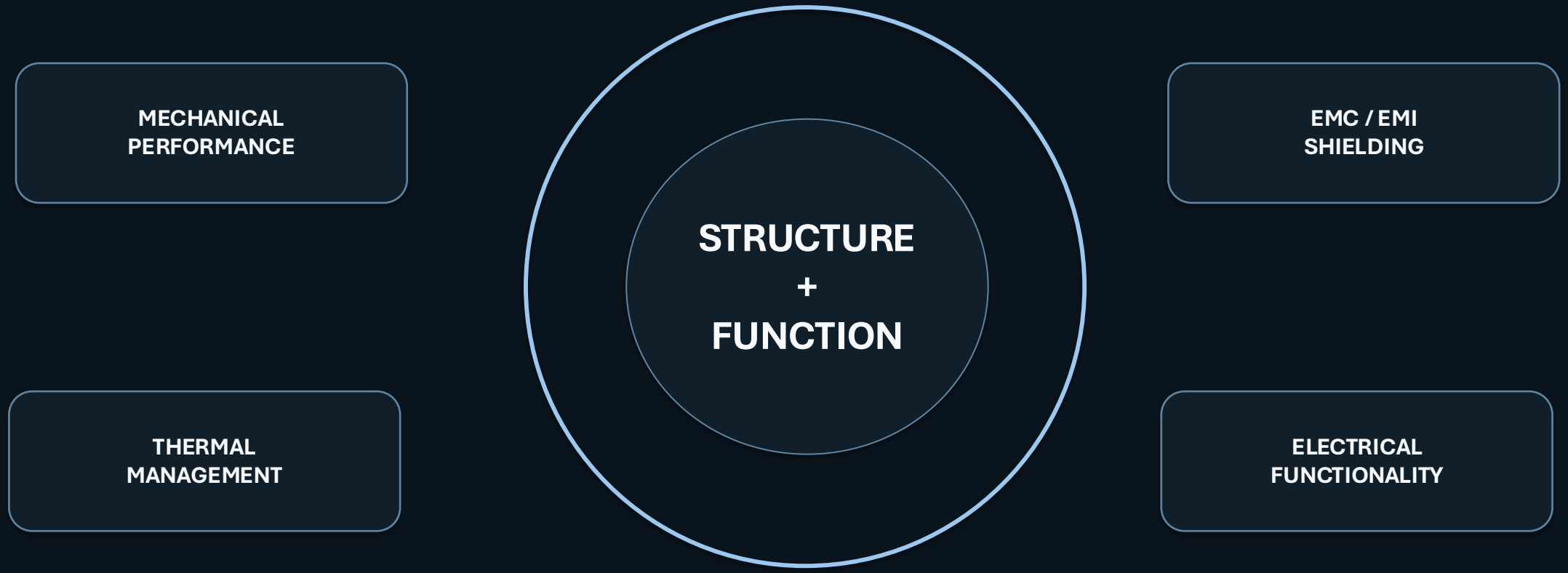
- LIGHTWEIGHT STRUCTURES
- ADVANCED COMPOSITES
- ADDITIVE MANUFACTURING
- JIGS & TOOLING
- PROTOTYPING
- PRODUCT ENGINEERING

ENGINEERING KNOW-HOW

2M Engineering
& PRODUCT DEVELOPMENT

LIGHTWEIGHT IS MORE THAN REDUCING MASS.

What if the structure can also provide functionality?



2M Engineering
& PRODUCT DEVELOPMENT

FROM ENGINEERING CAPABILITY TO REAL APPLICATIONS.

Examples of what we already do — and where we are going next.

01



PRODUCT DEVELOPMENT

COMPONENTS & SUBCOMPONENTS

- Product engineering
- Plastic & composite components
- CAD · simulation · design validation

02



JIGS & TOOLS

LAMINATION TOOLS · ASSEMBLY JIGS

- Composite lamination tooling
- Assembly & checking fixtures
- Industrialization support

03



TECHNICAL ENCLOSURES

LIGHT WEIGHT - EMC

- Embedded electronics
- Lightweight protection
- EMC / EMI · thermal integration

NEXT STEP

Automotive experience → transferable engineering → Aerospace & Defense applications

2M Engineering
& PRODUCT DEVELOPMENT

WHAT CAN A MICRO-COMPANY BRING TO DEFENSE?

A complementary role inside a much larger ecosystem.

AGILITY

SPECIALIZATION

SPEED

COLLABORATION

Not replacing large Defense companies. Complementing them.

2M Engineering
& PRODUCT DEVELOPMENT

ENTERING DEFENSE DOESN'T ALWAYS MEAN STARTING FROM ZERO.

TRANSFER. ADAPT. COLLABORATE.

THANK YOU

2M ENGINEERING.TECH

Manuel García Lopez

Co-Founder & General Manager · 2M Engineering

Barcelona

PROUD MEMBER OF

Part of an ecosystem built around collaboration.

AEROS ECOSISTEMA AERONÁUTICO Y DEL ESPACIO

pimec

Clúster Mav MATERIALS AVANÇATS DE CATALUNYA

2MENGINEERING.TECH 2MENCLOSURES.COM



PRESENTATION 3 OF 4

Samanta Simon

HAPS Systems Manager, Airbus GeoTech (ES)

Ultralight payloads: The challenges of flying onboard High-Altitude Platforms (HAPS)

DEFENCE AND SPACE

Ultralight Payloads

The challenges of flying onboard High-Altitude Platform Station (HAPS)

Samanta Simón Bernabeu
HAPS Systems Manager

08/10/2026



AIRBUS

HAPS (High-Altitude Platform Station)



Satellites
Long endurance
Global Coverage
Low revisits
High capital cost



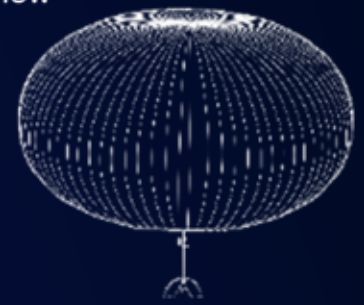
Drones
Low endurance
Local coverage
High revisits
High operational cost

HAPS | Complementary
- Long endurance like satellites
- Local coverage like drones/aircrafts
- Persistent

HAPS: flights at ~20km altitude

Low winds and stable environment
- Far above air traffic (10km)
- Wide coverage point of view





Fix-wing

Precise and maintained position

Worldwide reach
(10 days max to get anywhere)

Proven operability

→ Endurance record without refueling for a heavier than air: 64 days

Maneuvering balloons

Higher payload capacity

Cost efficient

Simple launch & recovery

→ Flights up to 200 days carried out

Use cases



Defence

Meteorology

Mapping

Air quality



Maritime

Earth Observation stratospheric payload

Agriculture

Smart Cities





Environment

Forest Fires



Emergencies

The challenge

Stratospheric payload design

Stratospheric atmosphere

20 km altitude

- Down to [-90, -70]ºC
- Sun radiation like in Space at [20, 30]ºC
- Low air pressure
- Radiation
- Ozone

And sea level compatible!

Platform constraints

Weight

- 4 - 10 kg 
- 5 - 15 kg 

Power

Solar powered (batteries)

Aerodynamics

Neutral

Electromagnetism

Neutral

Use cases needs

High resolution

→ Heavy optics

Steerability

→ Resistant structure

→ Lubrication

→ Pointing accuracy

Multi-sensor

→ As many as possible!

Operational needs

Resistance

- Vibration (platform)
- Stress (weight, movement)
- Impact (landing)

Autonomy

→ Remote ops

→ Safety

Reusability

→ Mission cost reduction

Environmental resistant and compatible materials

Ultra-lightweight materials

Flexible design and manufacturing

Resistant materials

AIRBUS

So, are you up to the challenge?

Q&A

Thank you!

Defence, Security and Dual-Use Technologies

8 October · 14:00 – 15:30 · Main Auditorium

ELN CONFERENCE SPAIN 2026



PRESENTATION 4 OF 4

Stanislav Landa

R&D Consultant, Danish Technological Institute (DK)

Lightweight Ammunition Packaging: Strengthening Danish Manufacturing Capacity and Strategic Supply for Modern Defence



Lightweight Ammunition Packaging

Strengthening Danish Manufacturing Capacity and Strategic Supply for Modern Defence

Stanislav Landa, Danish Technological Institute
in collaboration with PPD

European Lightweighting Network Conference
Barcelona, 8 October 2026

Lightweight ammunition cases (LWACs) and defence logistics



Less mass in every shipment

Packaging contributes to the weight that users carry, handle and transport.

Protection remains essential

The container must withstand demanding handling and storage loads.

Danish industrial capability

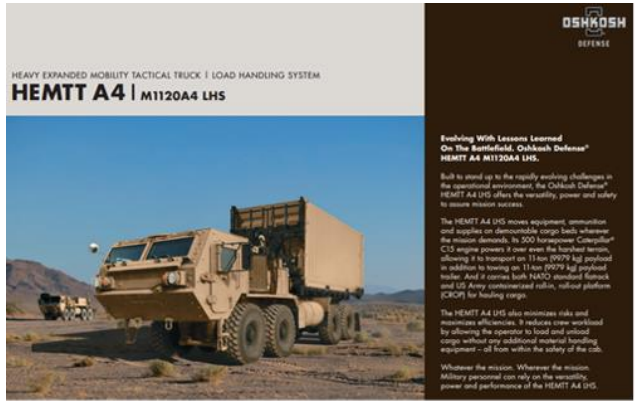
PPD product development combines with DTI simulation and testing expertise.

Packaging mass: the scale of the opportunity



Steel Case	2.50 kg	6.50 kg	8.90 kg
PPD Case	0.75 kg	1.75 kg	2.70 kg
Mass saved	1.75 kg / 70%	4.75 kg / 73%	6.20 kg / 70%

Lower weight mean higher capacity



HEMTT A4
Payload: 10,000 kg

Steel M2A1: 720 steel cans
LWAC M2A1: 815 PPD boxes



G1-M DRONE
Payload: ~25 kg

Steel M2A1: 1 steel can
LWAC M2A1: 2 PPD boxes



HERCULES C4
Payload: 20,000 kg

Steel M2A1: 1435 steel cans
LWAC M2A1: 1630 PPD boxes



SOLDIER
Reduced weight: 1.8 kg

1.8 kg = 15-20 extra rounds of 0.5 ammunition.

Reduced signature and equipment interference





Radar signature: Non-metallic packaging may reduce radar reflection compared with steel; the effect depends on geometry, radar frequency and contents.

Noise discipline: Polymer cases dampen vibration and avoid metallic clanking, supporting quieter transport when loads are properly secured.

Magnetic compatibility: The polymer body avoids steel-related magnetic interference with compasses and sensitive sensors, and does not attract metal shavings.

Physical performance tests

Typical load cases include:

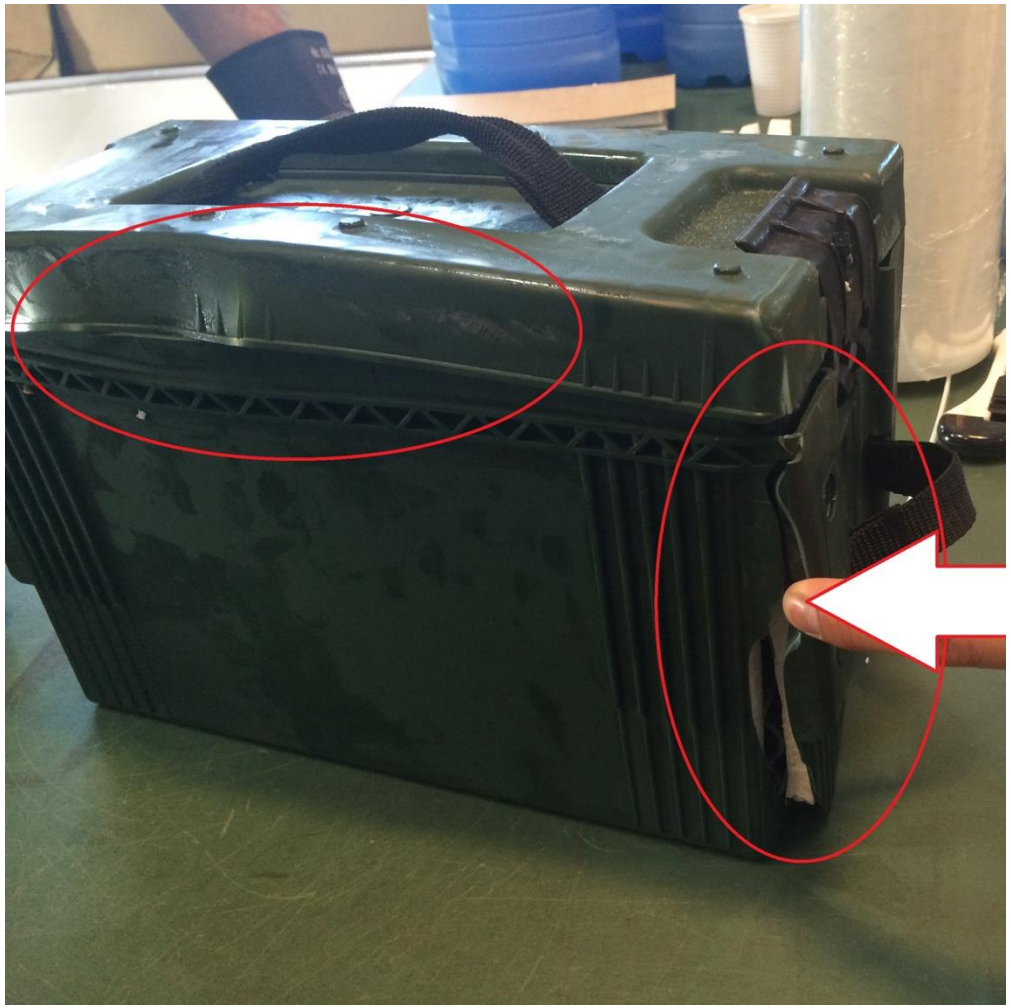
- Drop impact – including impacts on faces, edges and corners
  - 1.2m or 2.1m after conditioning at -18°C (or down to -54°C and up to 71°C)
- Stacking/compression – loads during storage and transport
  - Equivalent to a 3 m stack (2 pallets stacked vertically) for 24 hours (corresponding to approx. a load of 563 kg)
- Vibration and handling loads
  - In accordance with pre-defined standards for transportation via air, rail, road and sea.
- Temperature-dependent material behaviour (particularly for polymers)
- Tightness and protection of the packaged contents

Physical performance tests

Passable damaging of cases after drop and stacking include:

- Bent lid, corners, walls
- Minor cracks, chip-off
- Broken supporting elements (inserts, padding)

As long as the ammunition is secure and can be transported to its battlefield destination



Materials and limitations

- Replacing steel means redesigning, not just changing material
  - Tensile strength: Steel ~ 500-2000 MPa, conventional polymers ~ 30-90 MPa
- Limited geometric manoeuvrability, must be compatible with munitions (inner dimensions) and operating and transportation systems (outer dimensions)
- Design aim lies in unloading the areas of impact, redistributing and absorbing the energy elsewhere
  - Corners, edges → ribs, padding elements, gasket
- Gasket (rubber) provides excellent attenuation of impact waves and unloading towards it is crucial

The goal is equivalent functionality

DTI’s role: Digital validation before mould investment

DTI’s supporting role:

- Material characterization:
  - Assessing changes in mechanical properties and material behaviour with temperature and loading conditions
- FEM / 3D simulation:
  - Simulating drop, compression and stacking scenarios
  - Predicting stress, deformation and critical weak points
- Design optimisation
  - Improving wall thicknesses, ribs, corners, hinges and lid geometry
- Test planning, validation and documentation
  - Supporting physical test programmes
  - Comparing simulations with measured test results

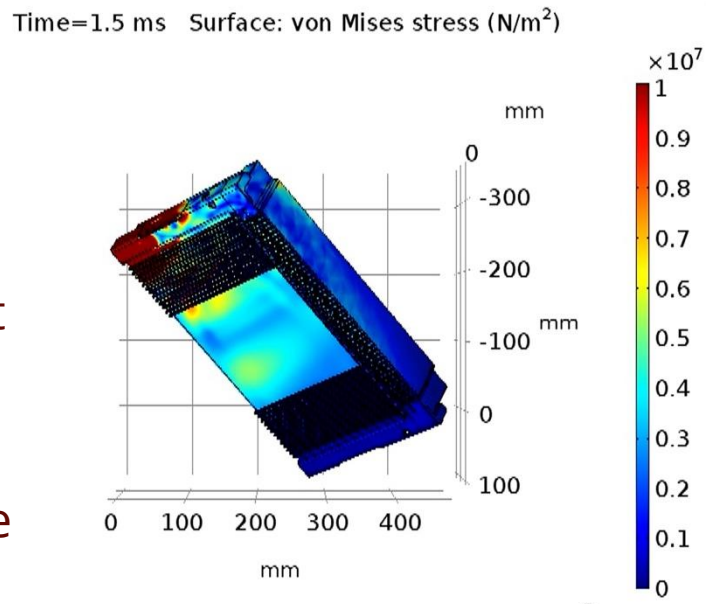
Digital design iteration before investment in production moulds

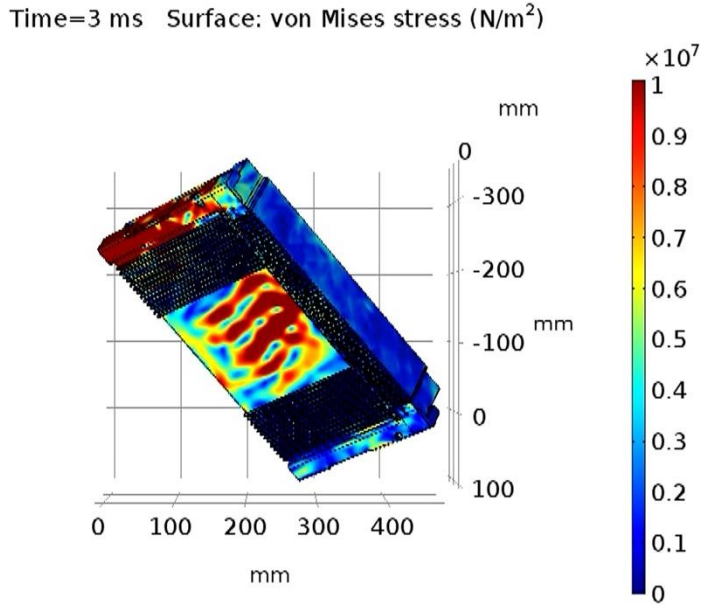
Example: Optimisation of LWAC-PA120 design

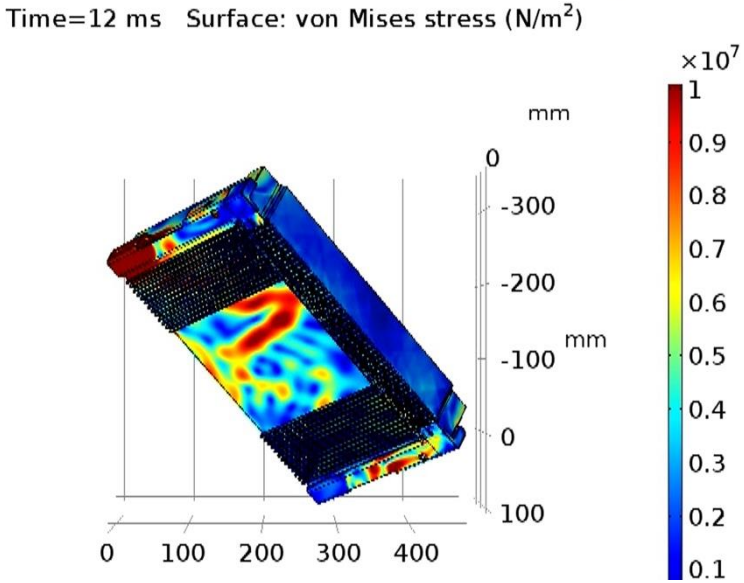
Identifying the corner-drop weakness

During the corner drop test, the impact zone remains overstressed for tens of milliseconds, causing structural failure that leads to munition spillage from the case.

The goal of the design optimization is to relieve the corner as quickly as possible and dissipate the stress field – specifically by redirecting stress waves upward toward the lid and the rubber gasket.





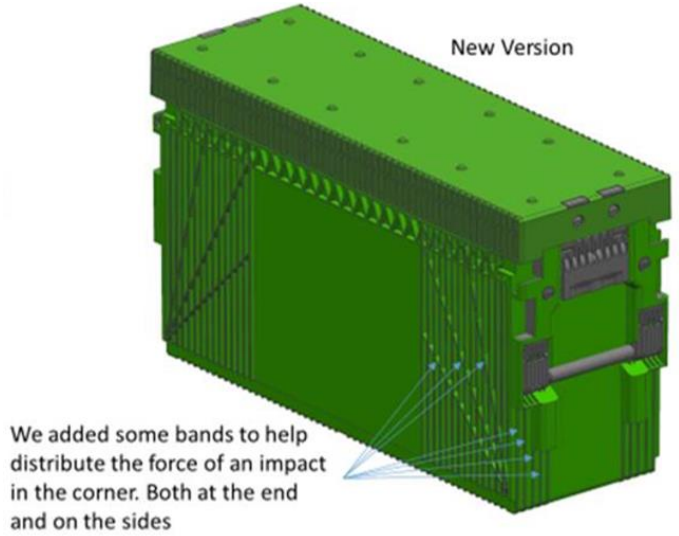


Example: Optimisation of LWAC-PA120 design

Guiding ribs: redesigning the impact response

- DTI analysed stress-wave propagation and vibration modes to understand the response.
- Divergent guiding ribs were proposed to direct the response towards the lid junction and rubber gasket.
- PPD developed two revised designs; DTI assessed their rib geometry and orientation.



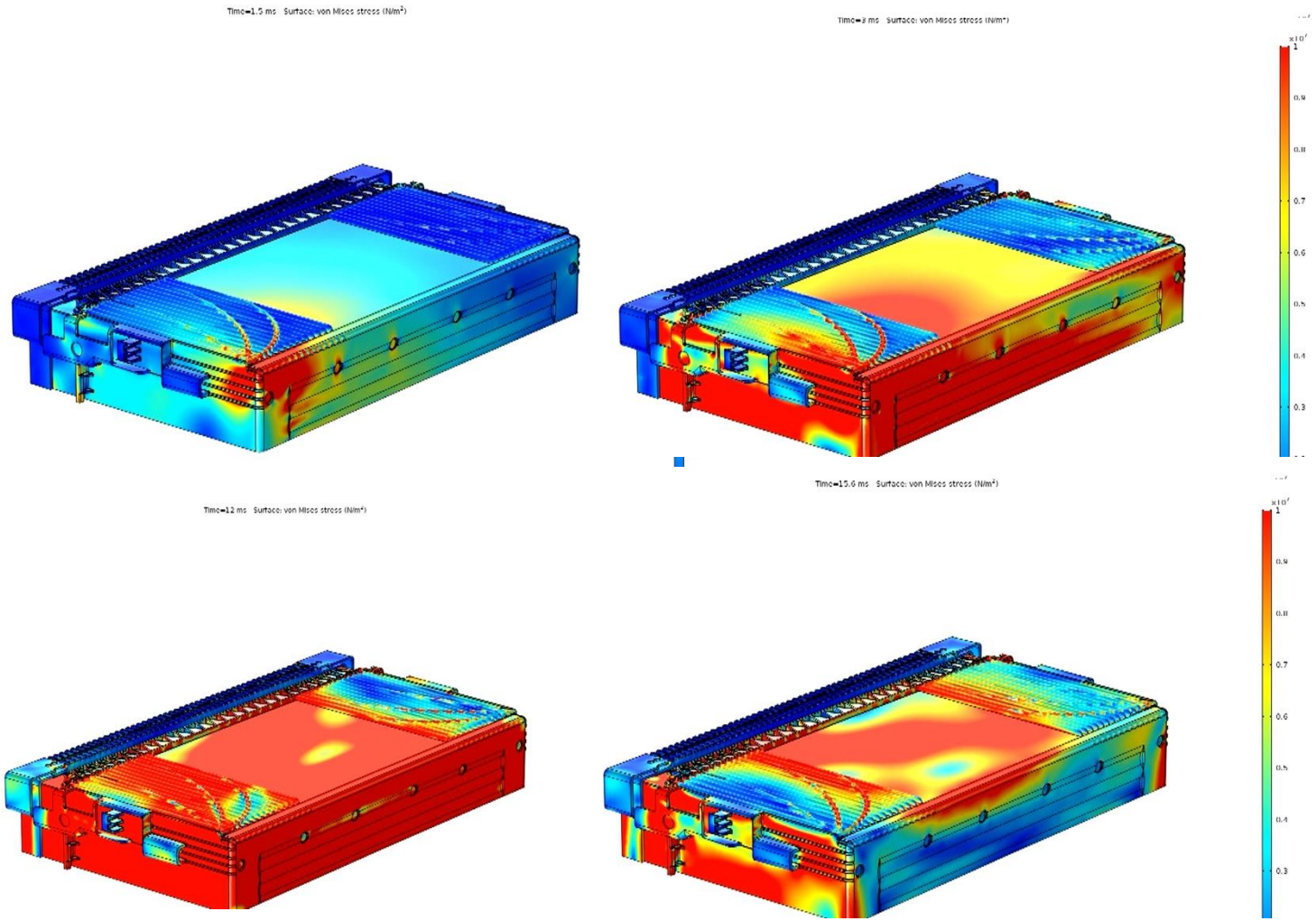




Example: Optimisation of LWAC-PA120 design

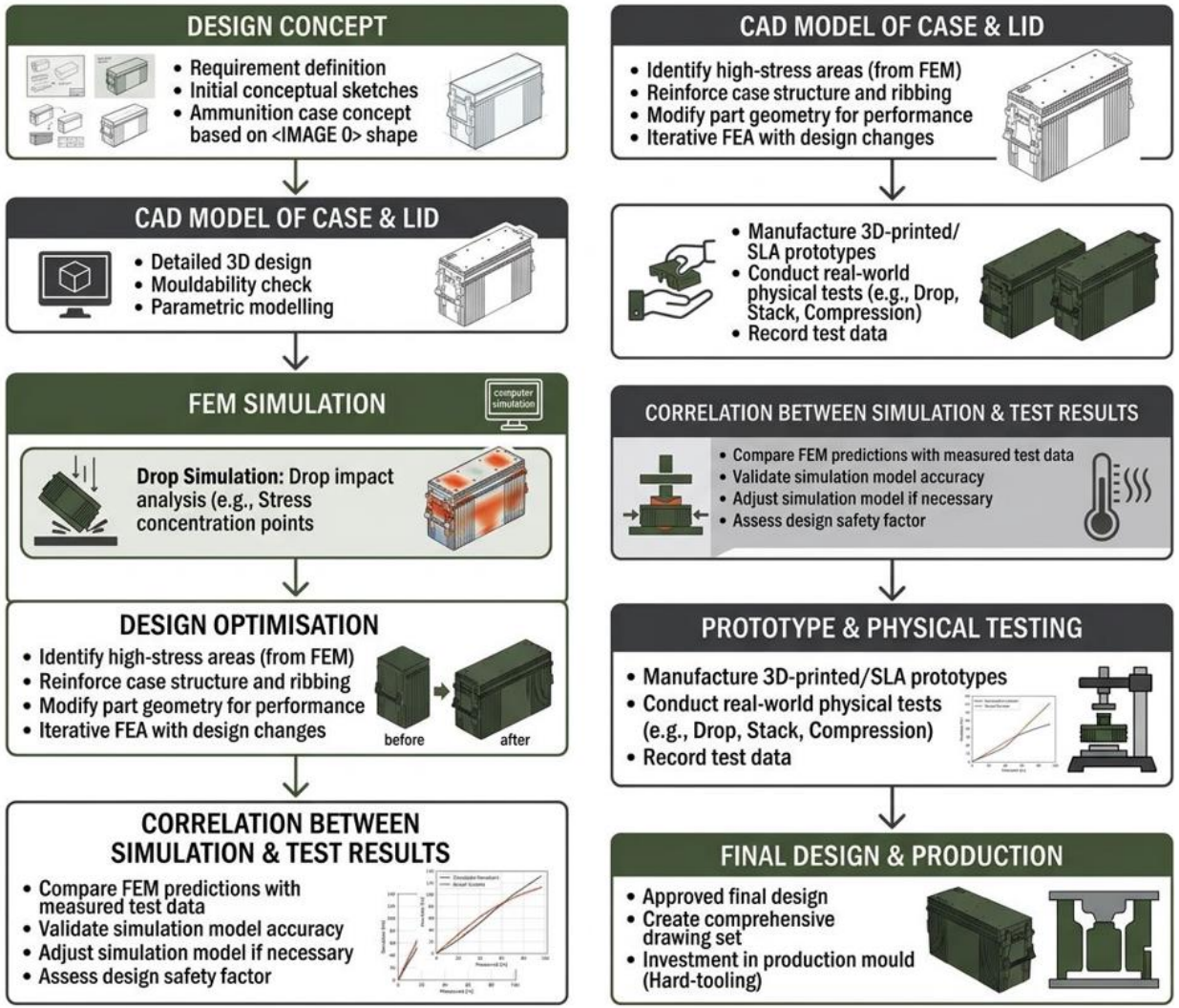
Revised PA120: from simulation to pilot production

- The revised FEM assessment predicted faster stress unloading, with case and lid stresses below yield in the analysed simulations.
- The digital assessment supported PPD's decision to order injection-mould tooling and produce a pilot series.
- Manufactured cases were prepared for physical testing at DTI to establish their performance.



Simulation guides design – testing verifies performance

- Simulation supports tooling decisions before expensive moulds are made.
- Physical testing verifies performance of the manufactured cases.
- PPD and DTI connect product development, simulation and testing to support Danish manufacturing capability.



Engineering lightweight performance

- Lower packaging mass improves logistics flexibility
- Replacing steel with polymer requires structural redesign
- FEM guides improvements before mould investment
- Testing verifies the product





Thank you!

Stanislav Landa, DTI
Alexander Leo Bardenstein, DTI
Jørgen Dahl, PPD
Jørgen Svane, PPD

stal@dti.dk



PANEL DISCUSSION

Defence, Security and Dual-Use Technologies

8 October · 14:00 – 15:30 · Main Auditorium



MODERATOR

Stephany Rivero

AeroS Ecosystem (ES)



Thomas Hipke

Fraunhofer IWU (DE)



Manuel García

2M Engineering (ES)



Samanta Simon

Airbus GeoTech (ES)



Stanislav Landa

Danish Technological Institute (DK)

15:30 · CLOSURE OF THE CONFERENCE

Thank you

See you at the next ELN Conference

Next up · 15:30 – 17:30 · Room 5

ELN Workshop

Open to ELN members and non-members

Conference Secretariat

Ricardo del Valle · ELCA / BAX

r.delvalle@baxcompany.com

eln2026.european-lightweight.net

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