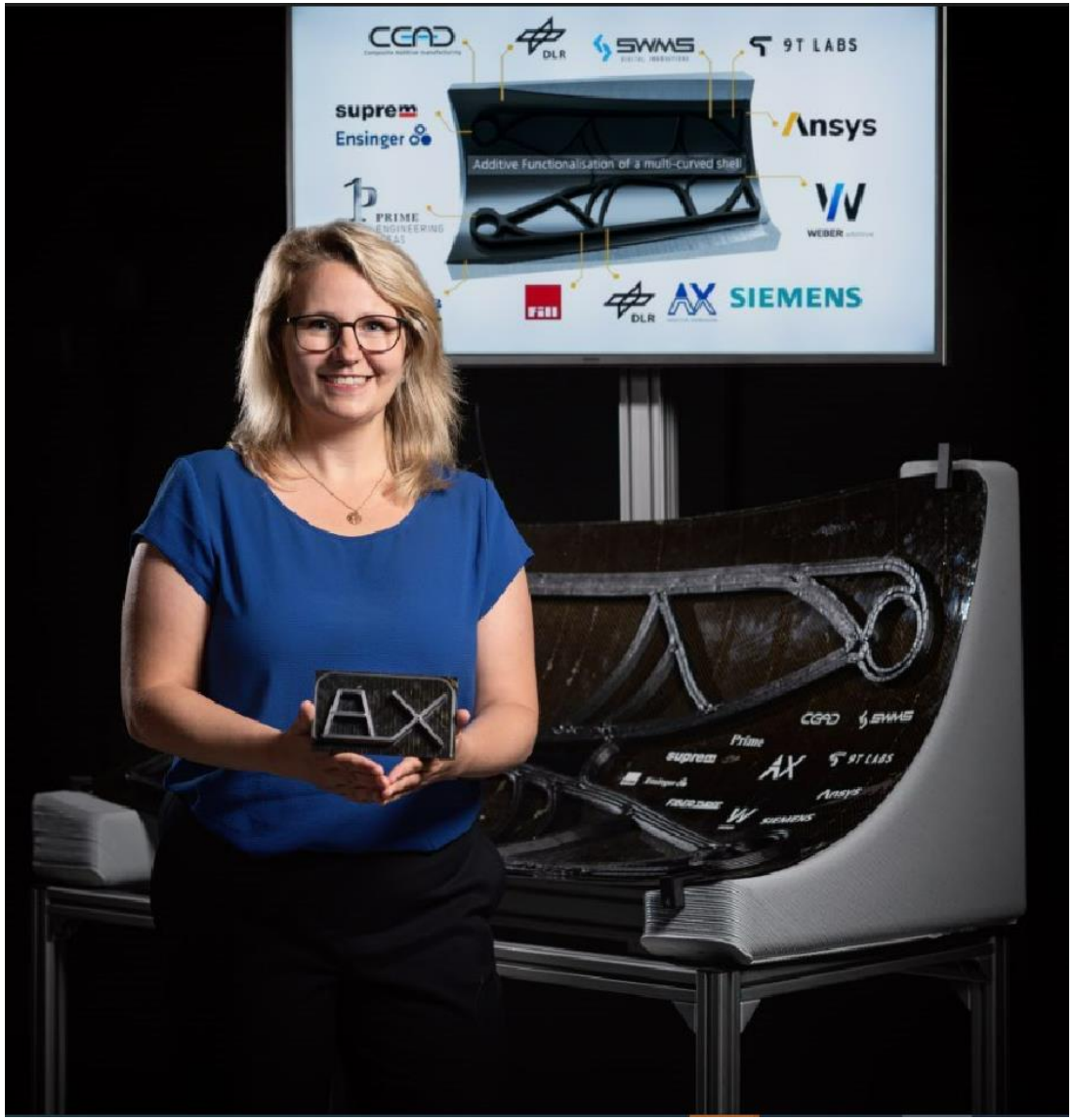
Additive Funktionalisierung – Kombination statt Substitution

DLR

Vorstellung der Referentin



ADDITIVE EXTRUSION
A DLR Innovation Lab

DLR

Xenia Stumpf, M.Sc.

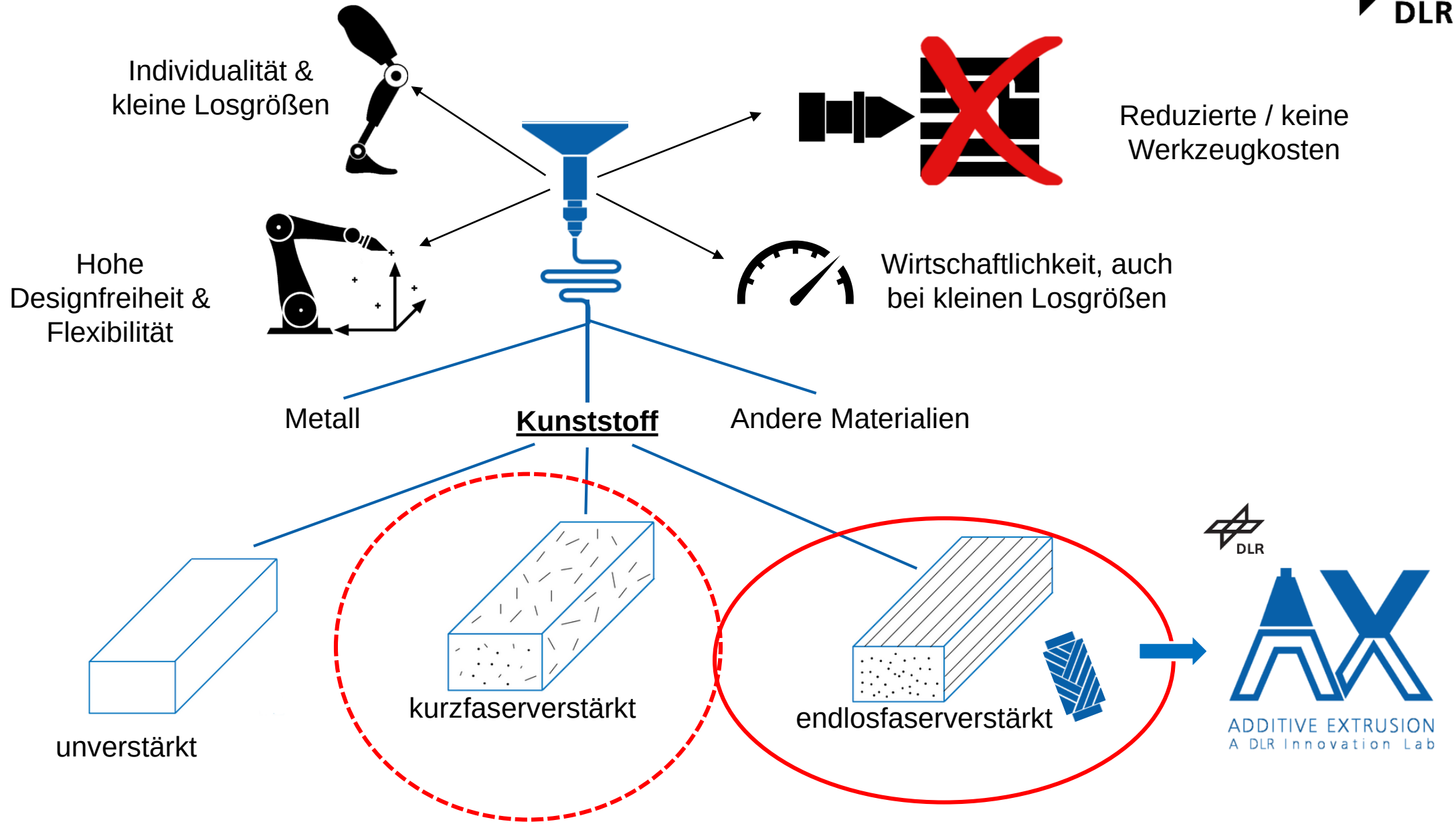
Lab Managerin
DLR Innovation Lab EmpowerAX

Deutsches Zentrum für
Luft- und Raumfahrt

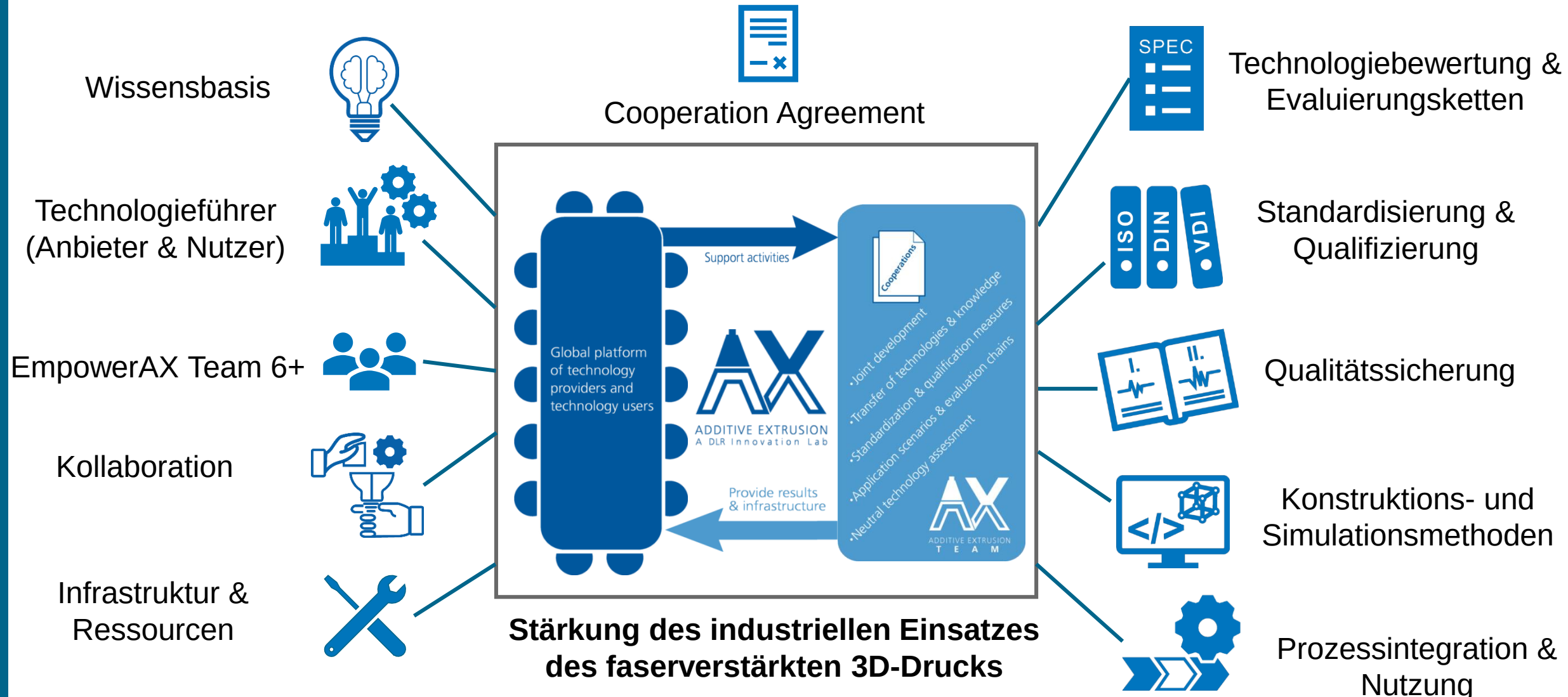
Institut für Systemleichtbau

Braunschweig

(Faserverstärkter) 3D-Druck eröffnet neue Möglichkeiten

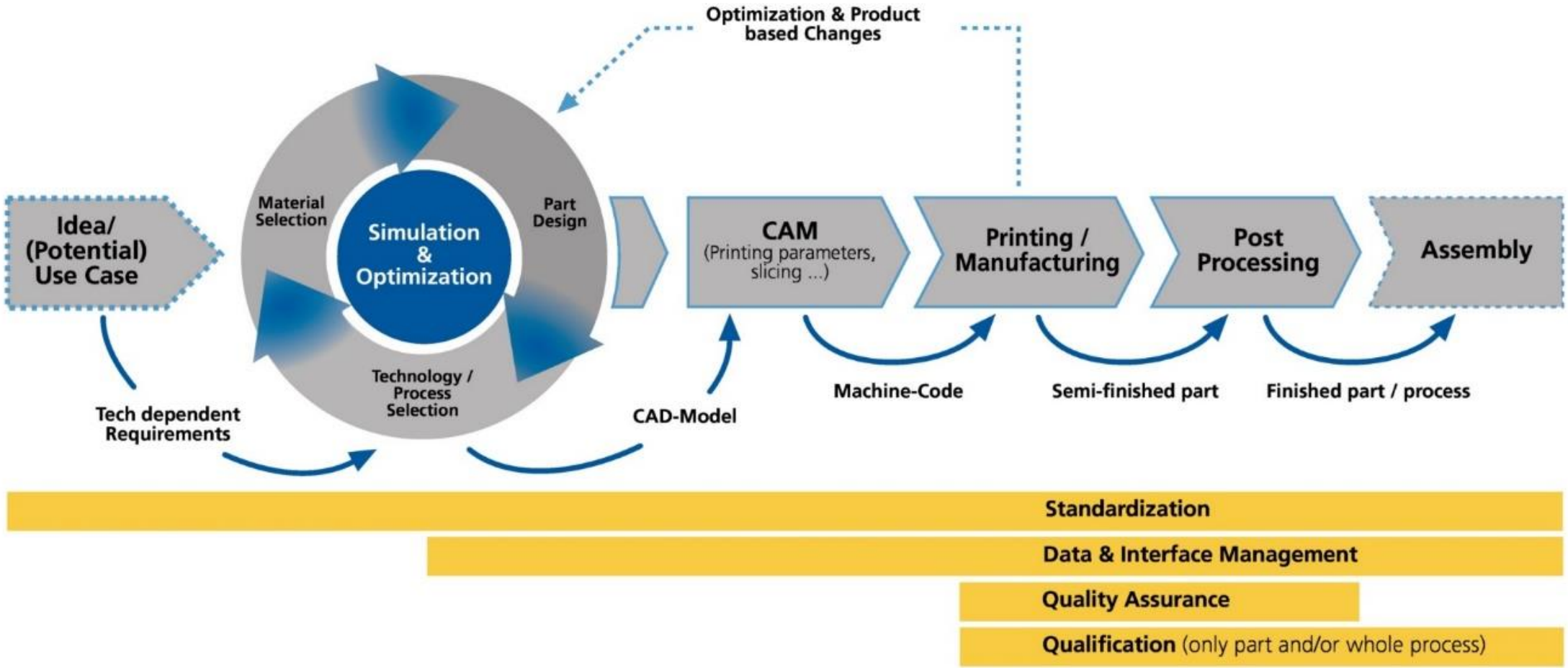


DLR Innovation Lab EmpowerAX – ein Überblick



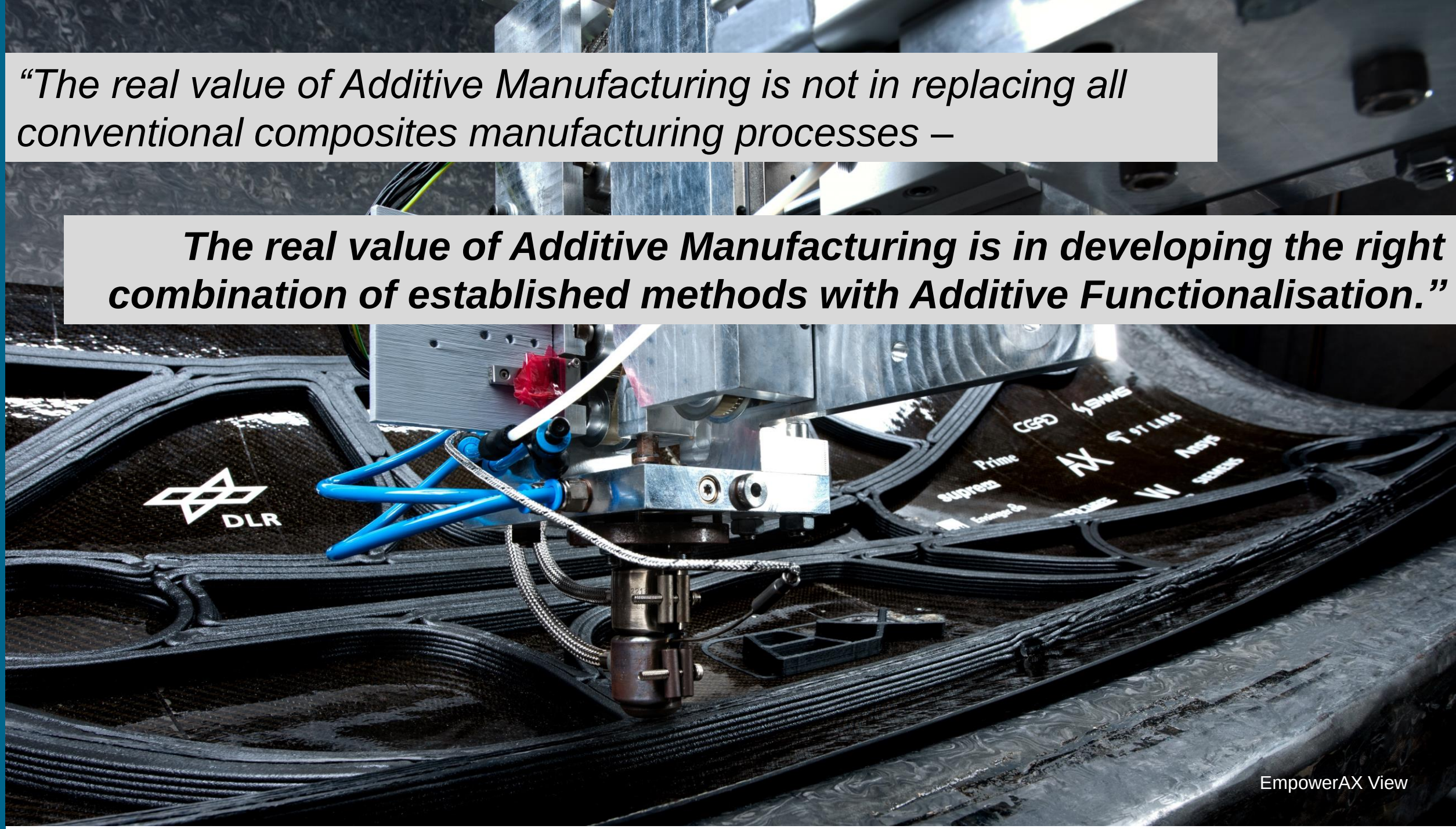
Stärkung des industriellen Einsatzes des faserverstärkten 3D-Drucks

EmpowerAX: Technologiekompetenz entlang der Prozesskette



“The real value of Additive Manufacturing is not in replacing all conventional composites manufacturing processes –

The real value of Additive Manufacturing is in developing the right combination of established methods with Additive Functionalisation.”

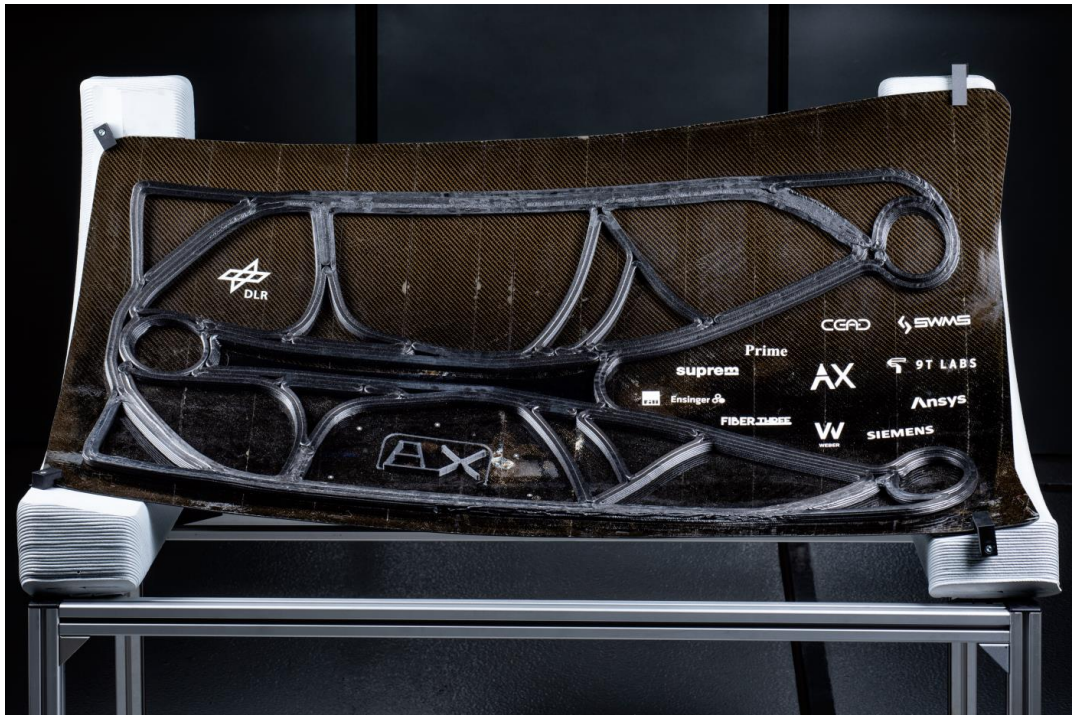


EmpowerAX View

Additive Funktionalisierung
Das richtige Material mit dem richtigen Prozess am richtigen Platz

- Kombination konventioneller mit additiven Fertigungsprozessen
- Kombination von Materialien abhängig von Bauteilfunktion
- Facetten der Additiven Funktionalisierung
  - Aufdrucken lokaler Versteifungsrippen
  - Integration von Montage- und Klebehilfen
  - Einbringen elektrischer Leiterbahnen
  - u.v.m

Additive Funktionalisierung am Beispiel des EmpowerAX Demo Parts



- Additive Funktionalisierung für die kosteneffiziente Fertigung von Kompositbauteilen
- Überdrucken einer mehrfach gekrümmten Schale mir kurz – und endlosfaserverstärkten Materialien
- Kombination von Thermoset und Hochleistungsthermoplast
- Demonstration einer industriell verfügbaren Prozesskette

EmpowerAX Demo Part
Die Grundidee

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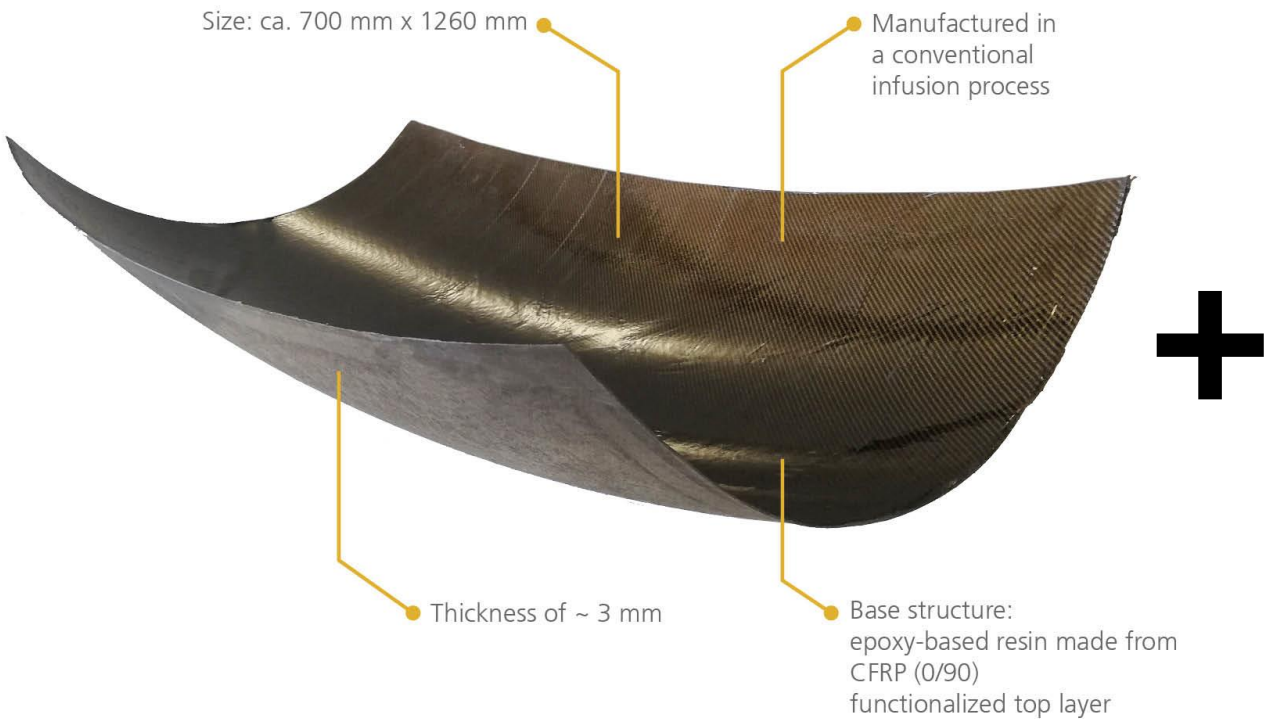
Funktionalisierung einer mehrfach gekrümmten Thermosetschale
mittels faserverstärkten 3D-Druck mit Hochleistungsthermoplast



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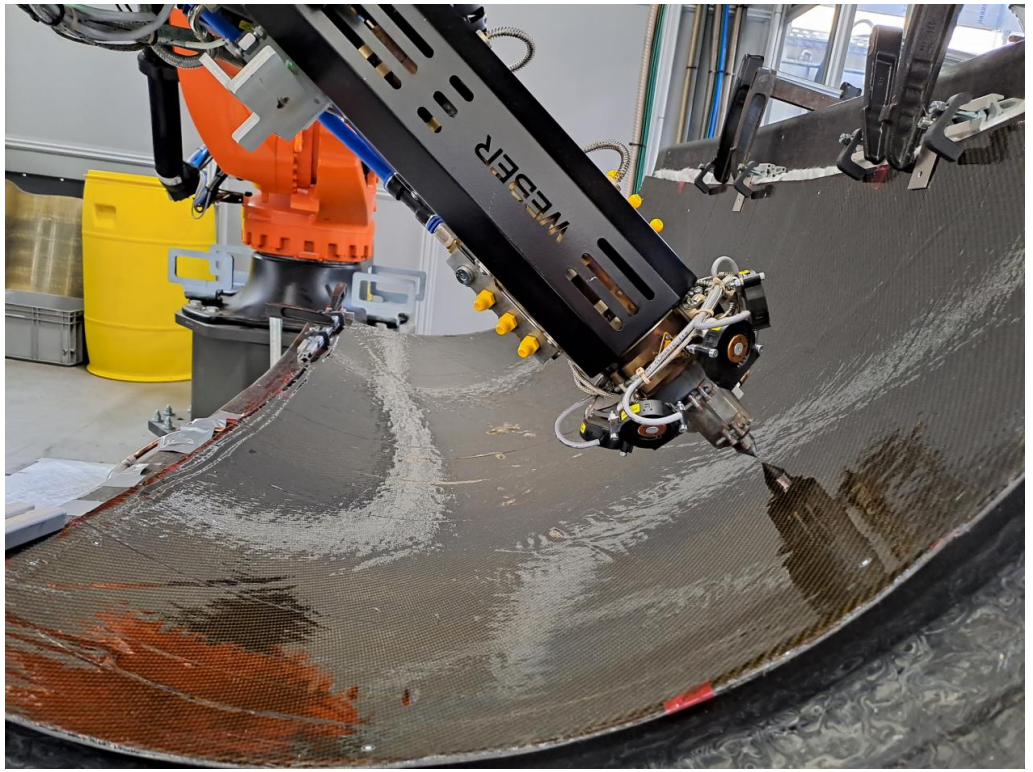

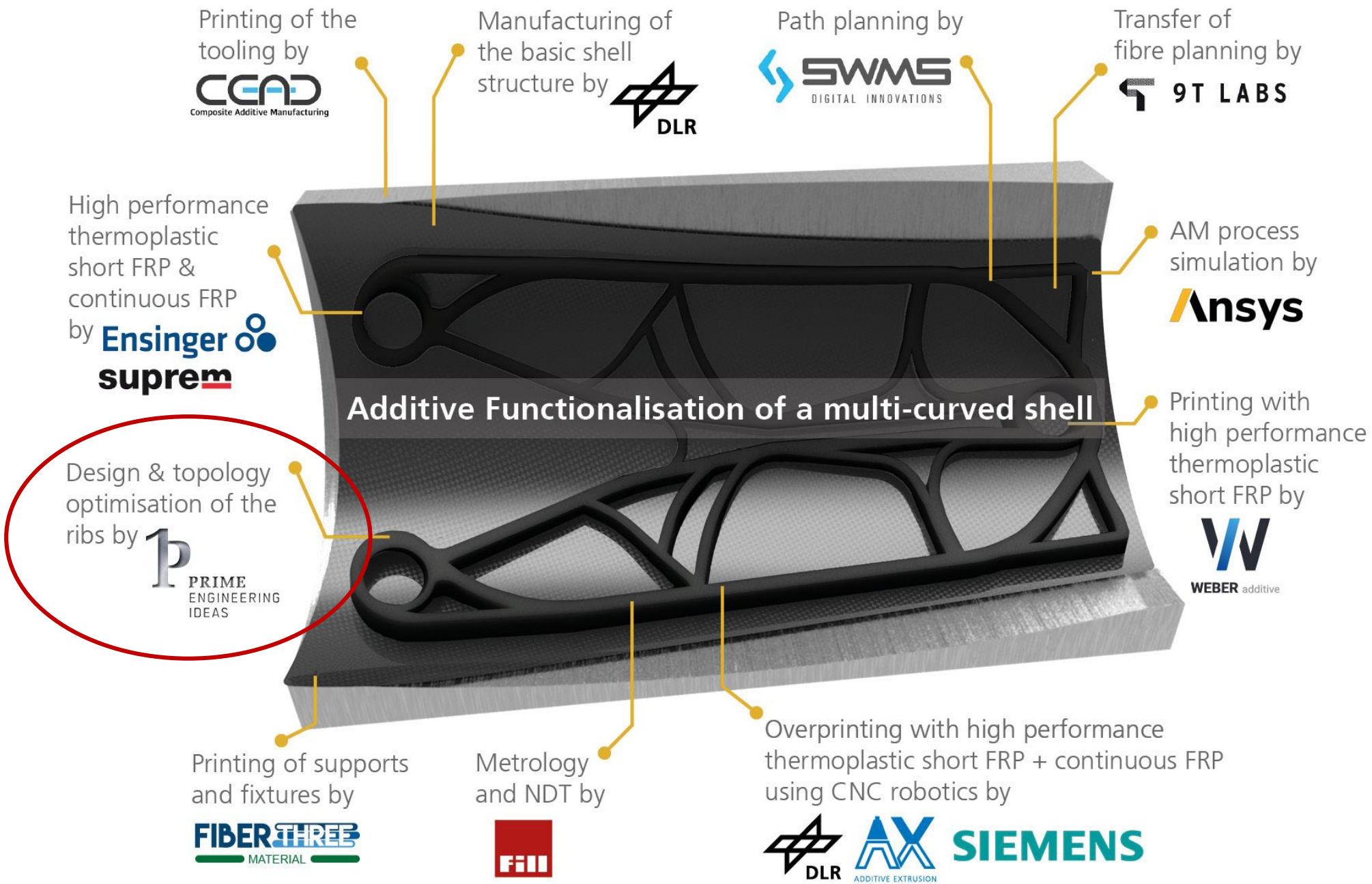
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CEAD Composite Additive Manufacturing
Manufacturing of the basic shell structure by
DLR
Path planning by
SWMS DIGITAL INNOVATIONS
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suprem
Additive Functionalisation of a multi-curved shell
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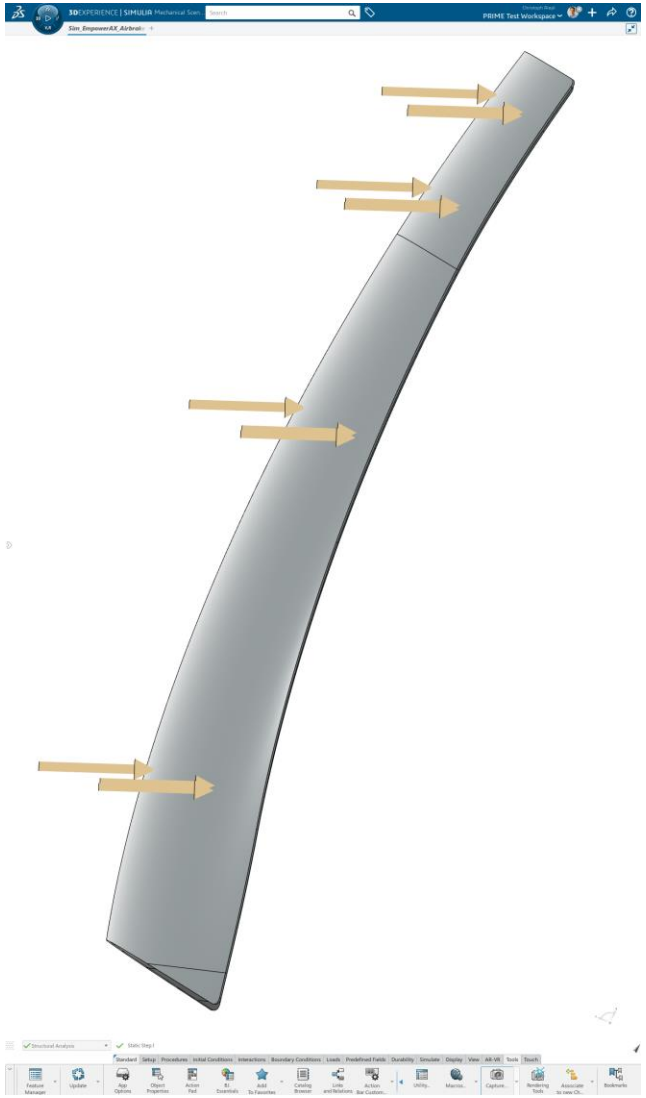
DLR
AX ADDITIVE EXTRUSION
SIEMENS

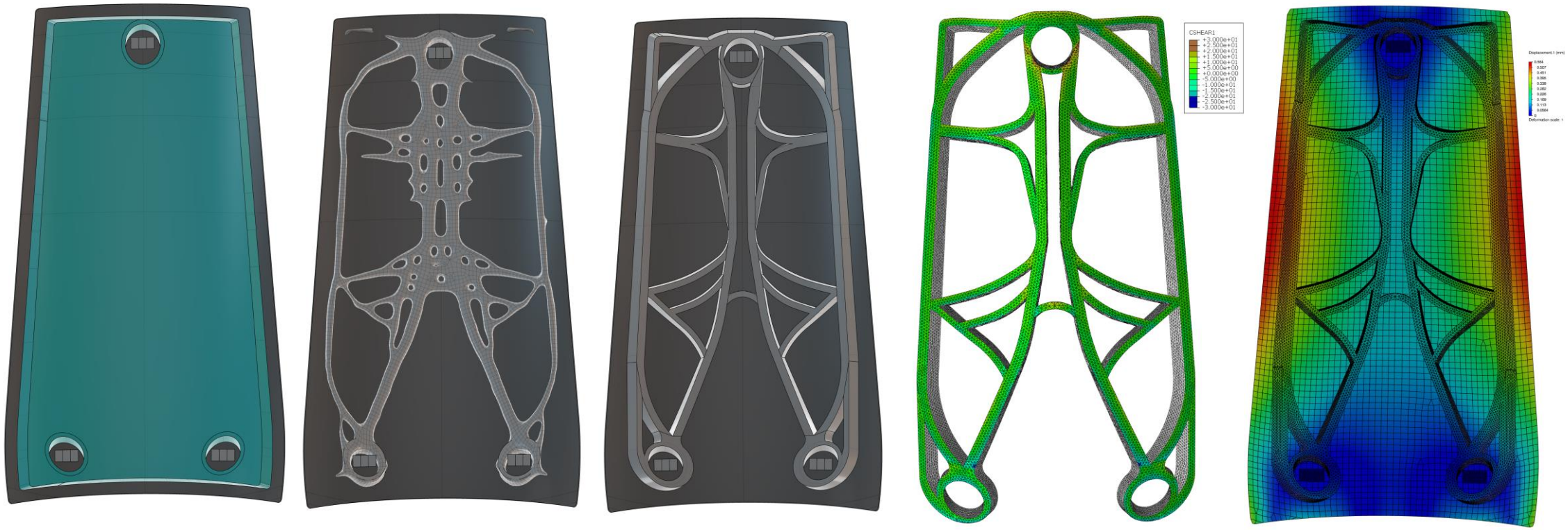
EmpowerAX Demo Part
Ausgangspunkt: Topologie-optimiertes Design by PRIME



Grundannahmen für den Lastfall als Designanforderung:

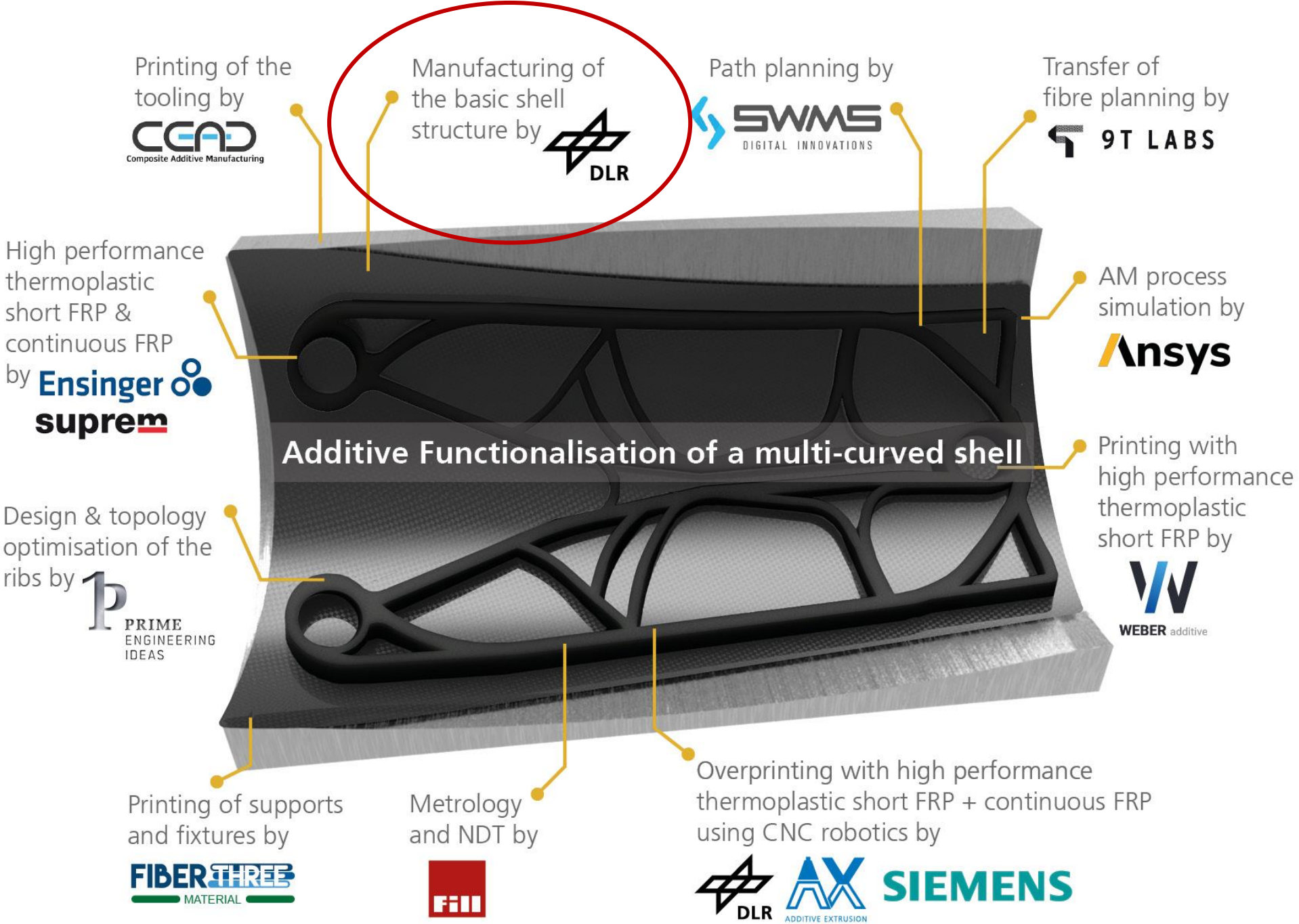
- Generischer Anwendungsfall aus der Luftfahrt
- Landung eines Flugzeuges bei 360 km/h
- Luftwiderstand kombiniert mit gleichzeitigen Front- und Seitenwinden

EmpowerAX Demo Part
Ausgangspunkt: Topologie-optimiertes Design



- Die Festigkeit der Grundstruktur reicht nicht aus, um dem angenommenen allgemeinen Lastfall standzuhalten
- Daher ist eine Struktur zur lokalen Verstärkung erforderlich

Ergebnis: Topologie-optimierters Design, um Material nur dort einzusetzen, wo es wirklich benötigt wird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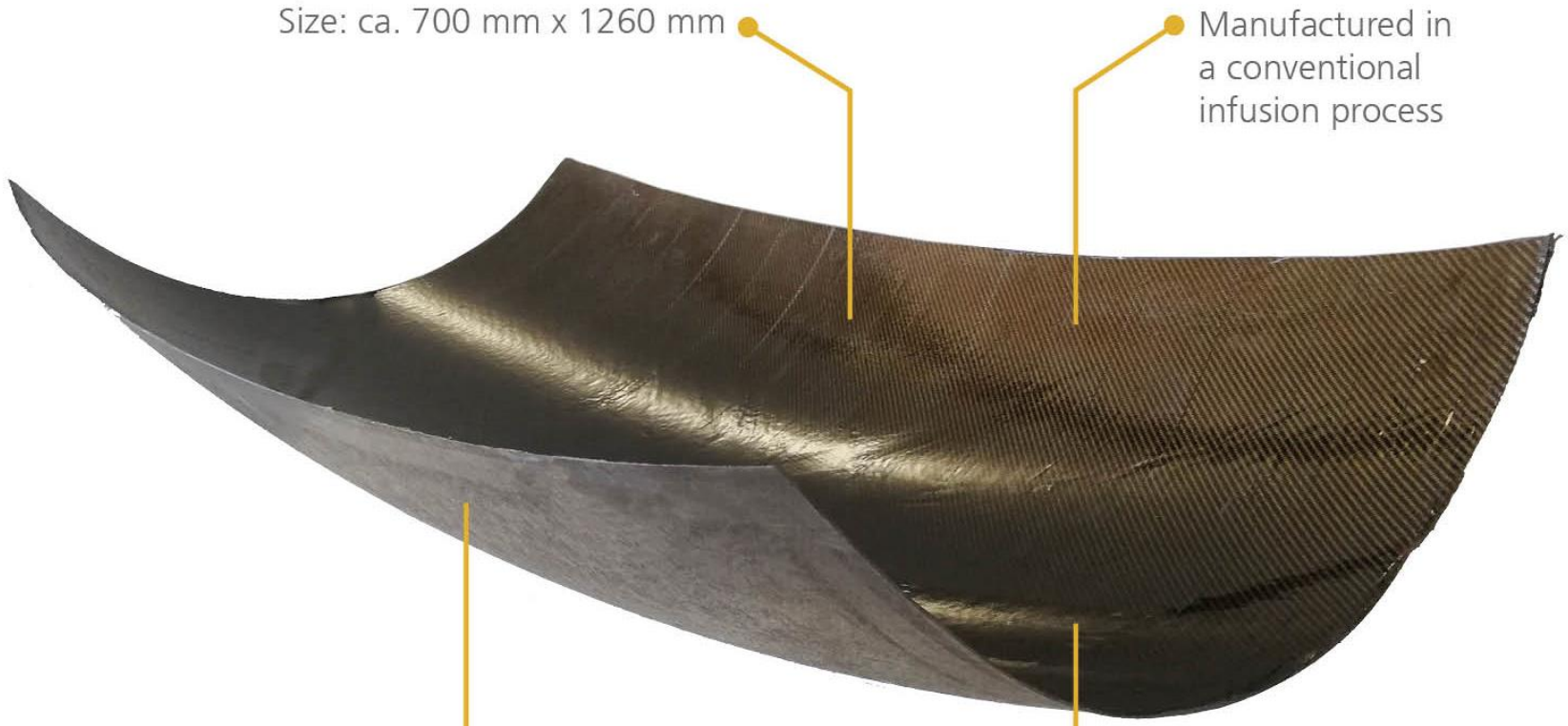
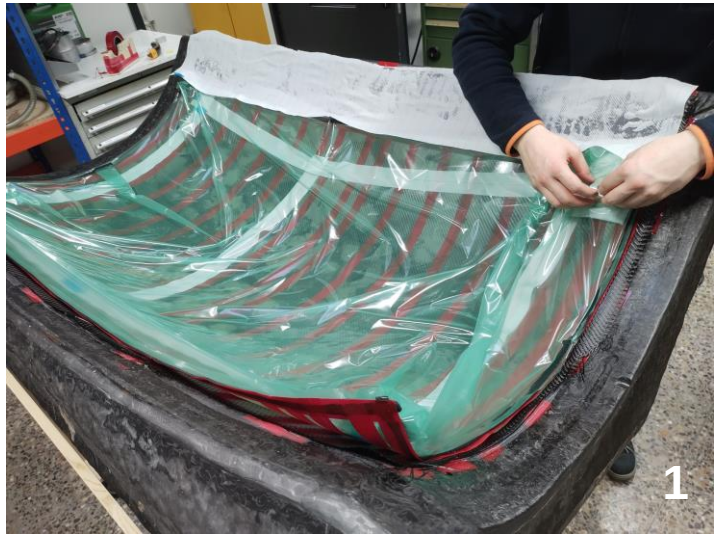
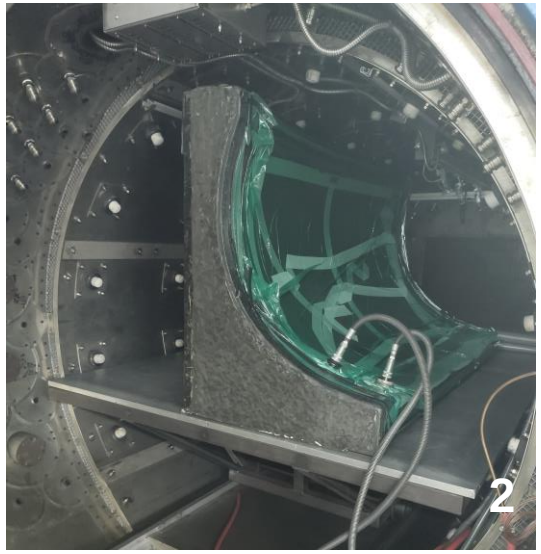
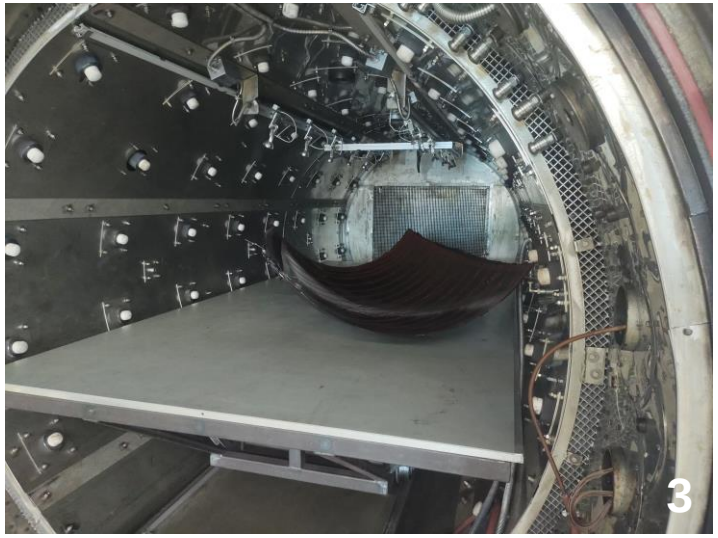
EmpowerAX Demo Part
Fertigung der mehrfach gekrümmten Basisstruktur by DLR

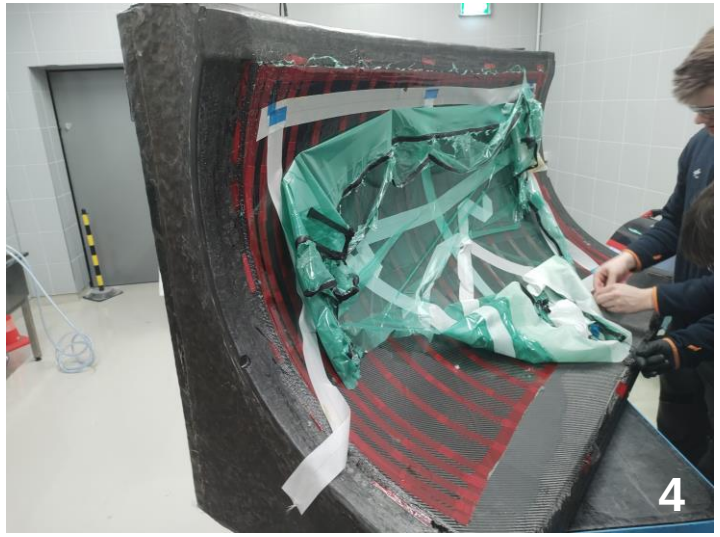


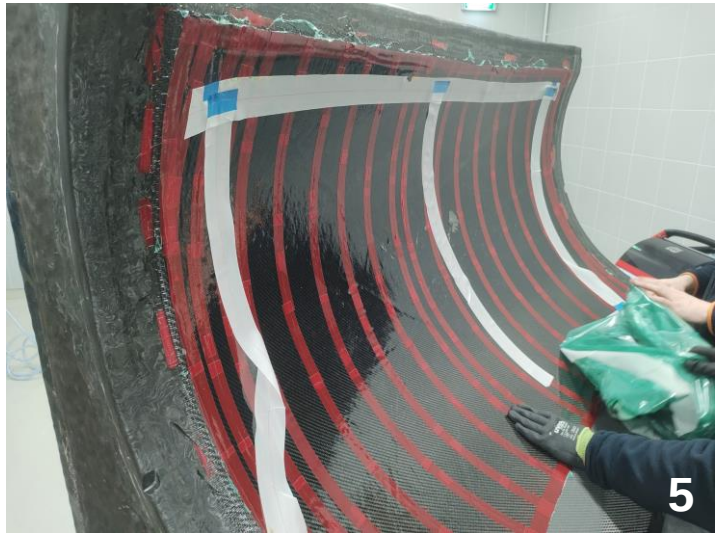
EmpowerAX Demo Part
Fertigung der mehrfach gekrümmten Basisstruktur by DLR

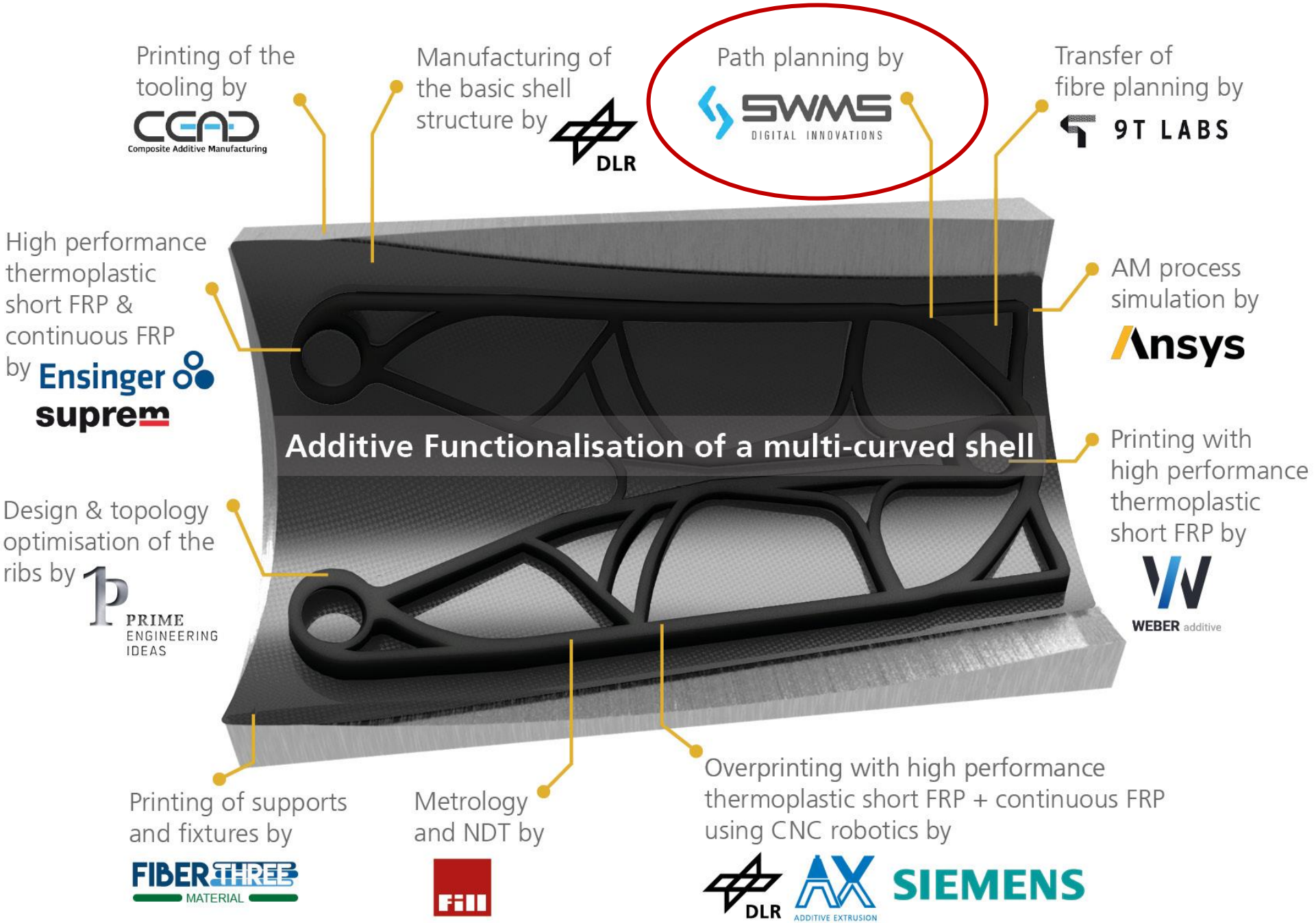








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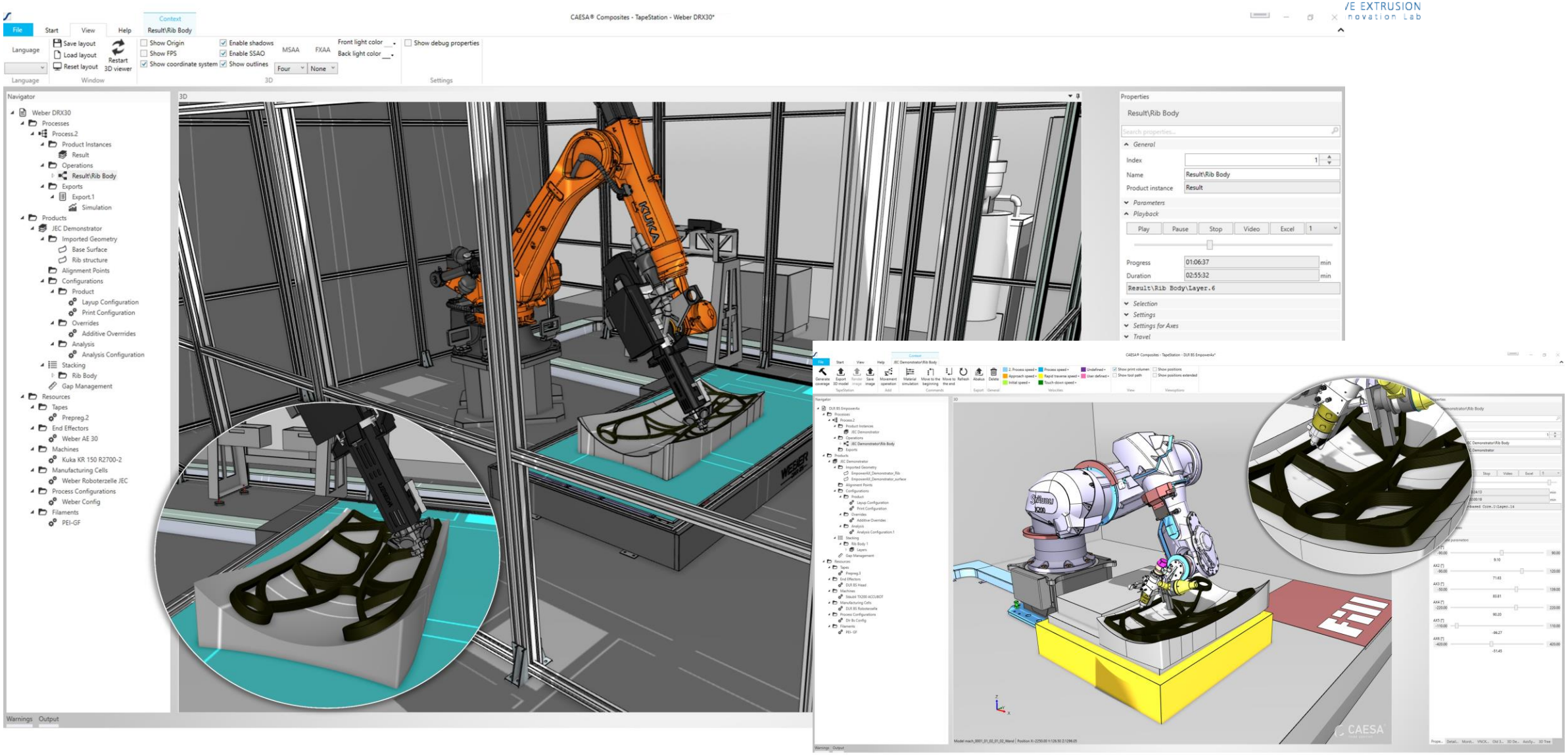
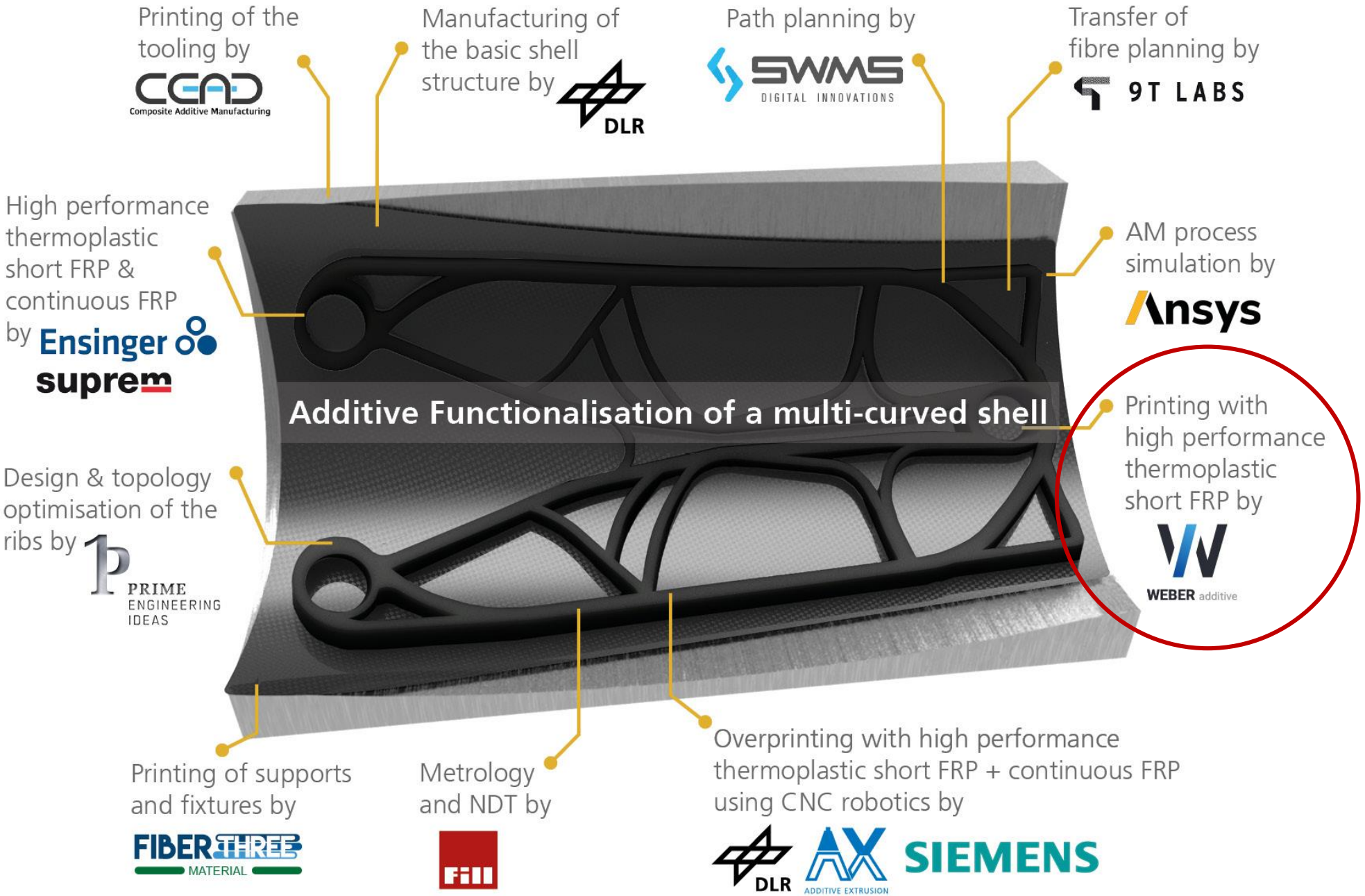
SIEMENS

EmpowerAX Demo Part
Pfadplanung für den robotischen 3D-Druck by SWMS

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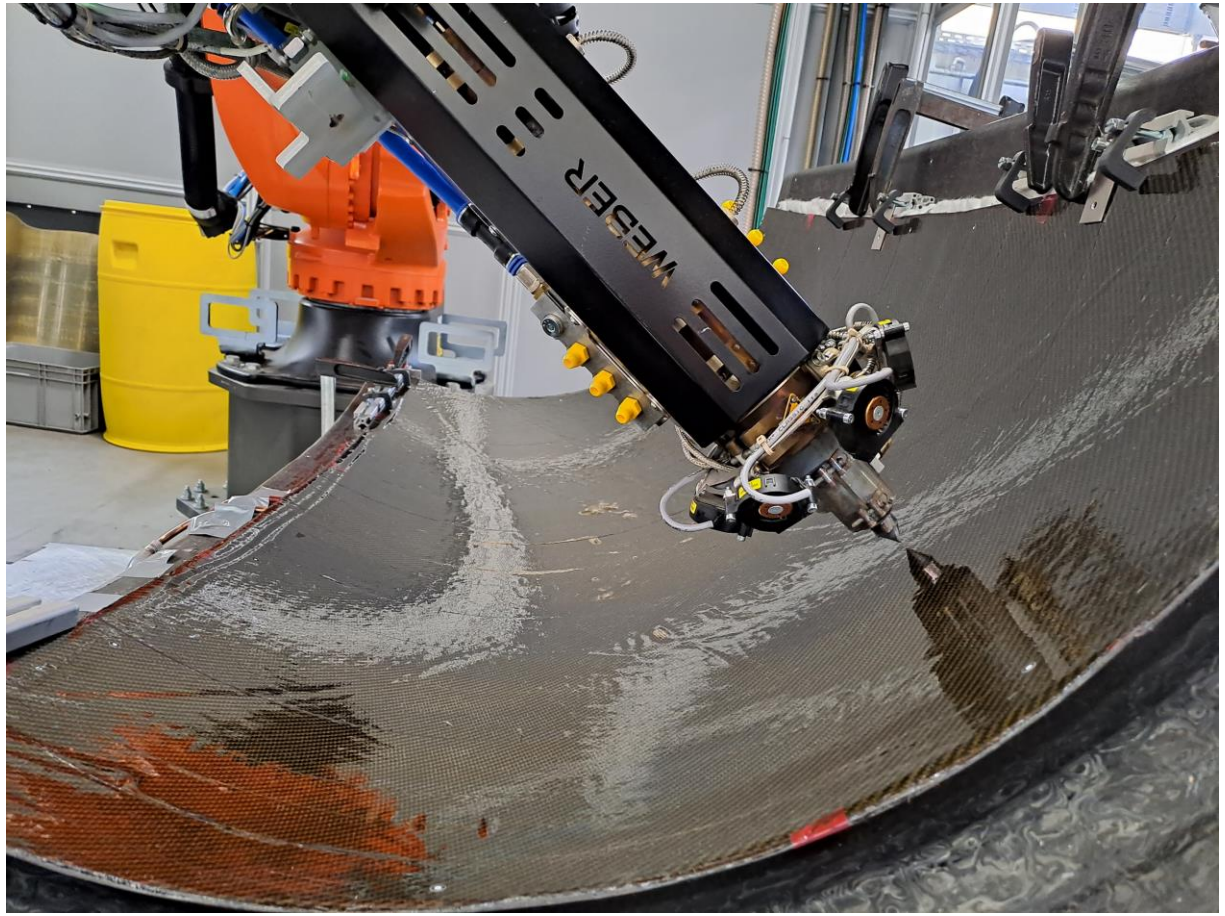
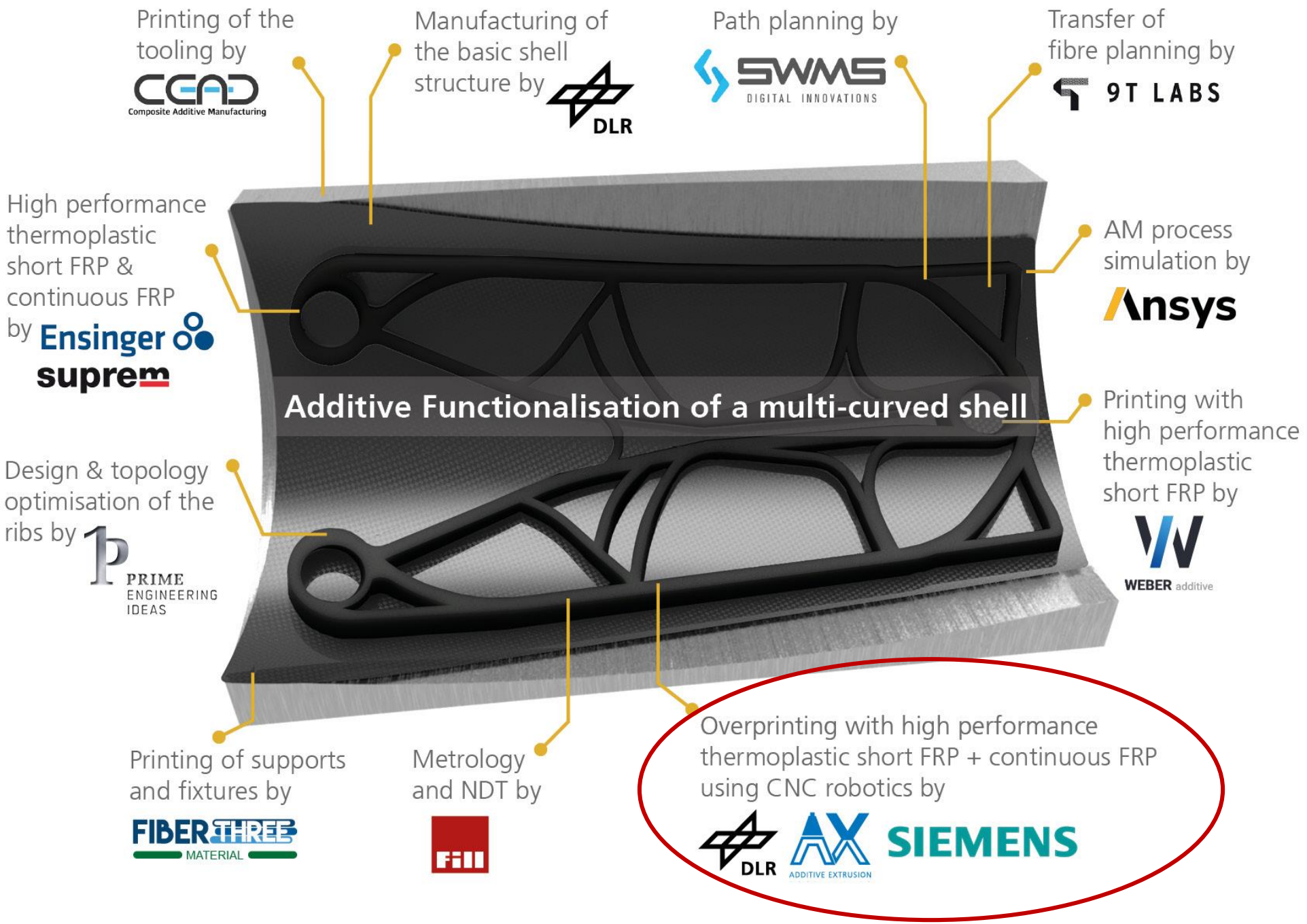
EmpowerAX Demo Part
Druck der Versteifungsrippen by WEBER



- Druck der Versteifungsrippen mit kurzfaserverstärktem PEI (Granulat)
- Funktionalisierte Oberfläche der Schale ermöglicht das direkte Aufdrucken
- Umsetzung des Drucks in Kollaboration mit DLR & SWMS bei WEBER vor Ort

EmpowerAX Demo Part
Druck der Versteifungsrippen by WEBER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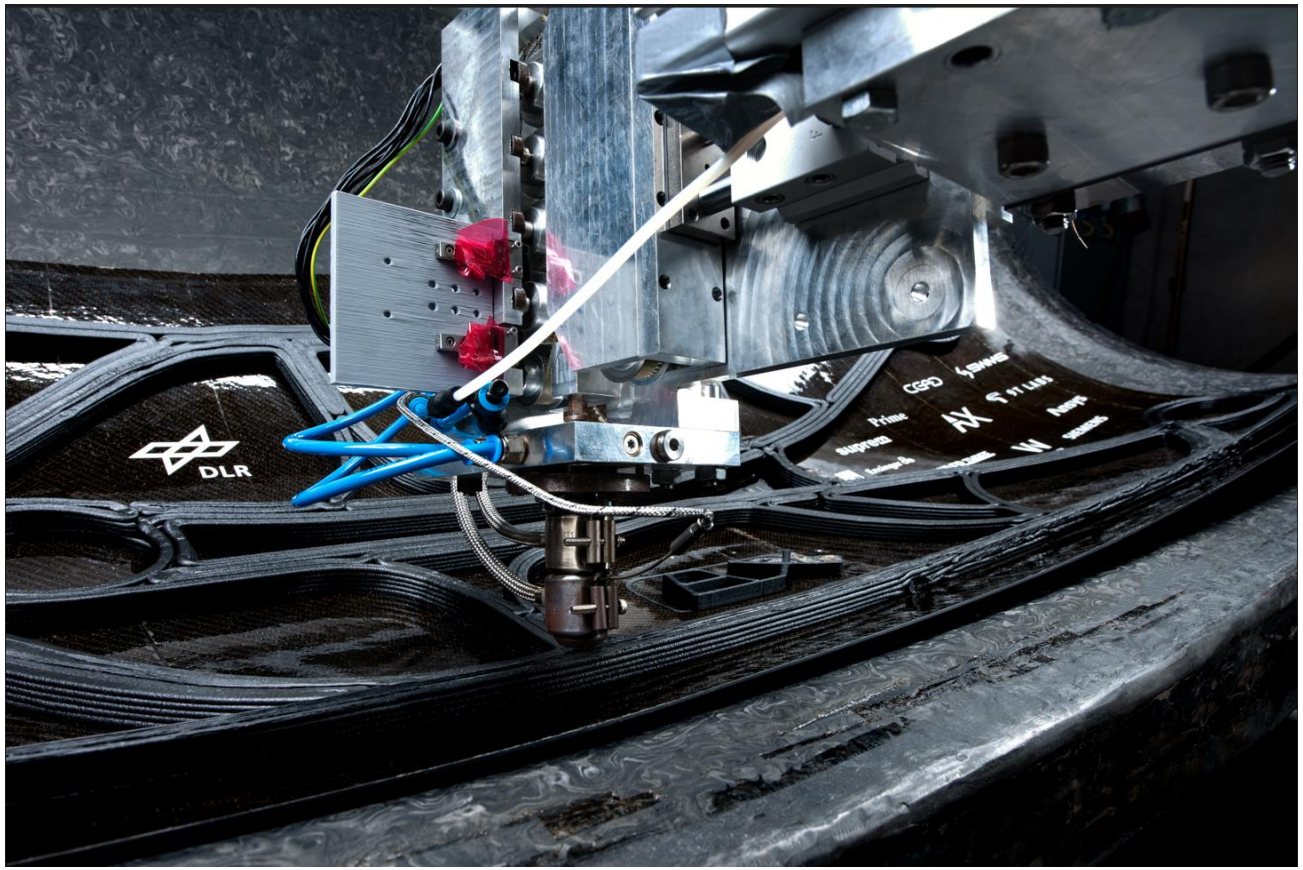
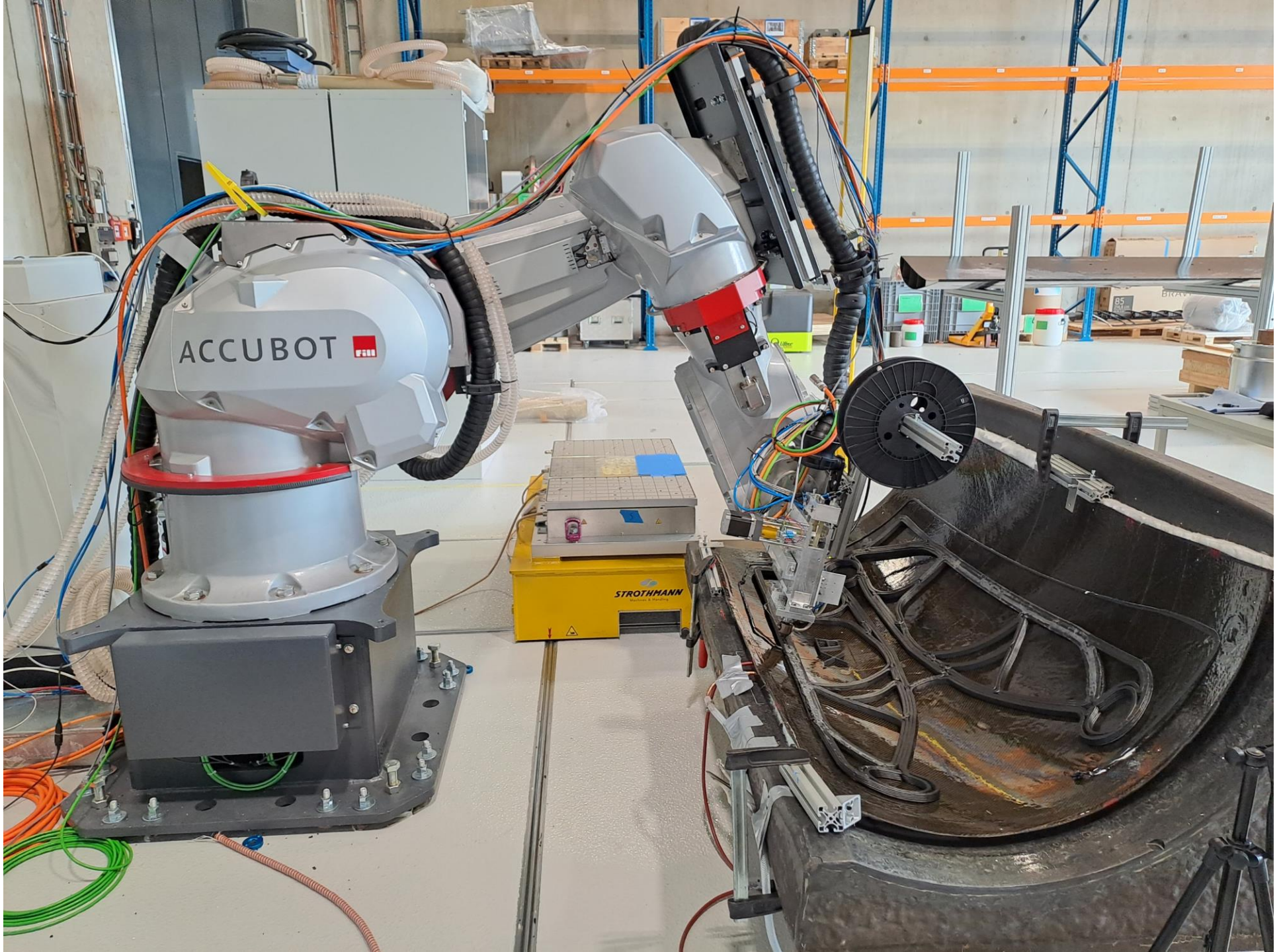
SIEMENS

EmpowerAX Demo Part
endlosfaserverstärktes Überdrucken by DLR



- DLR-Technologie ermöglicht direktes Überdrucken der duroplastische, mehrfach gekrümmte Schalen
- mit endlosfaserverstärktem Material
  - auf der Rippe: Suprem filaprem CFR PEEK Filament
- und kurzfaserverstärktem Material
  - AX-Logo: Ensinger TECACOMP PEEK-Granulat
- Einsatz eines CNC-Robotersystems mit selbstentwickelten Druckköpfen für die Granulat- und Filamentverarbeitung



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EmpowerAX Demo Part
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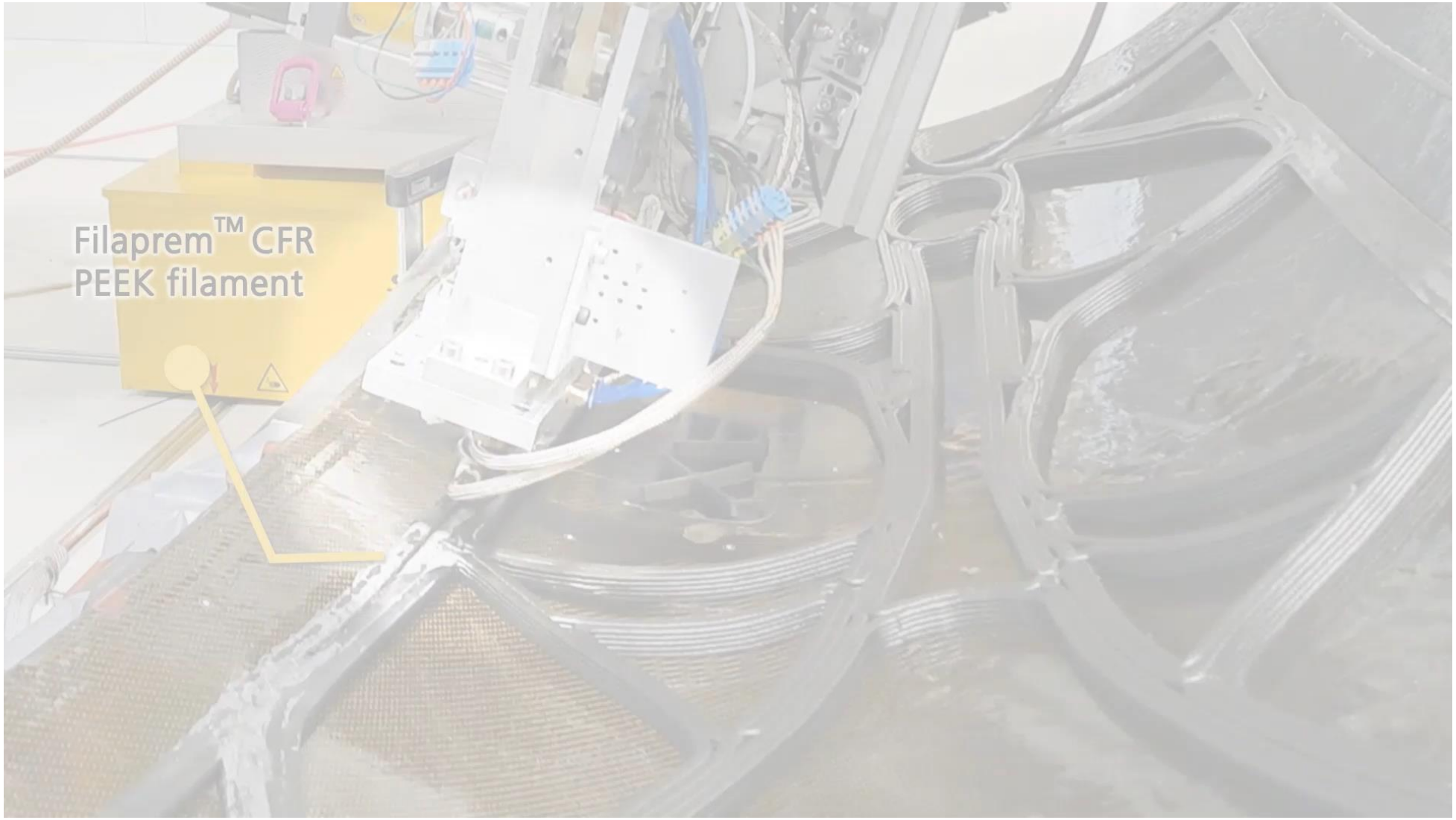

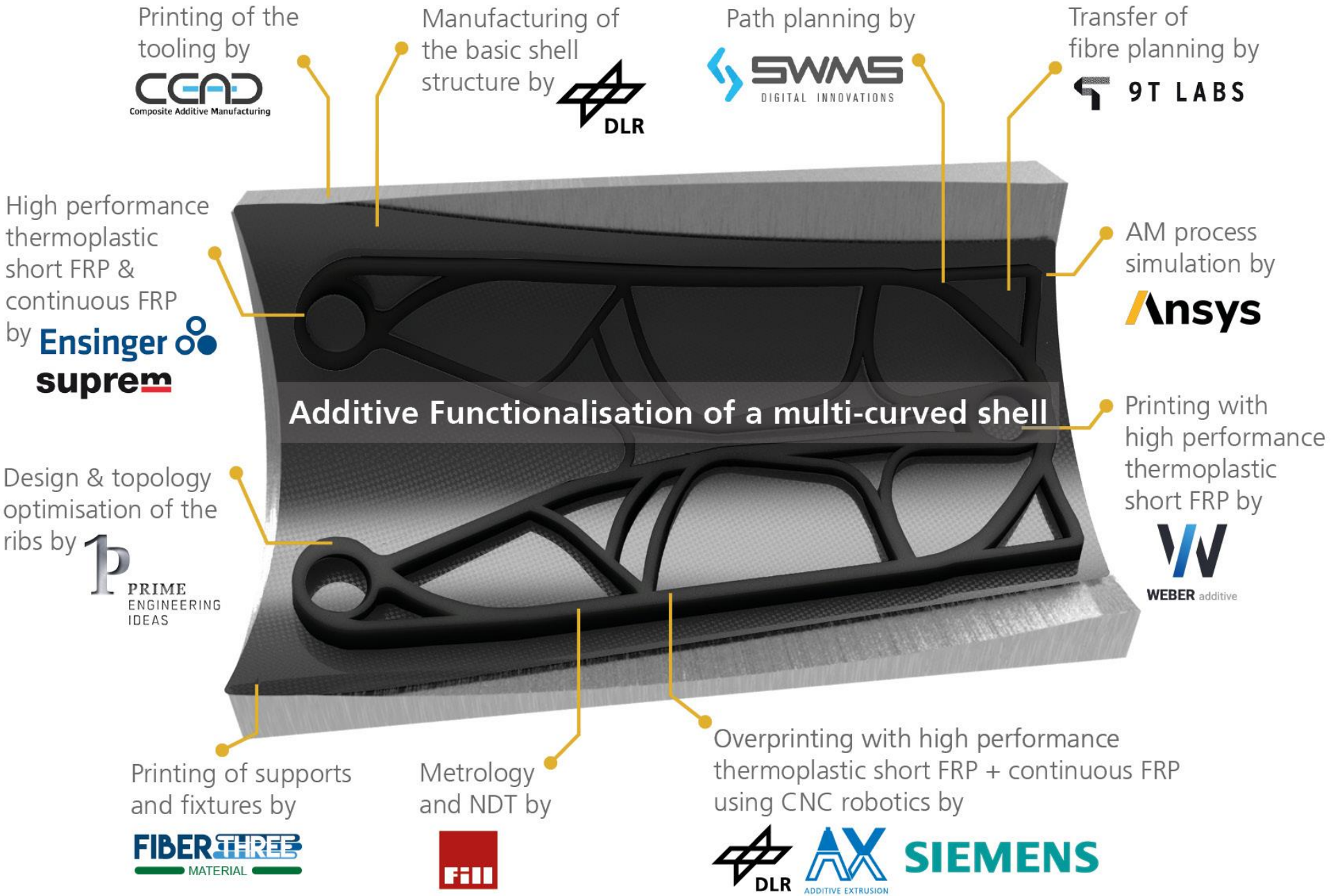
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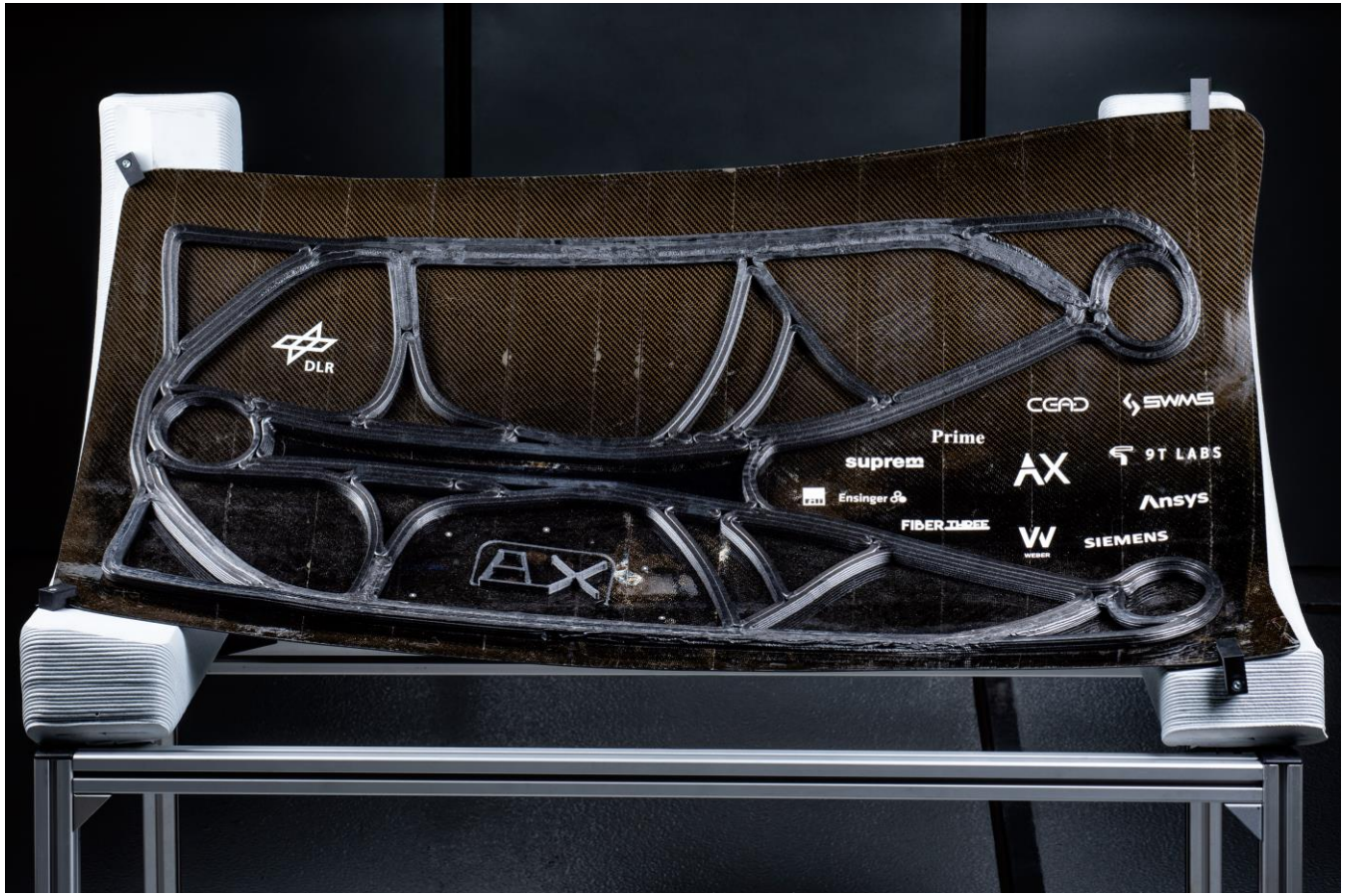
EmpowerAX Demo Part
Additive Funktionalisierung - Zusammenfassung



- Additive Funktionalisierung für die kosteneffiziente Fertigung von Kompositbauteilen
- Überdrucken einer mehrfach gekrümmten Schale mir kurz – und endlosfaserverstärkten Materialien
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EmpowerAX Demo Part
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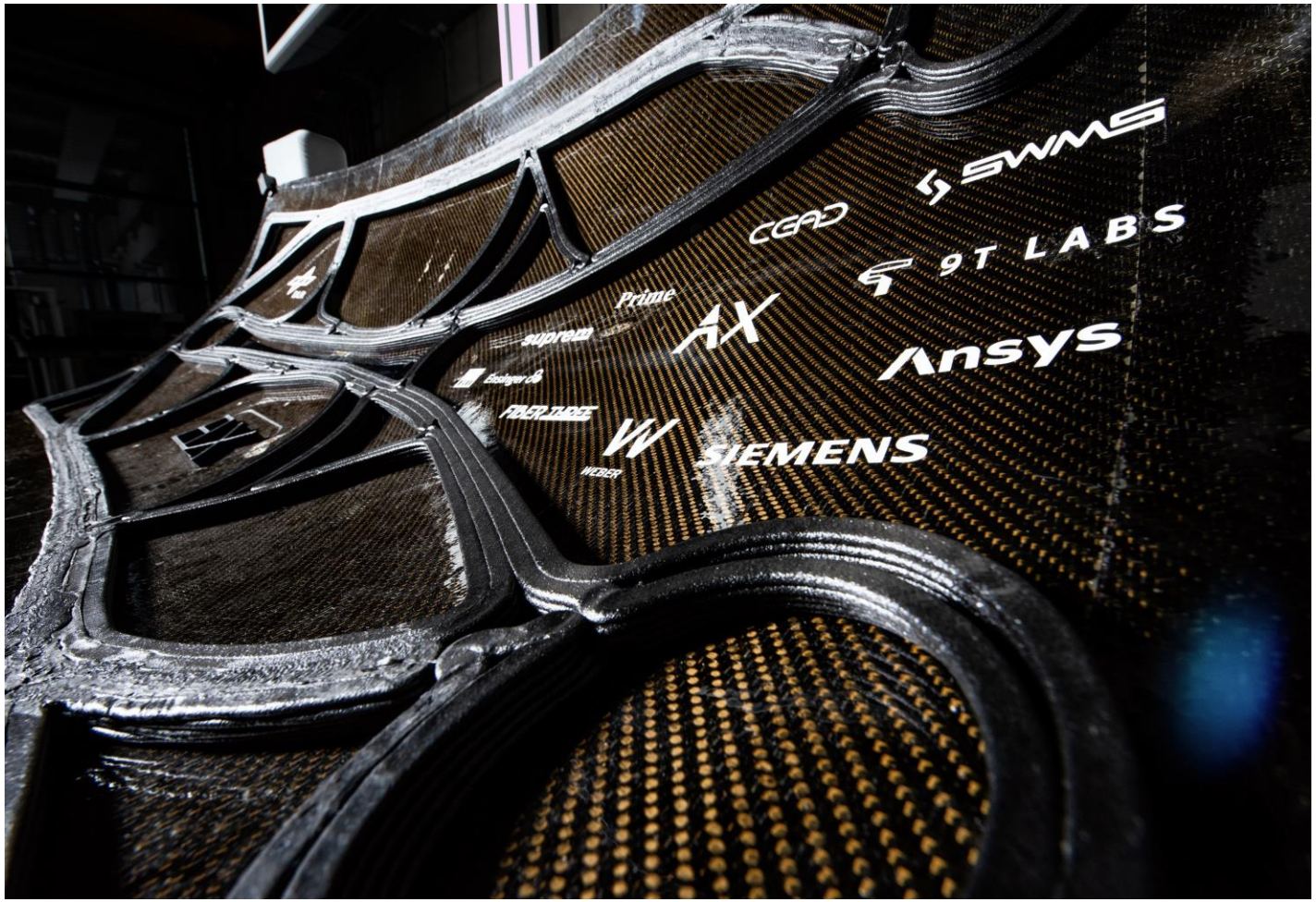
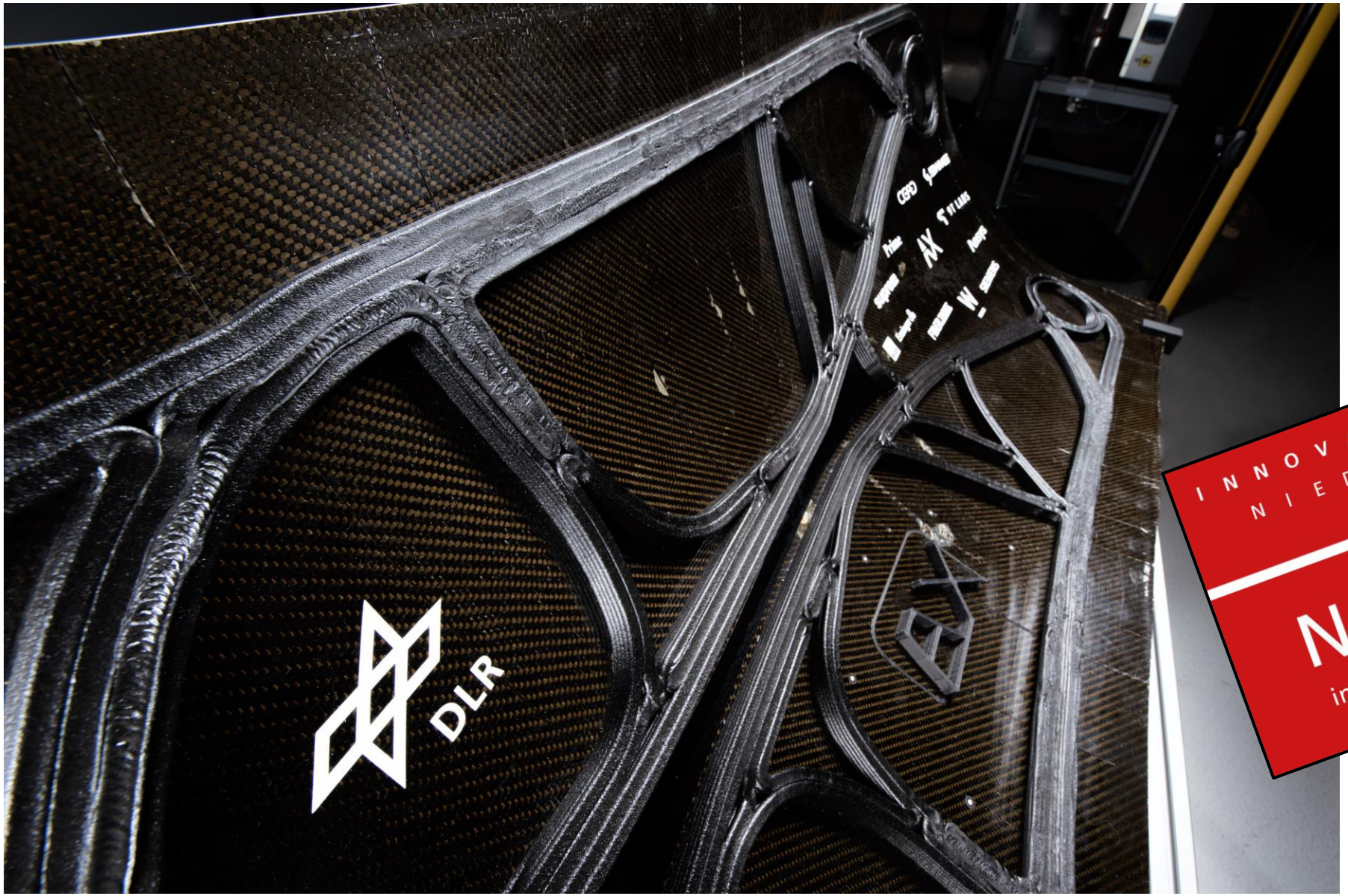


- Kombination der kosteneffizienten Herstellung der Grundstruktur mit der hoher Flexibilität und Designfreiheit der additiven Fertigung
- Paradigmenwechsel hin zu einem stärker integrierten Leichtbaukonzept

Additive Funktionalisierung – Wie geht’s weiter?



INNOVATIONSPREIS NIEDERSACHSEN 2023

Nominiert!

in der Kategorie „Kooperation“

Additive Funktionalisierung – Wie geht’s weiter?

Relevante Themen für den industriellen Einsatz

- **Fertigungsgerechtes Design**
  (Berücksichtigung von Fertigungsprozess und Maschinenrestriktionen)
- **Schnittstellendefinition**
  (Austauschformate, Genauigkeit bei Übertragung…)
- **Prozessüberwachung & Qualitätssicherung**

EmpowerAX Demo Part on Tour

EmpowerAX Science Day zum Thema

"faserverstärkter 3D-Druck in der Anwendung

Vorträge aus Wissenschaft und Industrie zu industriellen Anwendungsbereichen des faserverstärkten 3D-Drucks

EmpowerAX Demo Part on Tour

EmpowerAX Science Day zum Thema

"faserverstärkter 3D-Druck in der Anwendung

Vielen Dank für Ihre Aufmerksamkeit

Gibt es Fragen?