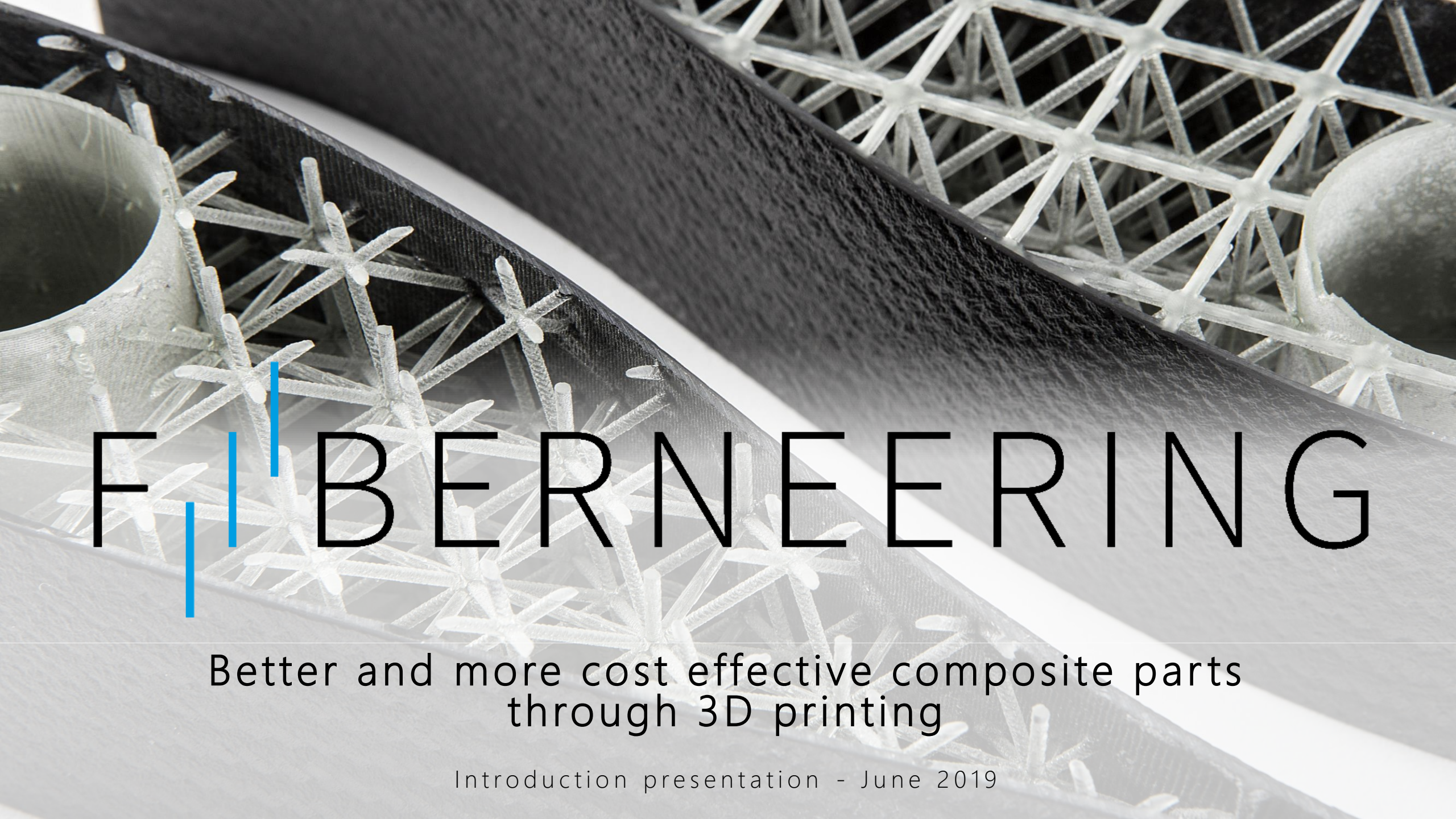

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Better and more cost effective composite parts through 3D printing

Introduction presentation - June 2019

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Started in 2015 with a patent on 3D printing for composites

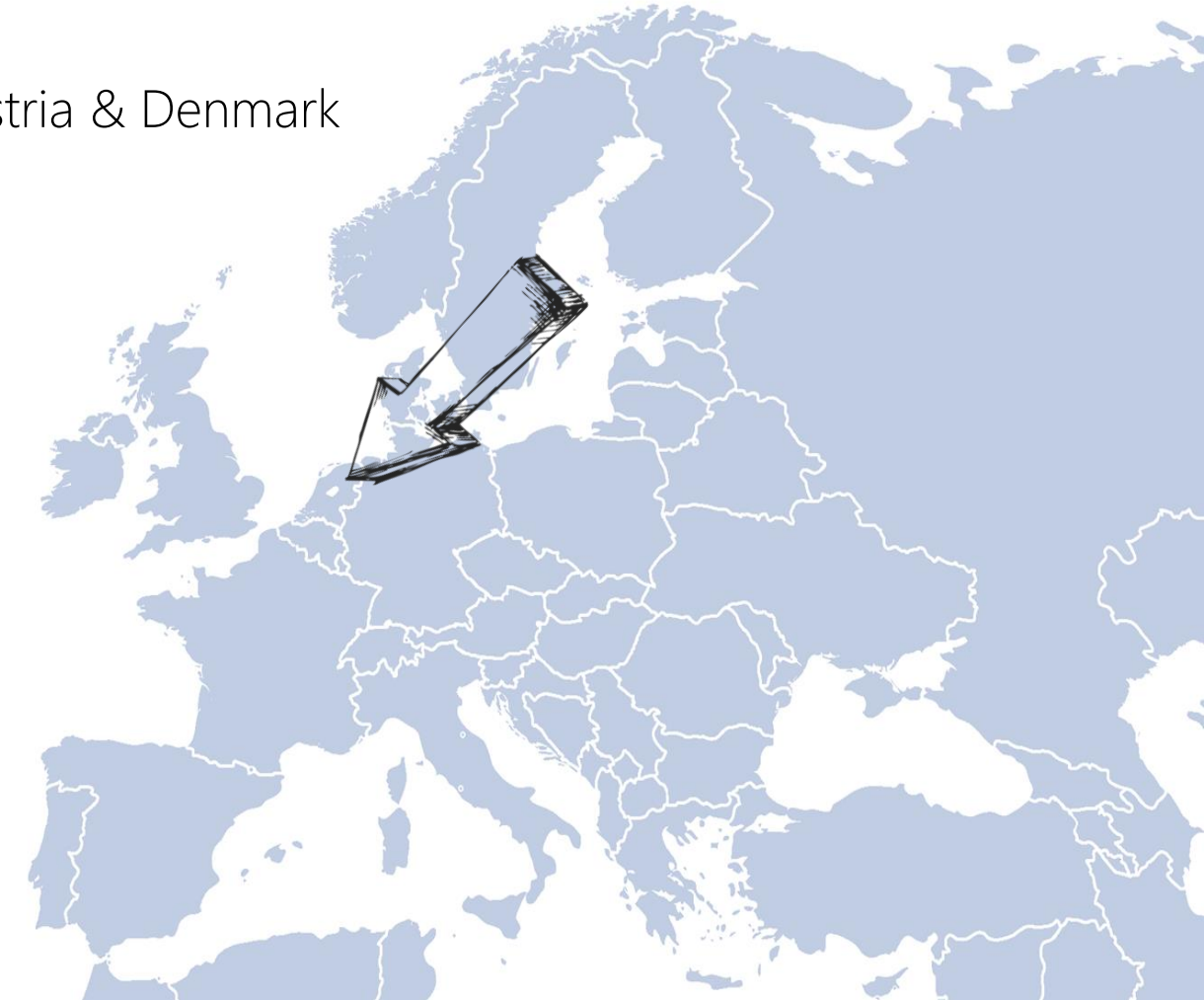
Now a team of 15 professionals: backgrounds in Marine-, Aeronautical-, and Mechanical engineering

Located in Zwolle (the Netherlands)

Customers in the Netherlands, Germany, UK, Sweden, Austria & Denmark

Focus on B2B markets where performance is key:

- Mobility
- Marine & Offshore
- Human tech



MKB INNOVATIE TOP 100 2017

MKB INNOVATIE TOP 100 2018

MKB Nederland Regio Zwolle Starter van het jaar

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With our customers we develop and produce exciting performance products based on high-tech composite materials and 3D technologies

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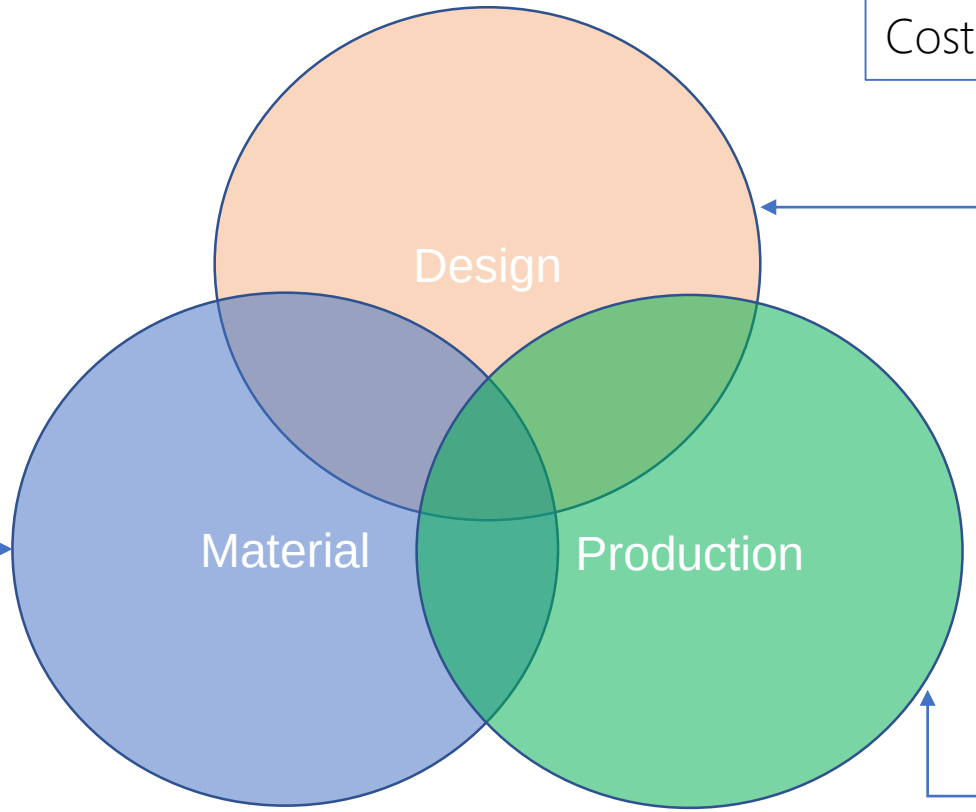
Why 3D printed composites?
Not just a different production technique!

Opportunity

Optimisation
Functional integration
Cost reduction



Challenge to keep

High strength fibres
Directional control important
Fibre volume content

"Standard" benefits

Automation
Cost reduction
Reduced assembly complexity

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Our Solution

Print

1

Complex geometry
Large (0.5 x 0.5 x 1m)
Vacuum tight parts
“Co-curable” surface

Apply fibres

2

Known processing
High quality composite
Shared 3D files
Structurally optimised part

Opportunities

Tooling

Production
Repair

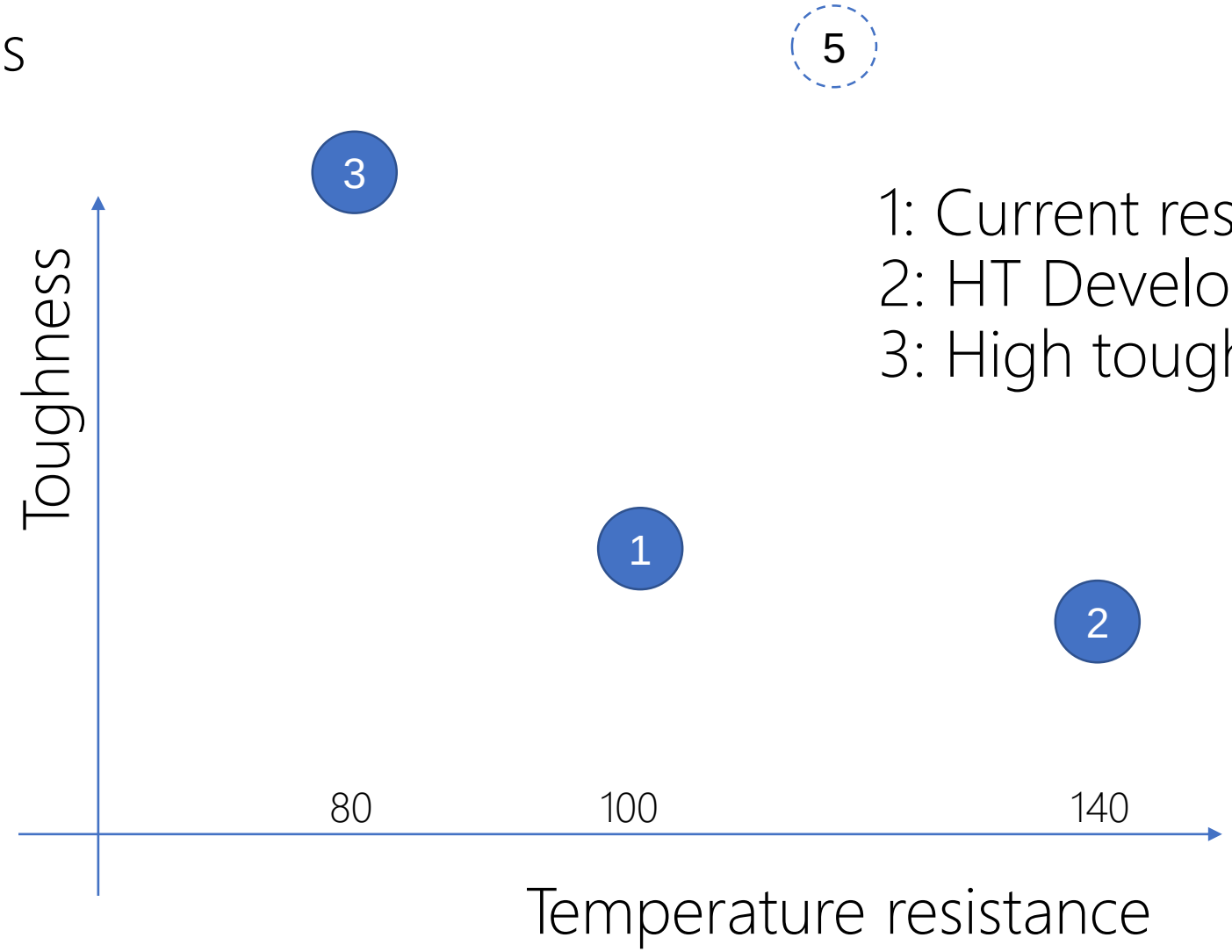
Non-structural parts

Cores for shaping
and integration

Structural parts

Cores for structural
optimisation

Materials



1: Current resin (Allround)
2: HT Development (OOA Prepreg)
3: High toughness development (Core)

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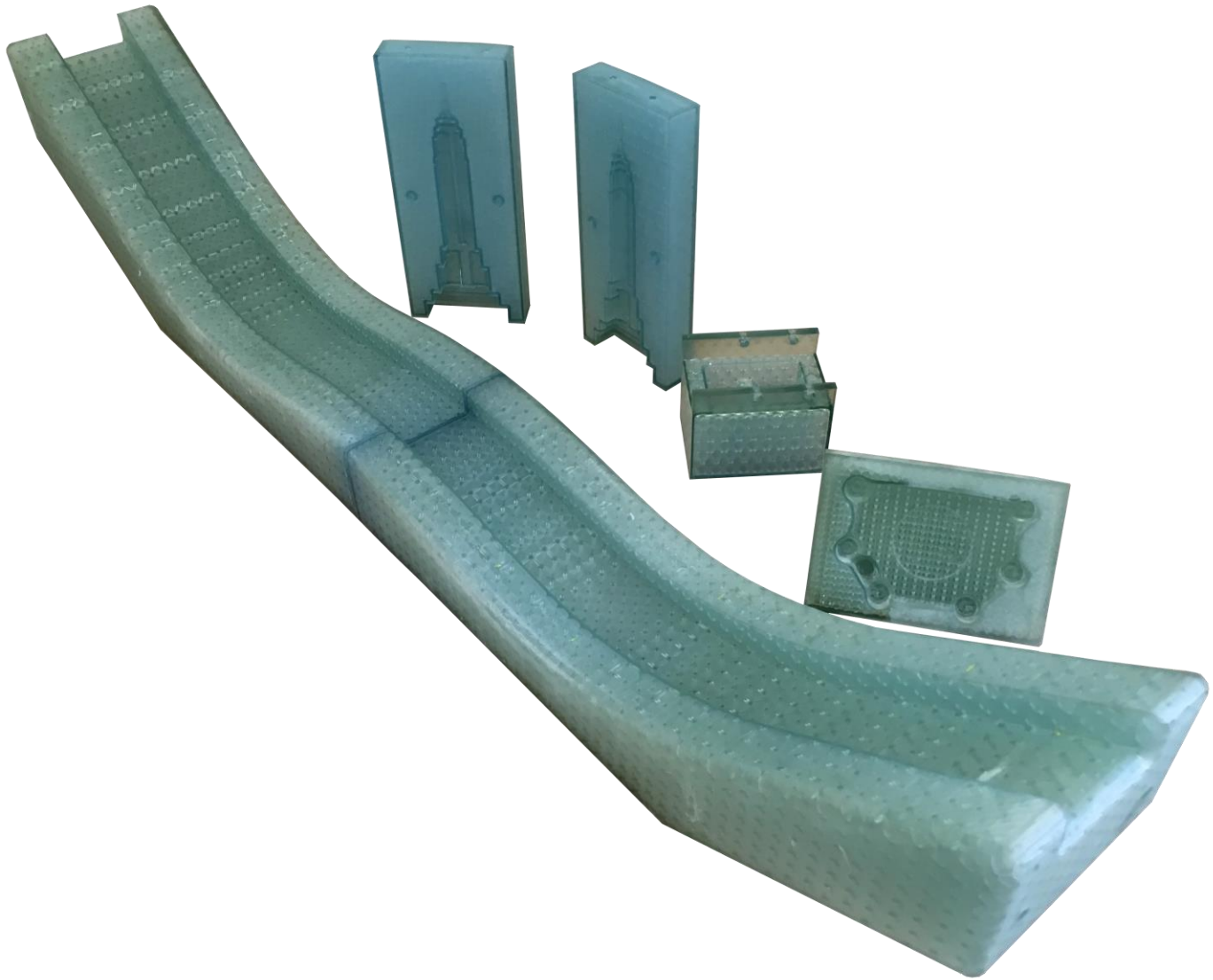
Tooling

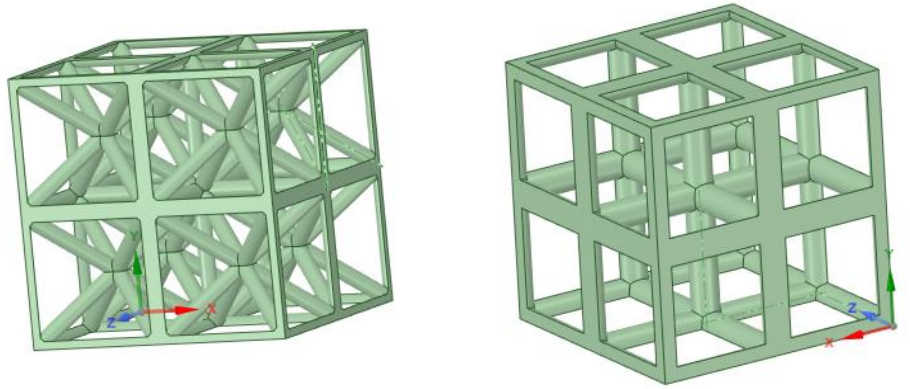


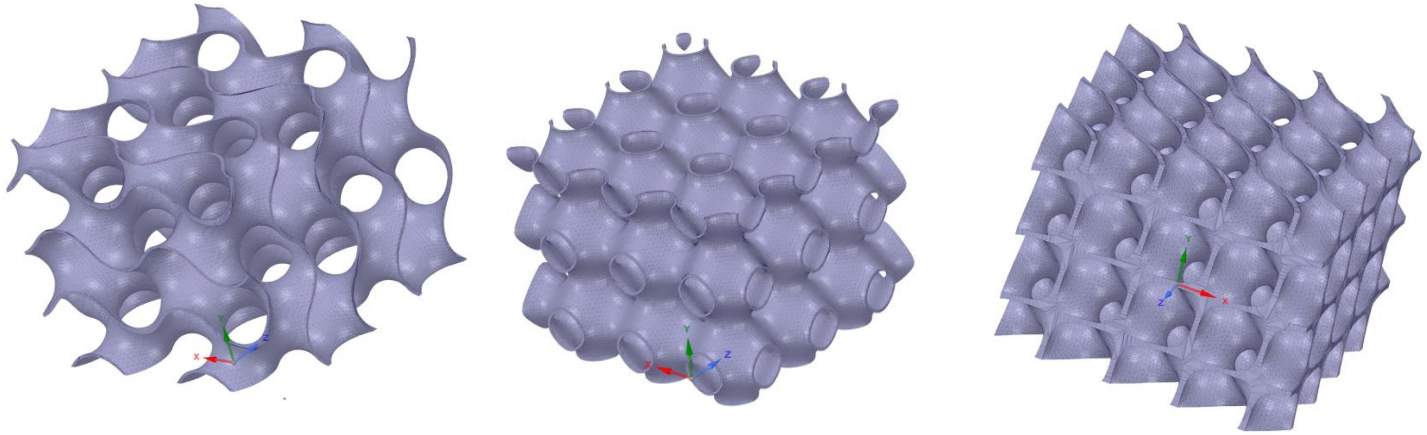
- ✓ Vacuum tight printing
- ✓ Heating / cooling / process sensors
- ✓ Printing +/- 0.5mm, machinable
- ✓ Composites, cast plastics (e.g. PU), vacuum forming
- ✓ Fast turnaround (days)

Printed cores

- ✓ Complex shaped core (no moulding or machining of foams)
- ✓ Stand-alone or use in traditional processing
- ✓ Co-cured (thermal or UV)
- ✓ Optimised

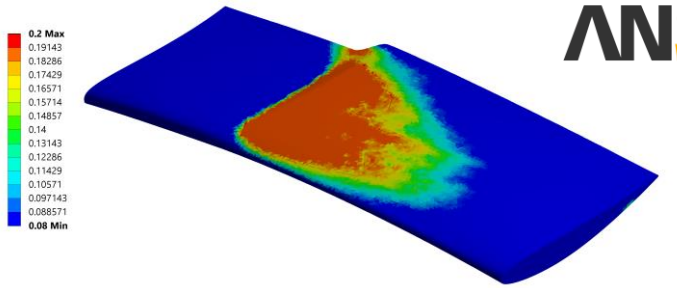
Weight optimised cores

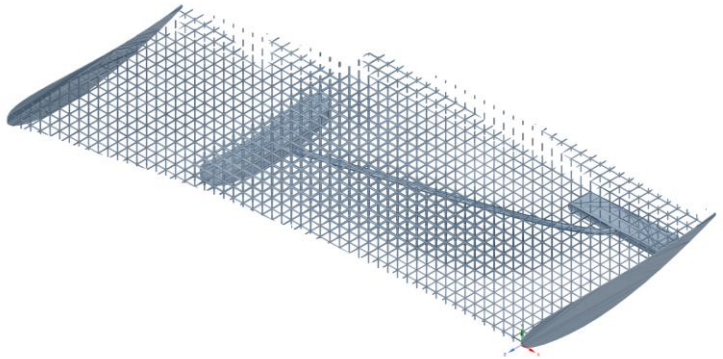




Step 1: Select repeat unit cell

Step 2: Modify local properties based on load case

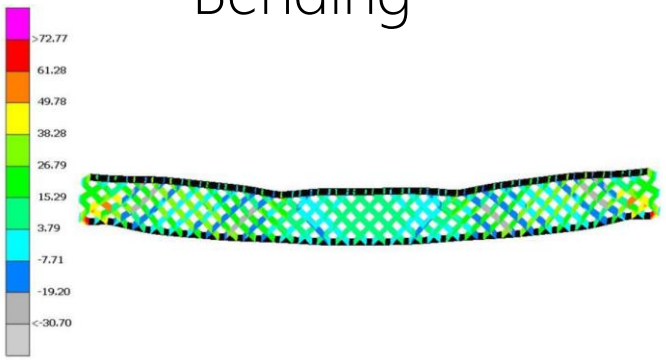


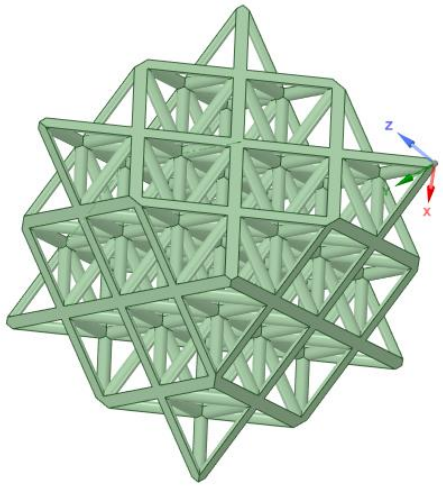


Possible Fiberneering core: 0 – 1150 kg/m3
Typically applied: 50 – 150 kg/m3

High end

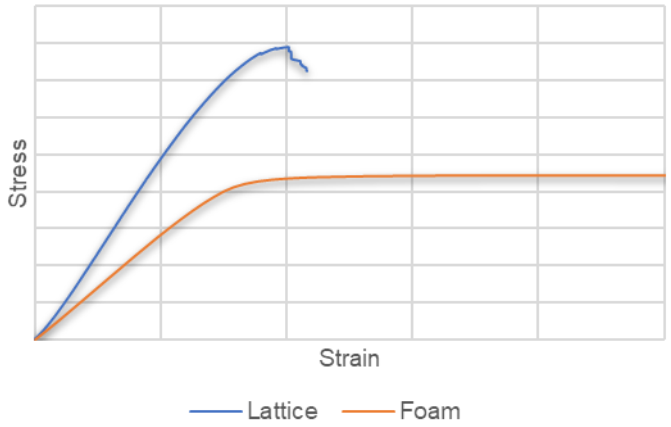
Bending

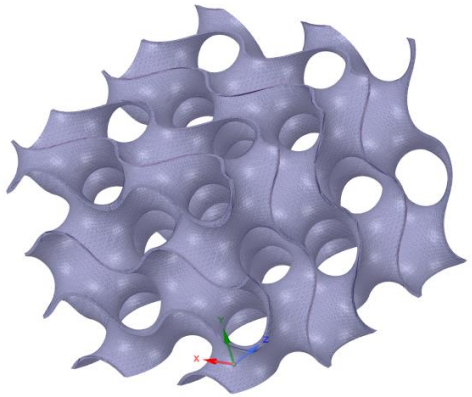


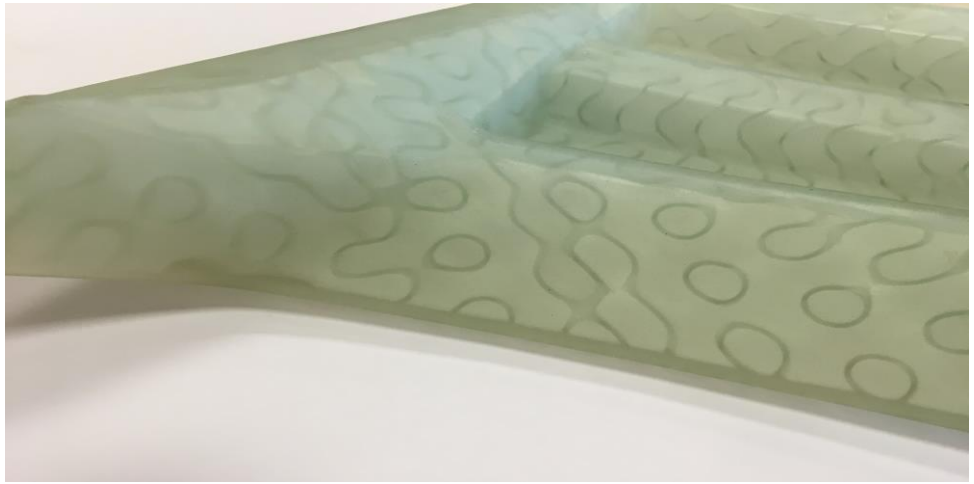


Exoskeleton by intespring

Compression







Compressively loaded core

Integrated structures

Traditional product:

- Foam core (heavy, needs tooling to produce)
- Assembly afterwards (extra step, complicated)

Our alternative solution:

✓ Printed core – structurally optimised, 75% lighter
✓ Integrated lighting, sensors & heating, no assembly costs
✓ No additional tooling required, flexibility to change design and no upfront investment

<u>Better composite product at lower cost!</u>

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Cost effective cores

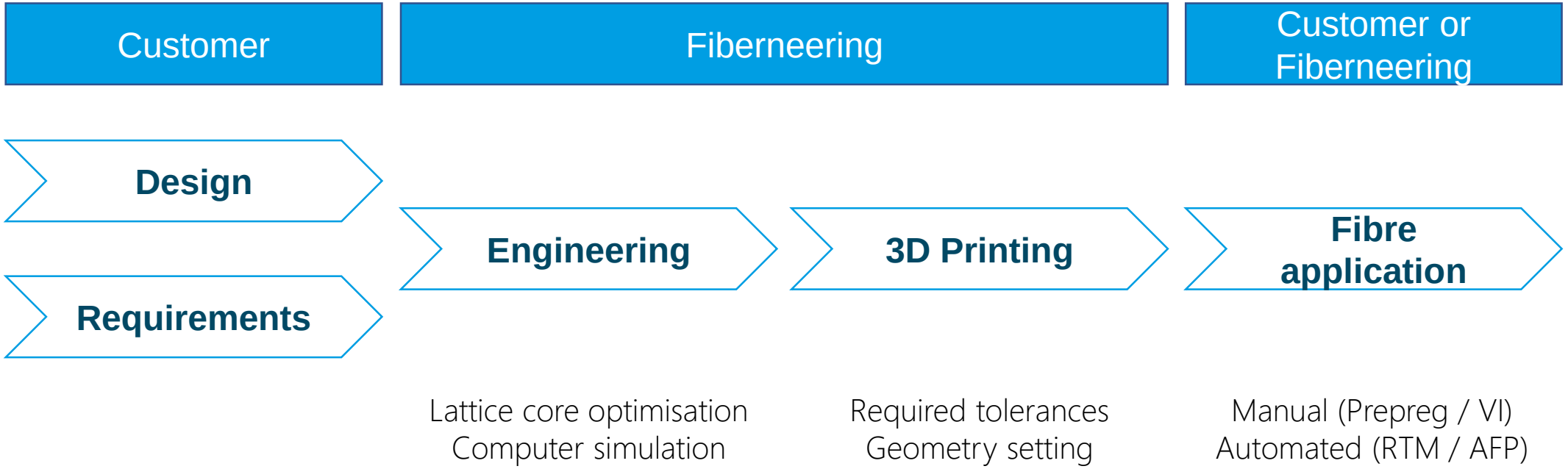
Small series

- ✓ Reduced (or no) cost of tooling
- ✓ Fast time to market
- ✓ Combine with traditional processing
- ✓ Functional products

Large series

- ✓ Reduced assembly and handling cost
- ✓ Direct material usage
- ✓ Opportunities in pre-forming
- ✓ “Drop-in” replacement

Fiberneering is a development, engineering and production partner



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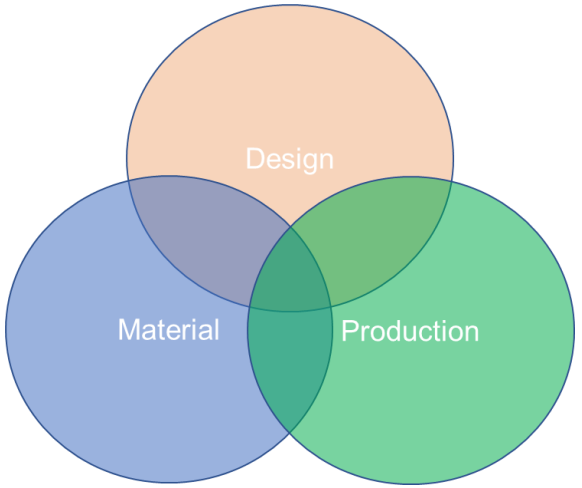
Summary / conclusion

Important to combine the benefits of 3D printing with true composite properties

Unique opportunities to optimise parts

Not only prototypes; also interesting for larger series

<u>Cost effective & Better parts!</u>



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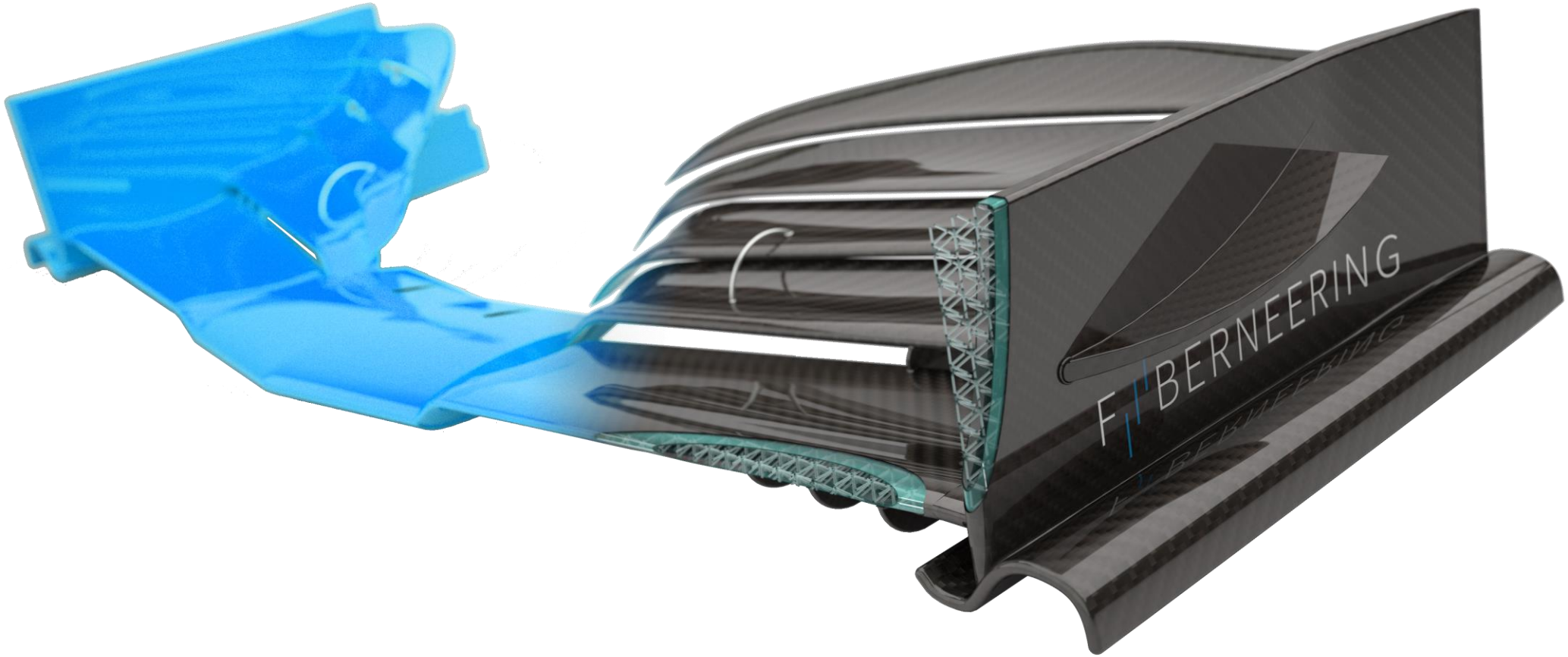
Questions / Ideas?



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