DIGITALISIERUNG DER ADDITIVEN PRODUKTION

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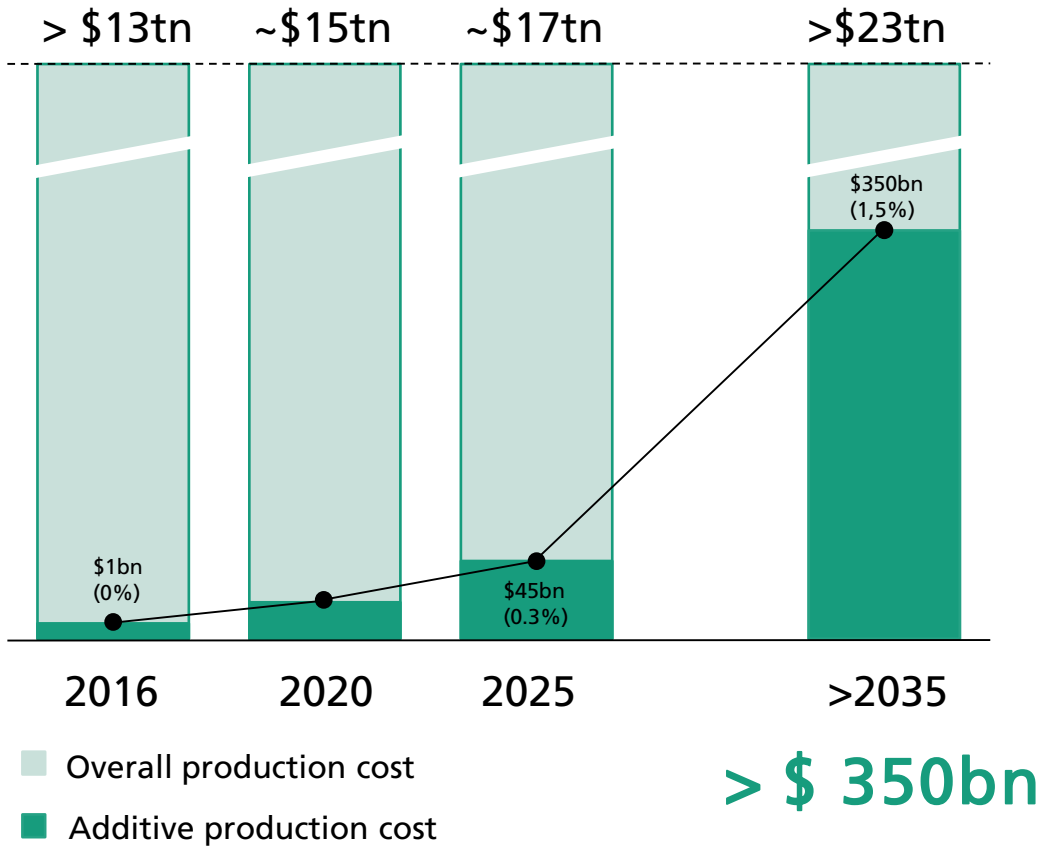
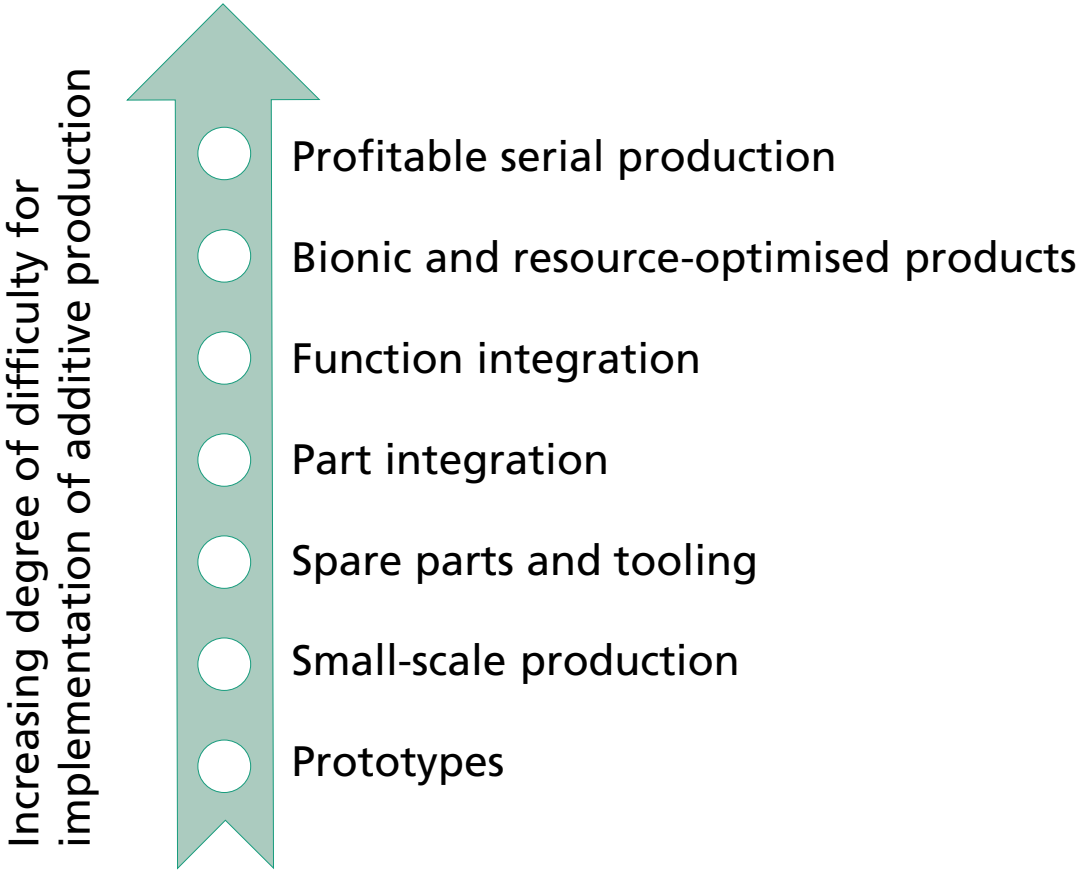
Long term growth of AM lies within production – which faces new challenges

Forecasted AM development for the entire addressable manufacturer's market



Markets



[Source: BCG Additive Manufacturing Report 2018]

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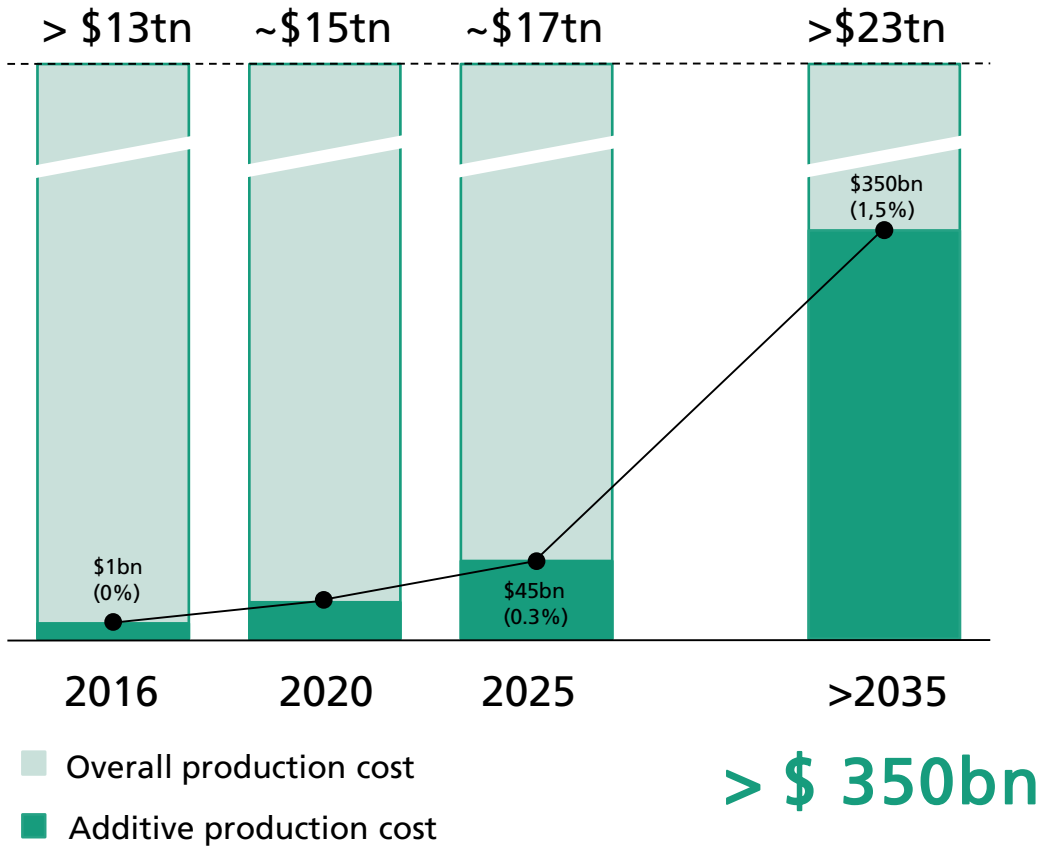
Long term growth of AM lies within production – which faces new challenges

Forecasted AM development for the entire addressable manufacturer's market



Key Success Factors for Serial Additive Production

- lowering costs of AM (by factor 10x)
- fully automate production
- robust processes with streamlined quality assurance

[Source: BCG Additive Manufacturing Report 2018]

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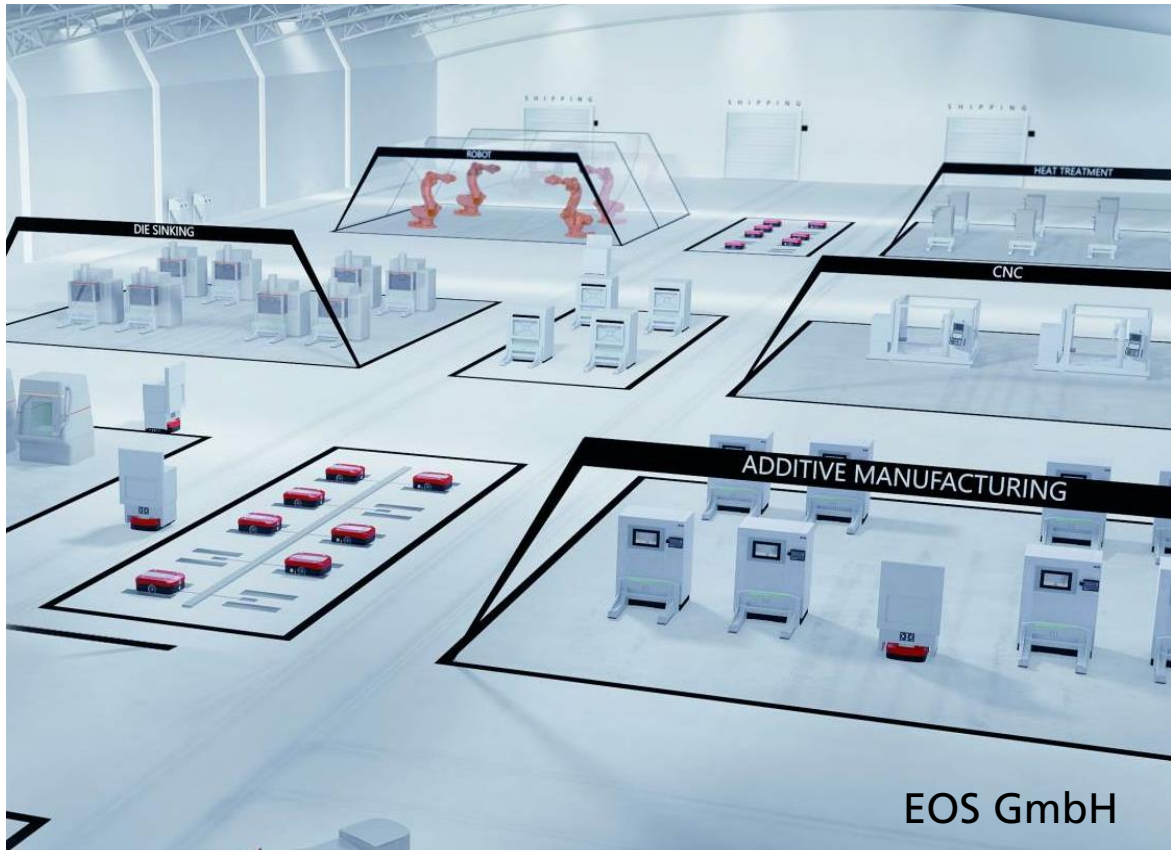
Vision of AM vs. Reality

Vision



Reality



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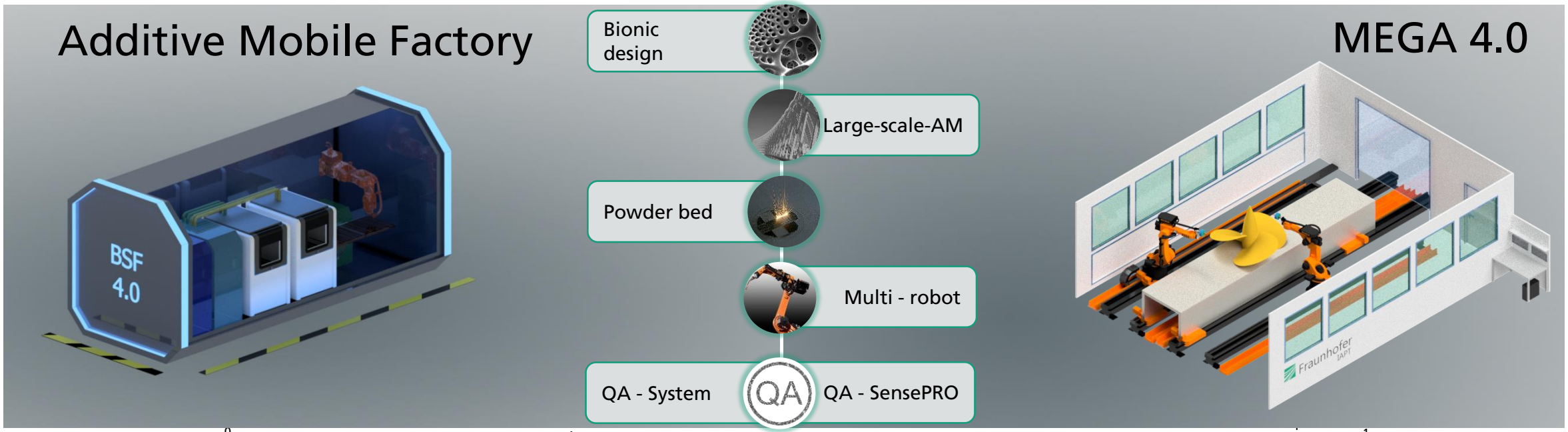
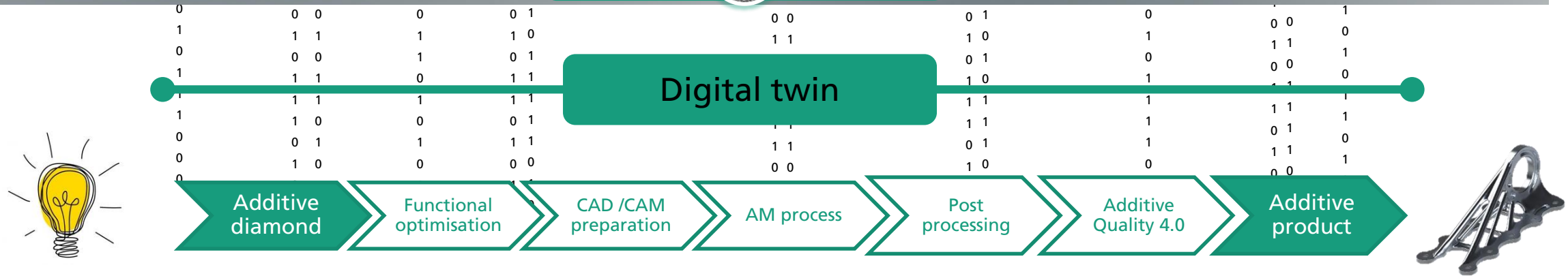
Challenge for additive production: Highly automated productivity





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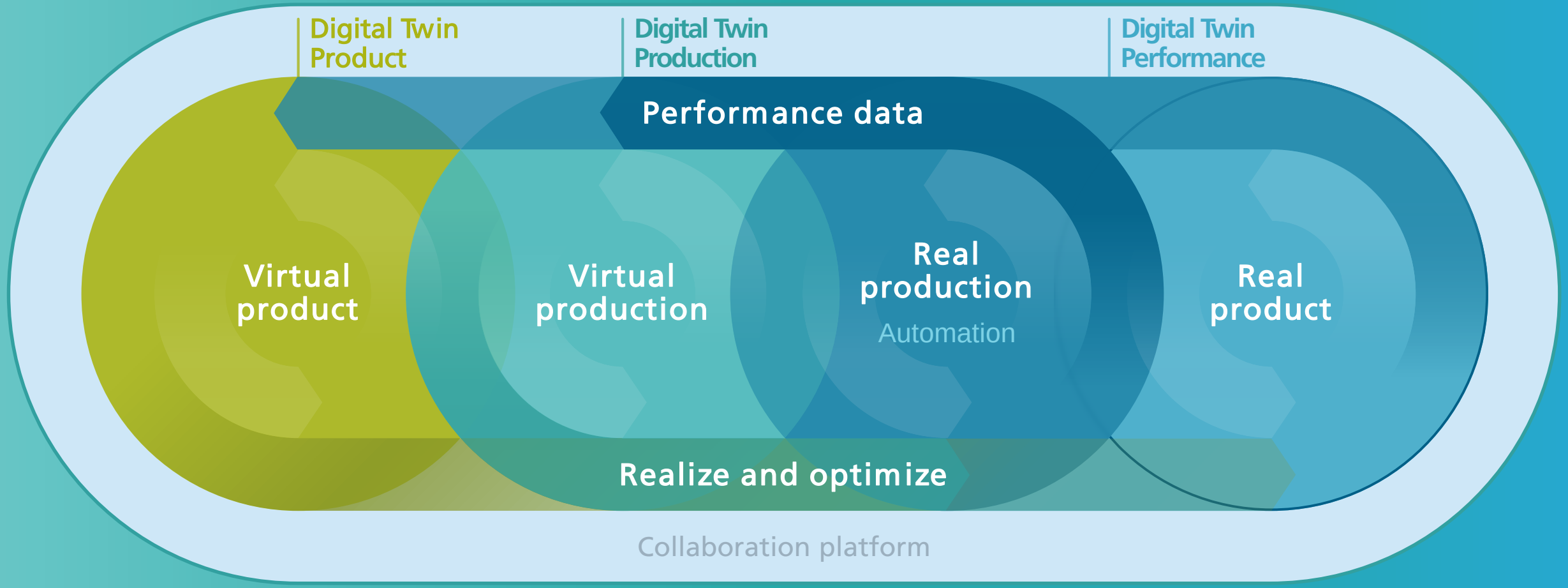
THE DIGITAL ENTERPRISE



FOR ADDITIVE MANUFACTURING

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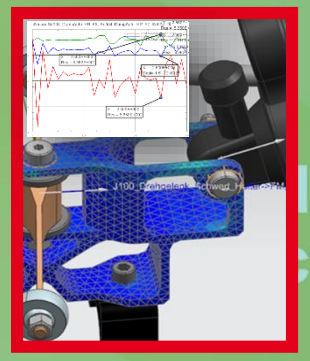
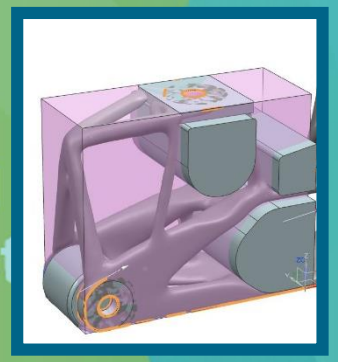
NX – One integrated Additive Manufacturing Solution
From requirement driven Generative Design to 3D Printing

1 - Product design

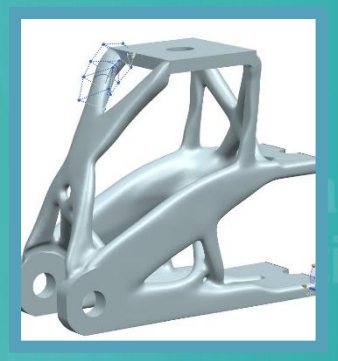
2 - Production planning



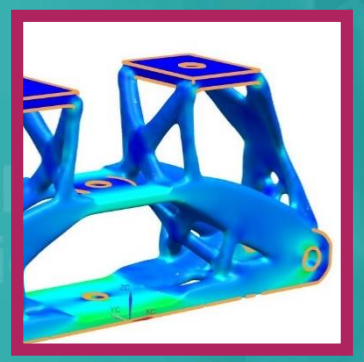
Requirements



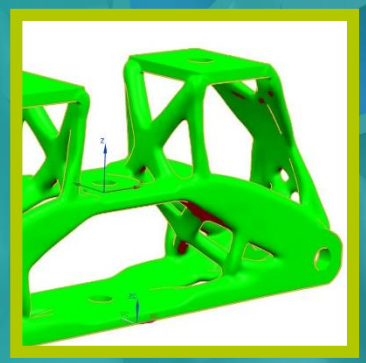
Generative Design



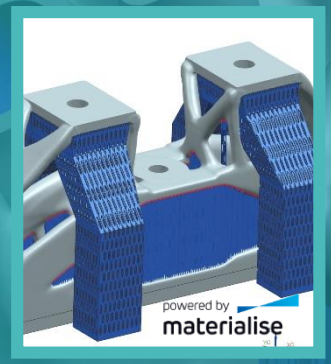
Adaption



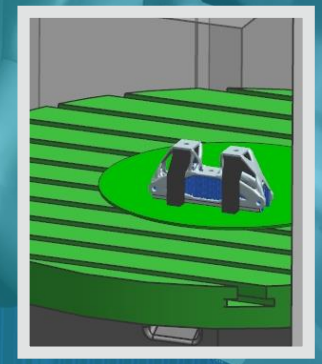
Performance Validation



Manufacturing Validation



Pre-Processing & 3D Printing



Part Finishing & Quality

Data and Process Management

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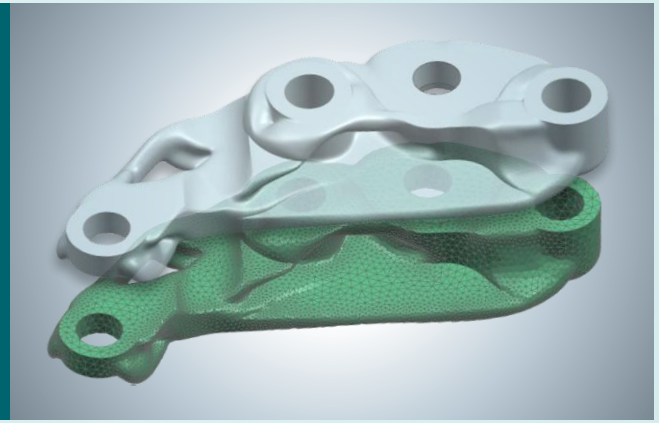
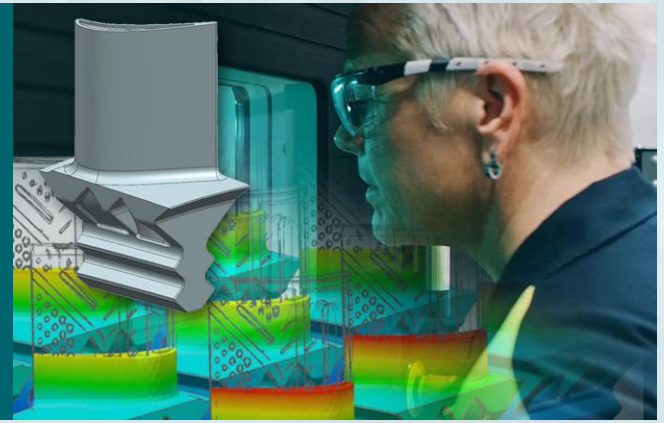
Generative Design for AM

Automate the optimization of part and system topology based on multiple objectives and disciplines.

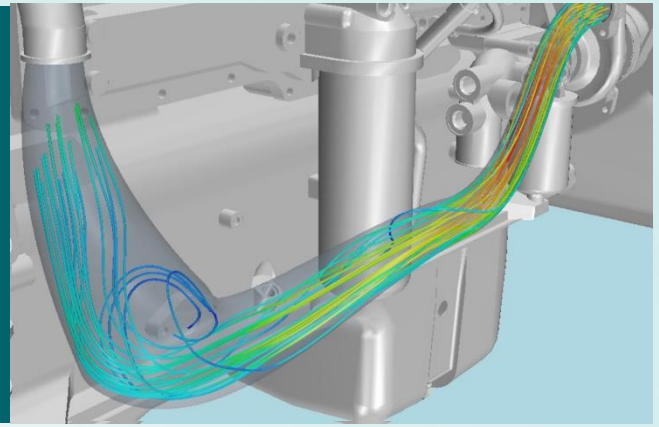
Make convergent pervasive across workflow (no STL!)



Create AM designs with geometry the target machine can print



Leverage HEEDS automated design exploration



Generative + HEEDS optimizer for “intelligent advisors”



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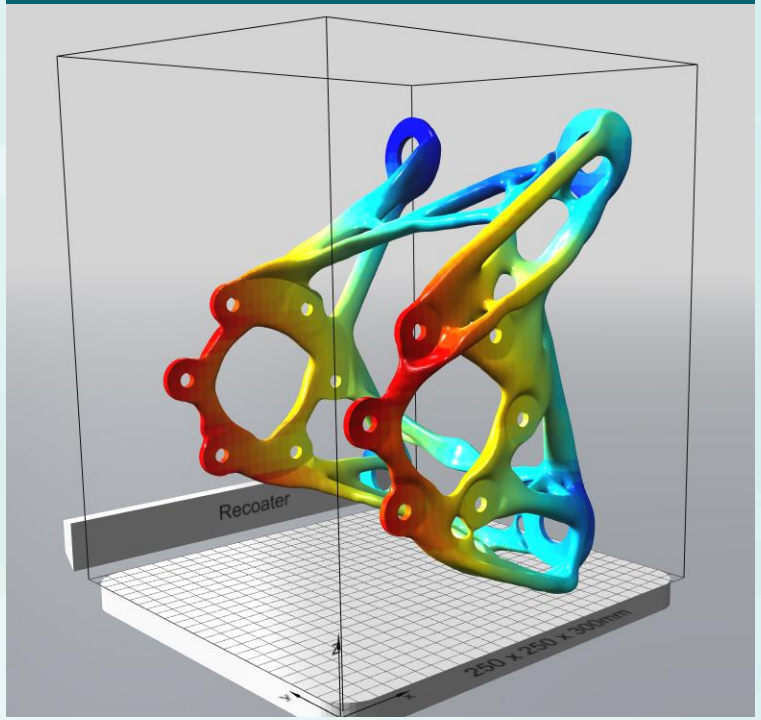
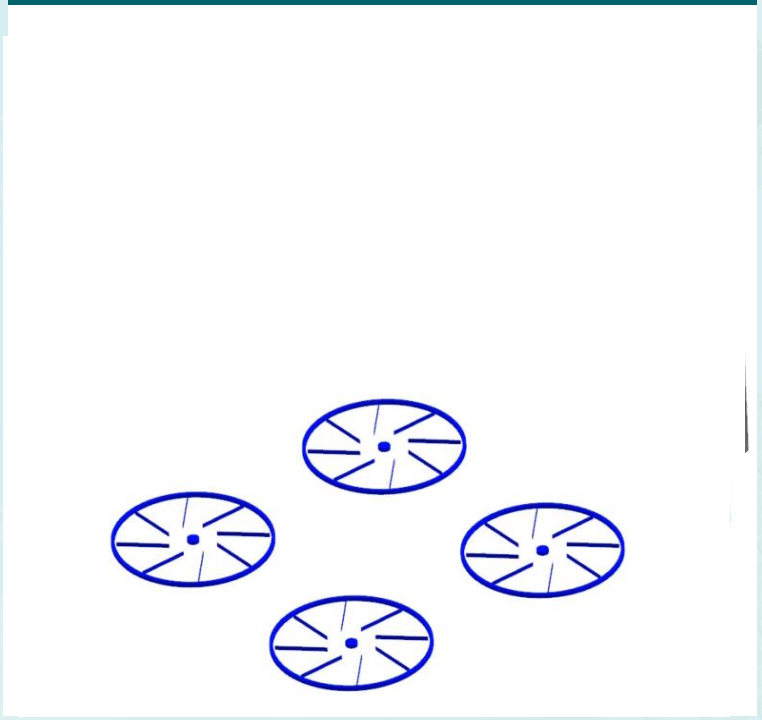
Build/Process Optimization

Use simulation to eliminate print errors in all phases of the workflow, from design, through engineering and production

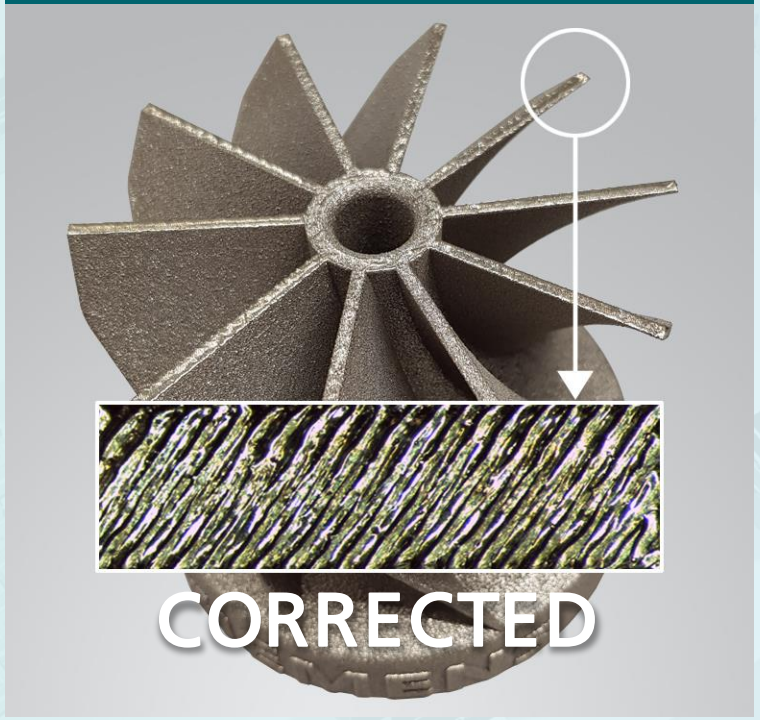
Design optimal orientation and support structures



Predict distortion, generate compensated model



Optimize toolpath to eliminate localized defects



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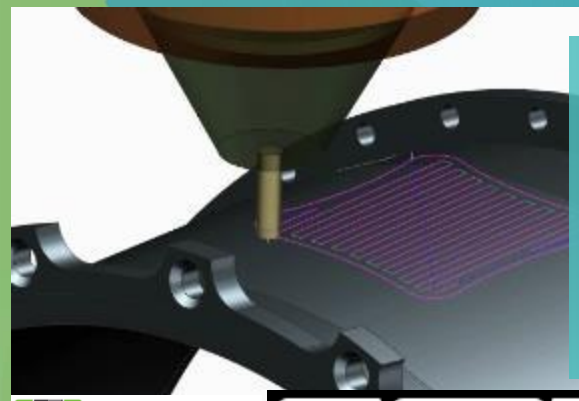
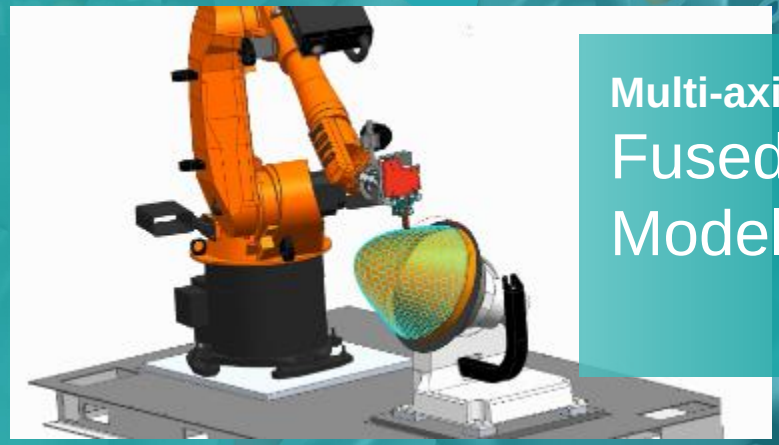
Industrialization of Additive Manufacturing
Supported Technologies



Hybrid additive
Directed Energy Deposition

BeAM an AddUp company · GEFERTEC · DMG MORI



Multi-axis
Fused Deposition Modeling



Powder bed fusion
Laser Material Fusion

SLM Solutions GmbH · CONCEPT LASER · RENISHAW apply innovation · ARCAM AB CAD TO METAL · Additive Industries · TRUMPF · eos



Multi jet fusion
Agent jetting/ inkjet technology

hp

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Applications / Automotive

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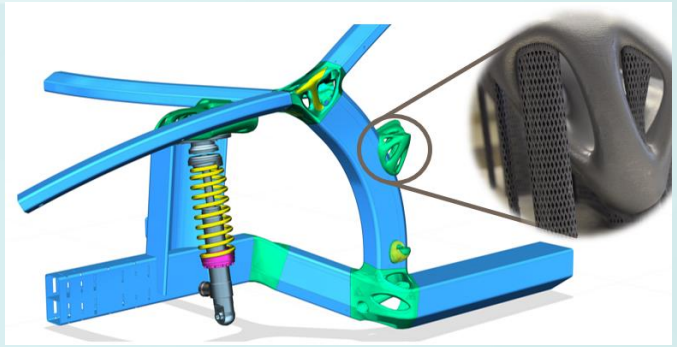
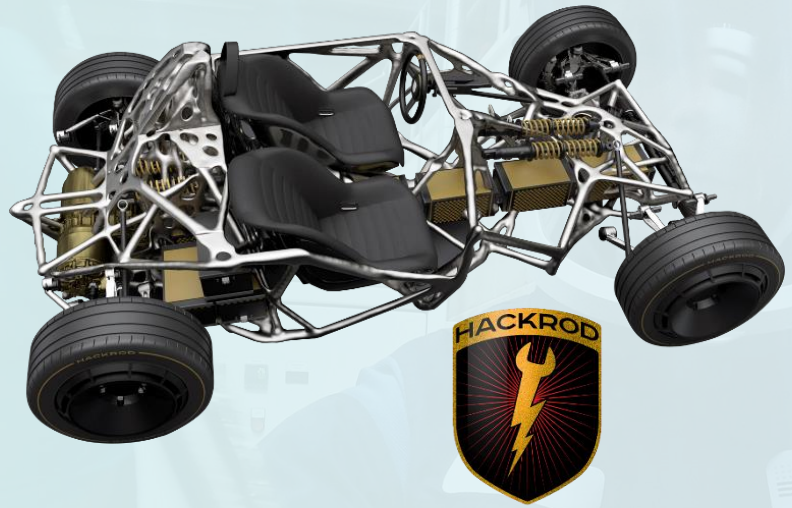




EDAG



BUGATTI

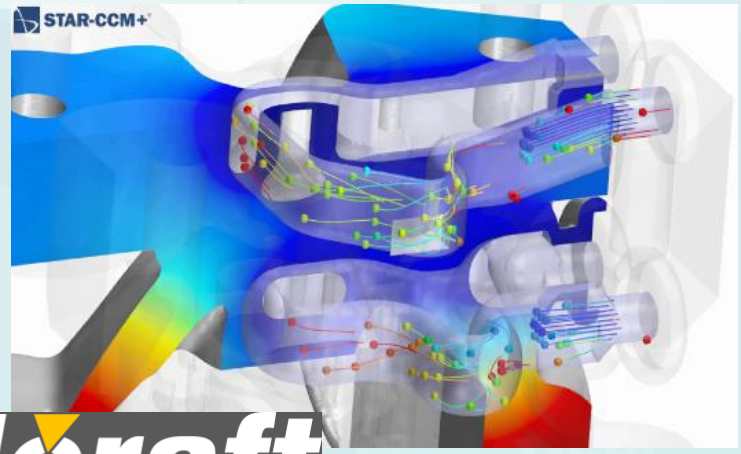




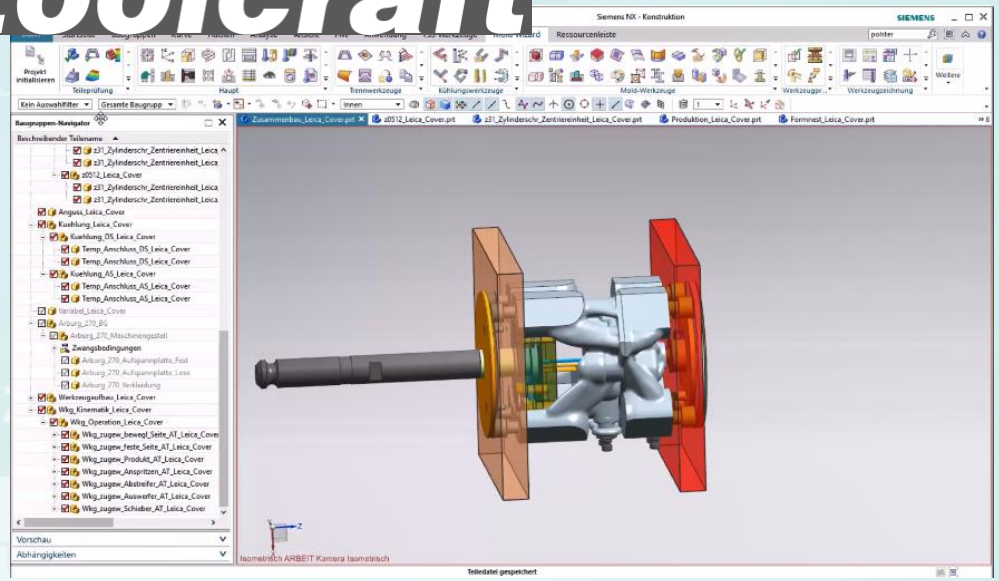
BMW/Formnext

Applications / Machinery

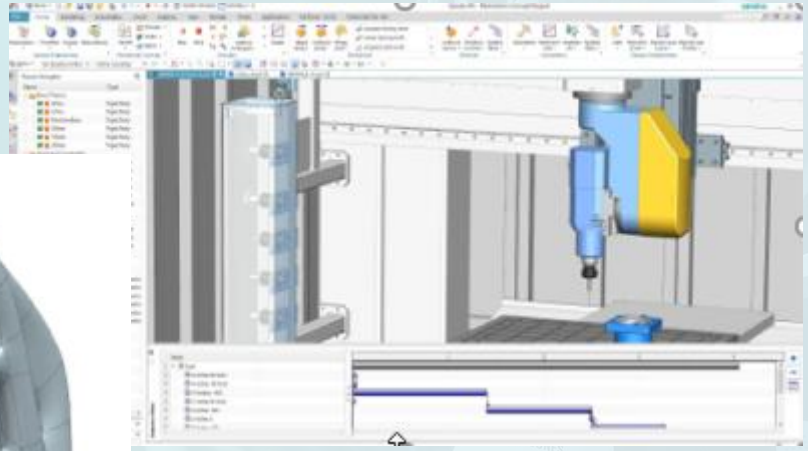
Injection mould

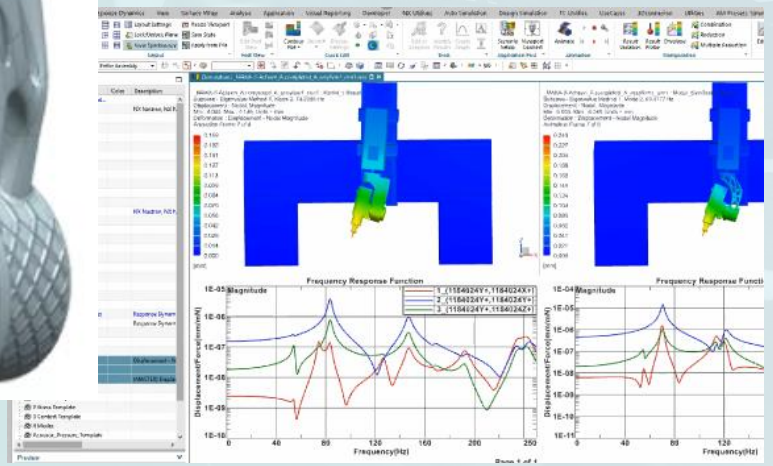


toolcraft





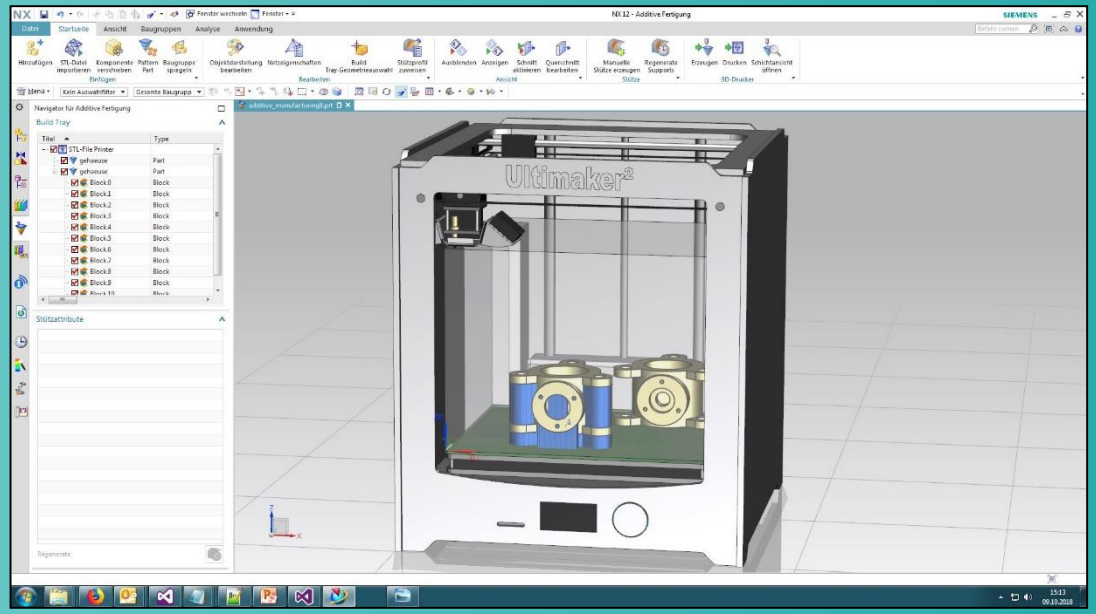




Optimised Spindle holder

CURA Integration in NX

- Build-Processor for nearly all smaller FDM printer
- Free Download and can be used commercially
- Completely integrated in NX!

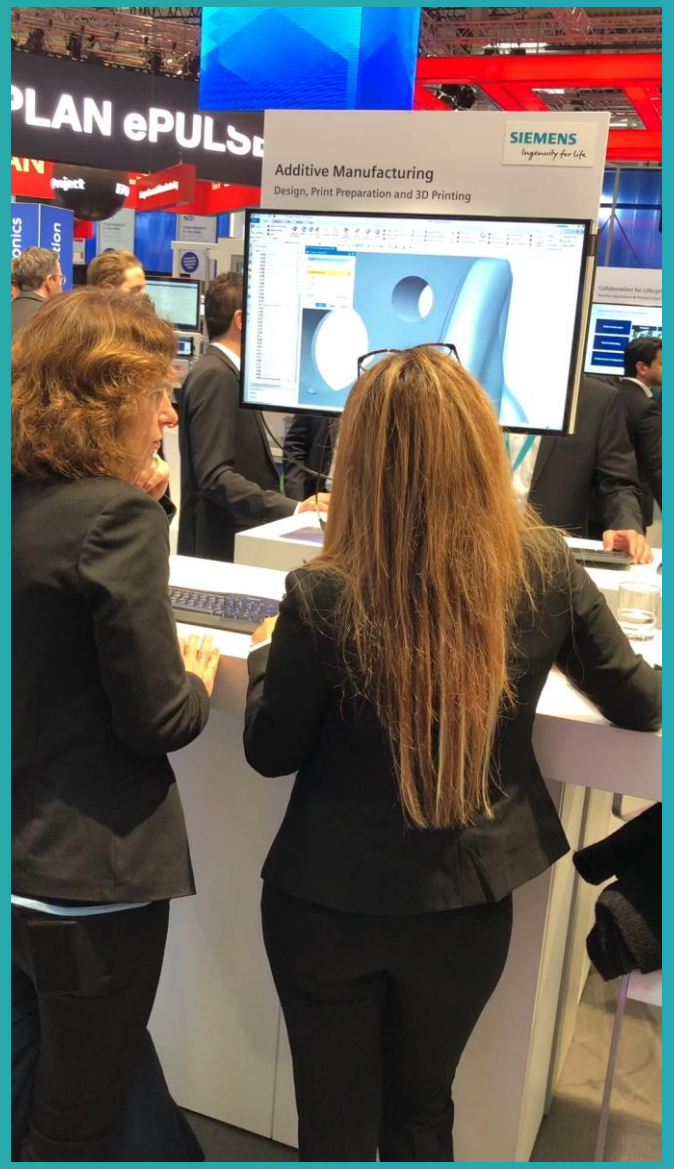


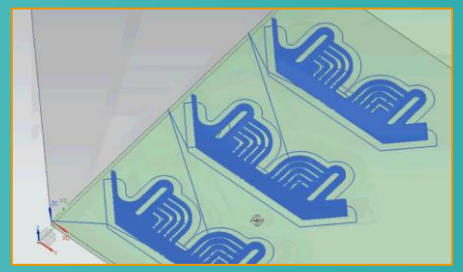
BENGCON solutions for education

didacta die Bildungsmesse Köln, 19.–23. Februar 2019

HANNOVER MESSE

PLM Benutzergruppe e.V.





All Ultimaker printers
101Hero
3DMaker Starter
3Dator
ABAX PRi3
ABAX PRi5
ABAX Titan
ALYA
AXPRO D7 series
BFB
BlackBelt
BQ Hephestos 2
BQ Prusa i3 Hephestos
BQ Prusa i3 Hephestos XL
BQ Witbox
BQ Witbox 2
Builder Premium Large
Builder Premium Medium
Builder Premium Small
Cartesio
Creality CR-10
Creality CR-10 S4
Creality CR-10 S5
Dagoma DiscoEasy200
Delta Go
DeltaBot
Deltacomb 3D
EastArts Ares
FABtotum Personal Fabricator
Folger Tech FT-5
German RepRap Neo
Hello BEE Prusa
IMADE3D JellyBOX
Innovo INVENTOR
Julia
Kemiq Q2 Beta
Kemiq Q2 Gama
Kossel Mini
Kossel Pro
Kupido
MAKEiT Pro-L
MakeiT Pro-M
MakerBotReplicator
Malyan M180
Mankati Fullscale XT Plus
Mendel90
Peopoly Moai
Printrbot Play
Printrbot Play (Heated Bed)
Printrbot Simple
Printrbot Simple Metal Extended
Prusa i3
Prusa i3 Mk2
Prusa i3 XL
Punchtec Connect XL
Raise3D N2 Dual
Raise3D N2 Plus Dual
Raise3D N2 Plus Single
Raise3D N2 Single
Renkforce RF100
Rigid3D
Rigid3D 3rdGen
Rigid3D Hobby
Rigid3D Zero
Rigid3D Zero2
RigidBot
RigidBotBig
RoVa3D
Robo 3D R1
Tevo Tarantula
Type A Machines Series 1 2014
Vertex Delta K8800
Vertex K8400
Vertex K8400 Dual
Zone3d Printer
makeR Pegasus
makeR Prusa Tairona i3

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Production Orchestration

Plan, execute and monitor AM production with full operational visibility to ensure optimal quality and efficiency.

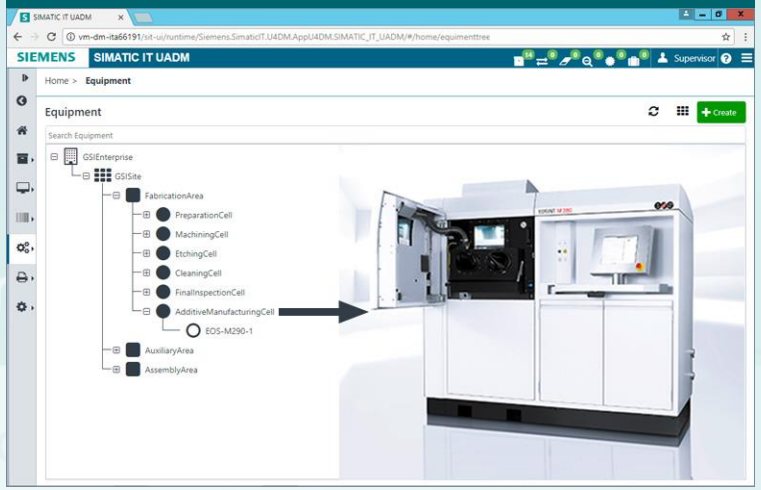
3D printer → Substrate → Powder → Print File → Process

AM configuration steps

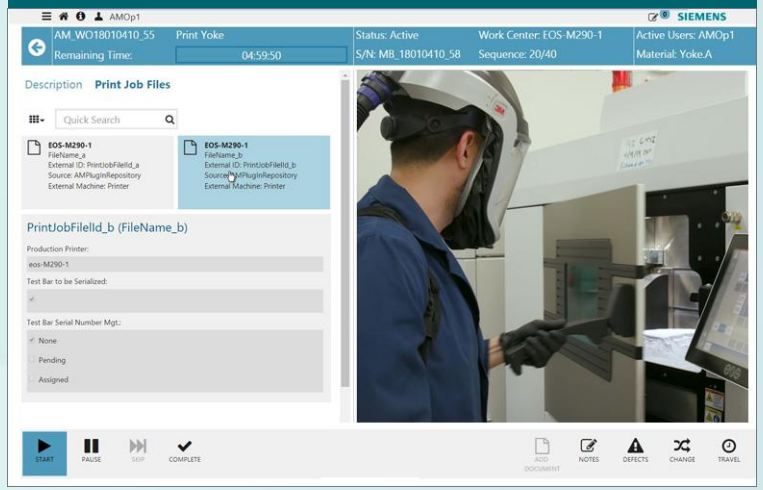
AM collateral processes

Work Order Execution → Powder Recycling → Powder Mixing → Powder Genealogy → Substrate Maintenance

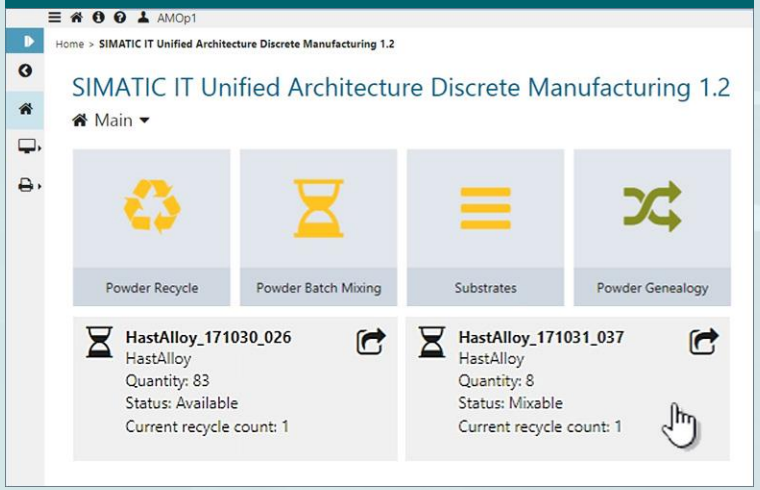
From configuring for AM…



To executing the work order…



To doing collateral processes



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Intelligent Automation

Realize volume production by automating and digitalizing your additive manufacturing operations.

Automating AM machines



Automating AM processes



Automating AM factories



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DiAMPro - Digital, automized and self-optimizing AM process chain

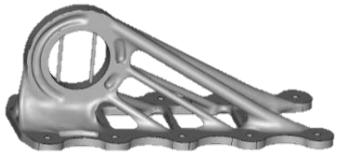


Digital twin

Additive diamond → Functional optimisation → CAD /CAM preparation → AM process → Post processing → Additive Quality 4.0 → Additive product



Printable Part → Orientation → Restrictions → Implementation



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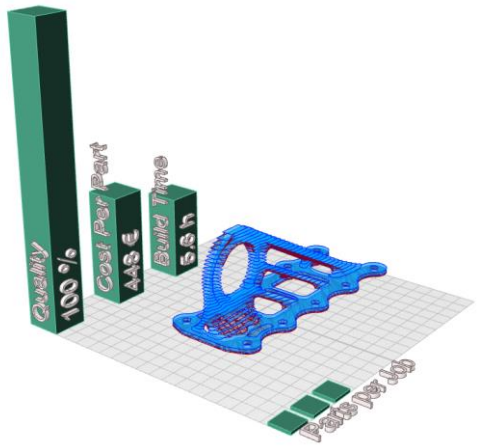
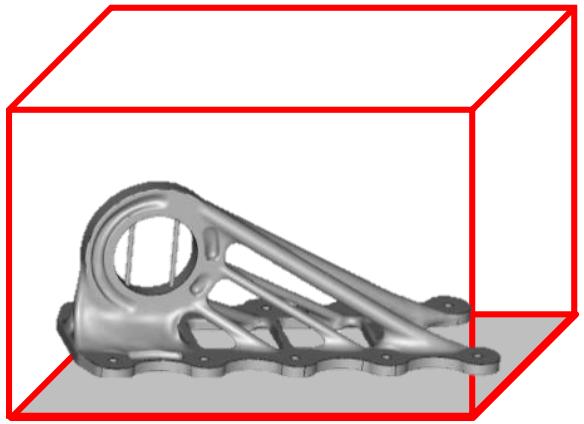
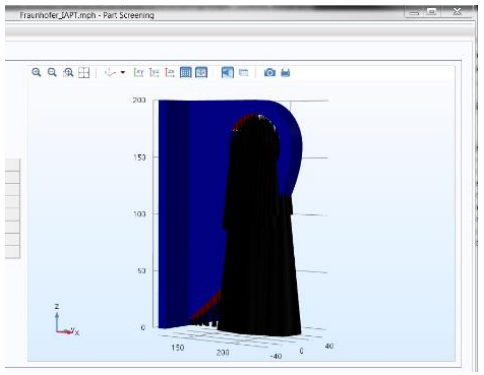
solid
facet normal 1.000000 0.000000 0.000000
outer loop
vertex 15.00000000 10.00000000 0.00000000
vertex 15.00000000 10.00000000 2.50000000
vertex 15.00000000 0.00000000 0.00000000
endloop
endfacet
```







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DiAMPro - Digital, automized and self-optimizing AM process chain



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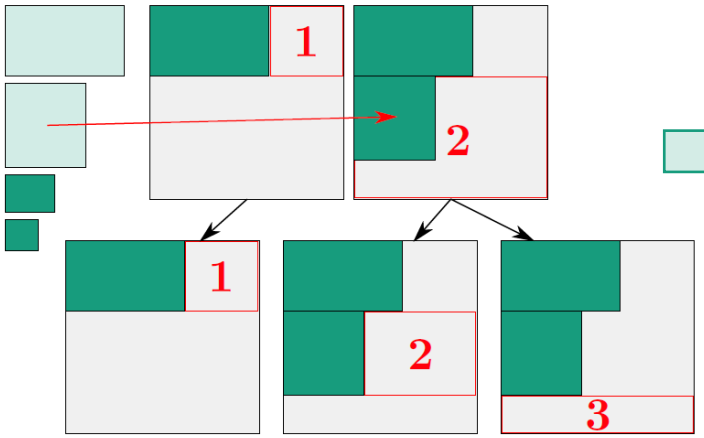

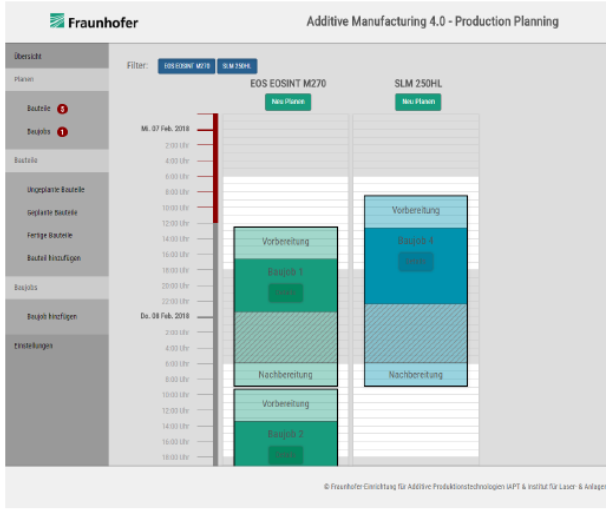

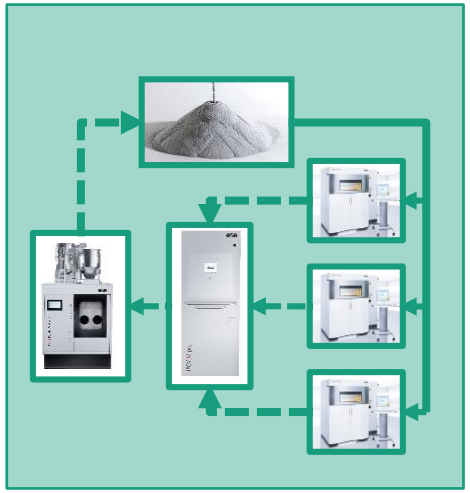

Build Job Management

Production Planning

Planning of Material-Flow

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Future AM - Virtual Lab

Digital Processes

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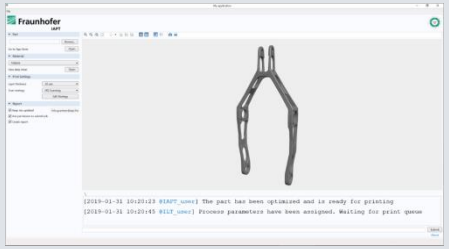
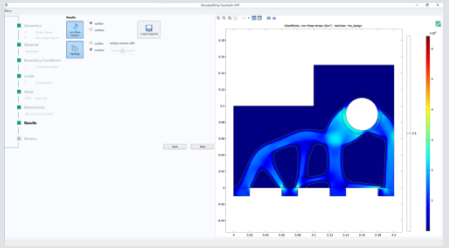


Digital Twin



Design & Redesign

AM-Processes

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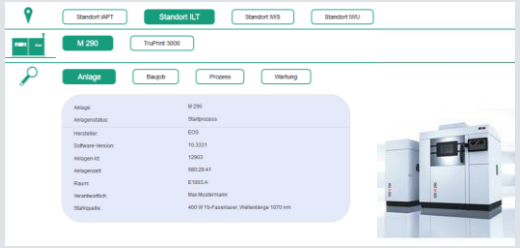

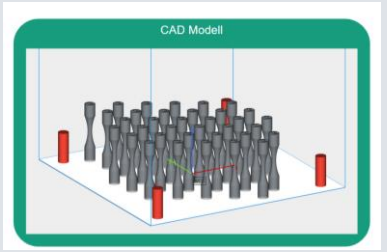

Process-Monitoring

Material

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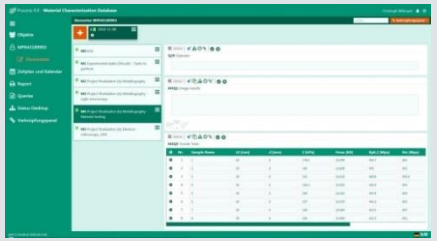
Raw Material QM



Material QM

Systemtechnology

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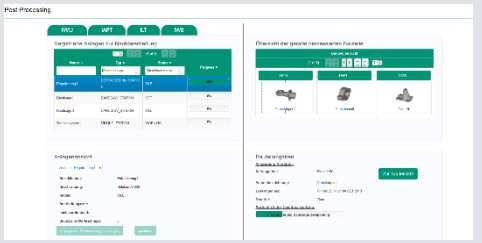



Post-Manufacturing

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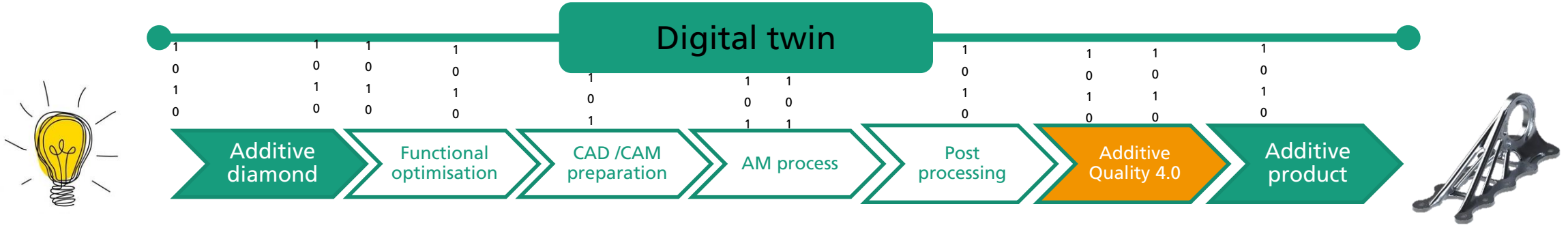
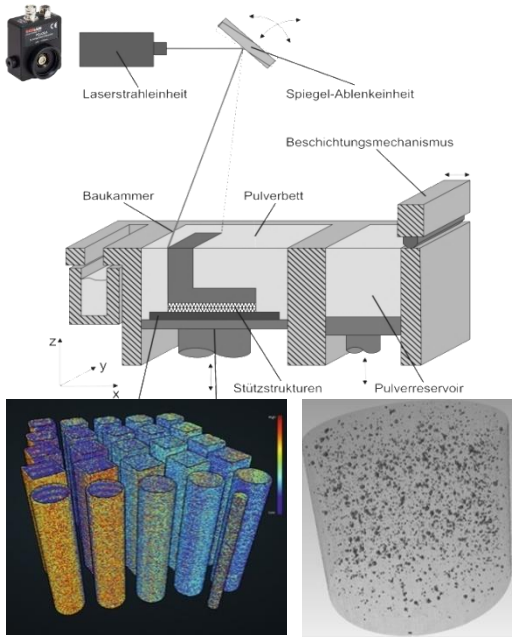
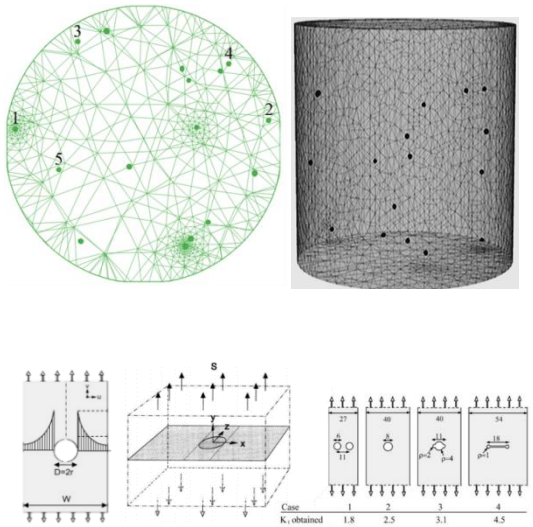
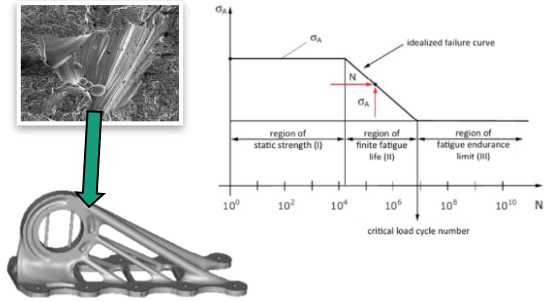
FutureAM – Life Prediction



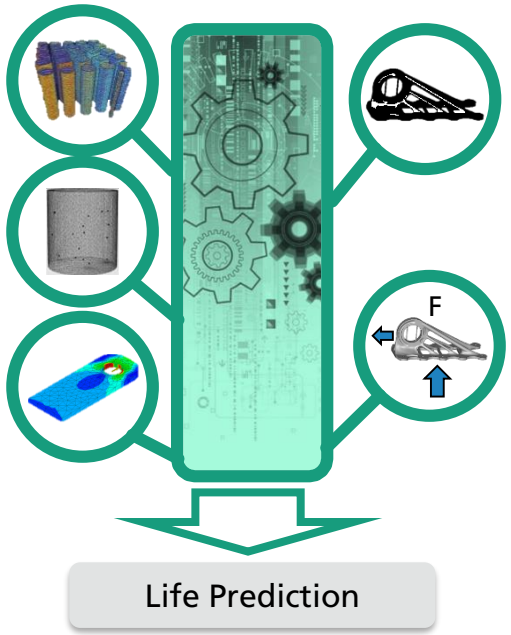






Simulation ⇄ Validation

Fault tolerance



1. Process Monitoring

2. Efect of Defect

3. Life Prediction

4. Automation

internal

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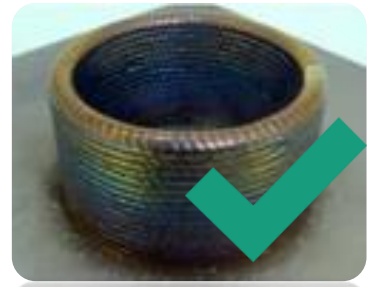
MindSphere as ‚vehicle' to enhance digitalization – Big Data LMD project



How do we get identical part quality from very print job in AM?







Solution

cloud based quality control solution for LMD process



Sensor data



Process data



Environmental data







intern

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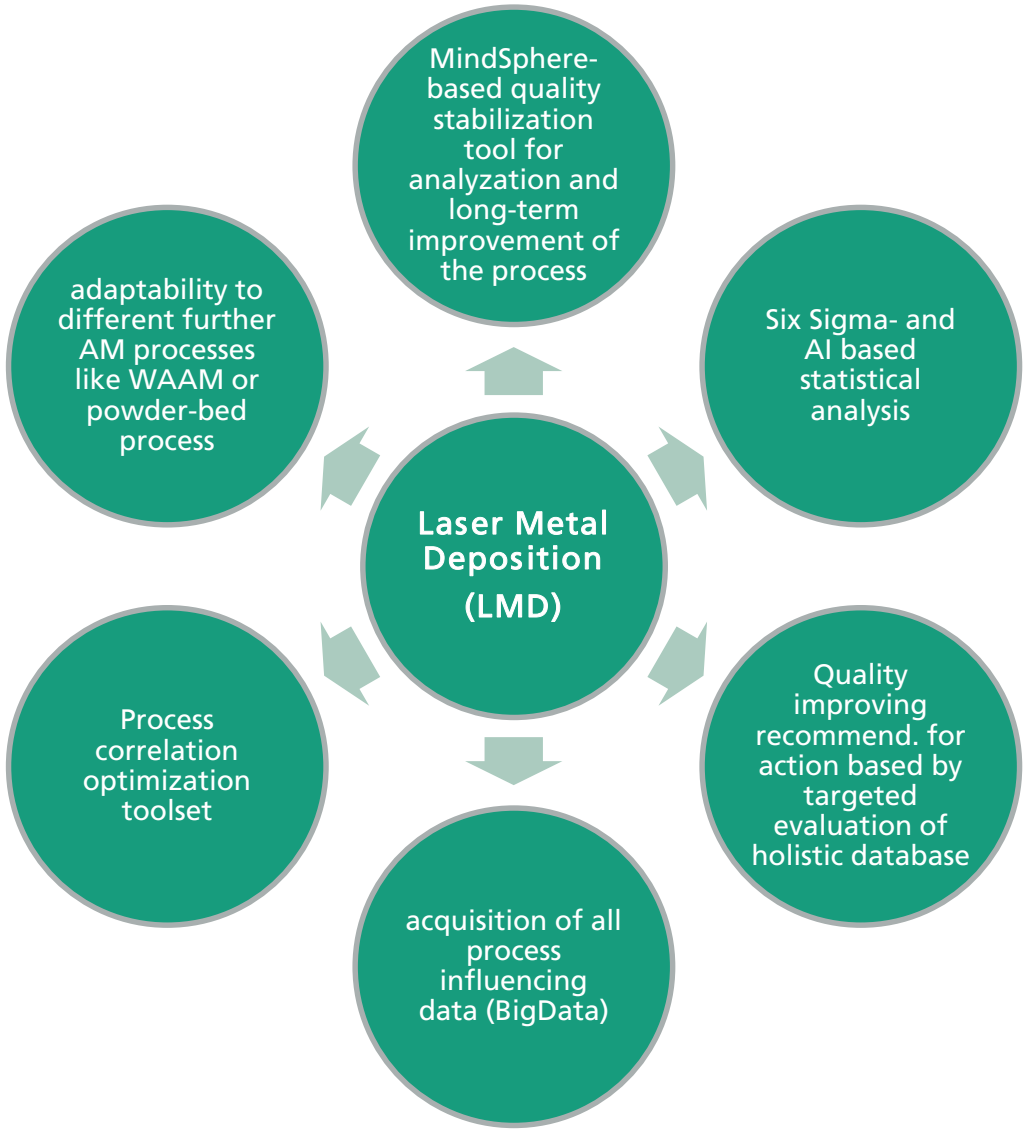
Overview of Project Goals



Partners (in negotiation):

Core partner:

SIEMENS

Fraunhofer IAPT

Project partner:

BeAM BE ADDITIVE MANUFACTURING

CRF CENTRO RICERCHE FIAT

SAFRAN

arianeGROUP

...

...

intern

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Thank you for your attention!



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