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European Association of the Machine Tool Industries
and related Manufacturing Technologies

Fraunhofer
GENERATIV

CECIMO WEBINAR

Additive Manufacturing: An opportunity to fill the gaps in traditional supply chains

Thursday 2nd of July, 11.00 am - 12.10 pm

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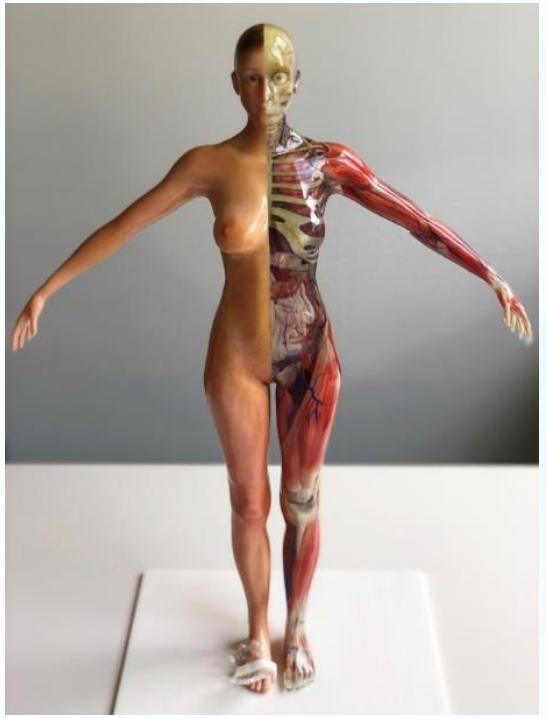


Embedding AM into industrial value chains

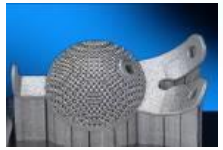
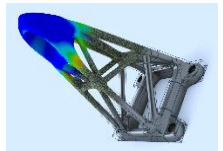
Dr. Bernhard Mueller

Fraunhofer Additive Manufacturing Alliance

Additive Manufacturing at Fraunhofer: One topic – twenty institutes – one alliance

- **Engineering**
  to invent and design new products and develop suitable process chains
- **Materials**
  to adapt new materials
- **Technologies**
  to achieve (cost-)efficient processes
- **Quality**
  to control and ensure manufacturing reproducibility and product quality
- **Software and simulation**
  to develop intelligent algorithms apply simulation efficiently



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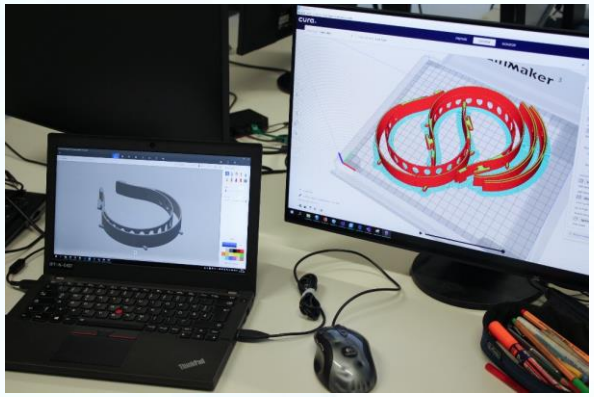
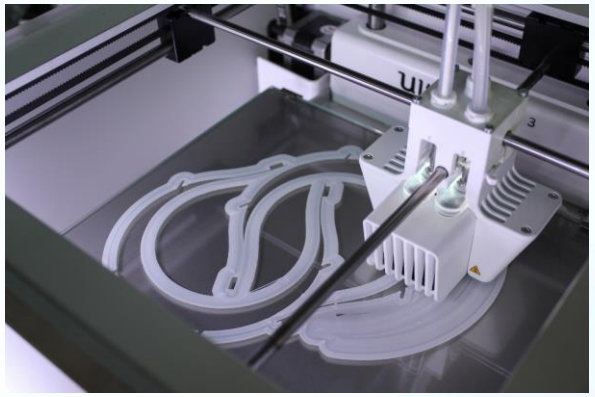
Fraunhofer vs. Corona: Providing 3D printed face shields to first responders

- Johanniter Unfall-Hilfe (German St. John's Order) asked for 5,000 face shields for training purposes
- AM network Medical goes Additive (MGA) supported Johanniter's call for help within its initiative "3D Printing fights Corona"
- Fraunhofer AM Alliance manufactured and donated 550+ of the 5,000 face shields
- 6 Alliance member institutes involved: EMI, IAPT, IGCV, IPA, IPT, IWU
- FFF and SLS technologies used to 3D print the face shields





Sources: Fraunhofer EMI, Fraunhofer IPA, Fraunhofer IPT, MGA Medical, Johanniter-Unfallhilfe

»This work was supported by the Fraunhofer Internal Programs under Grant No. Anti-Corona **072-600101**«

Fraunhofer GENERATIV
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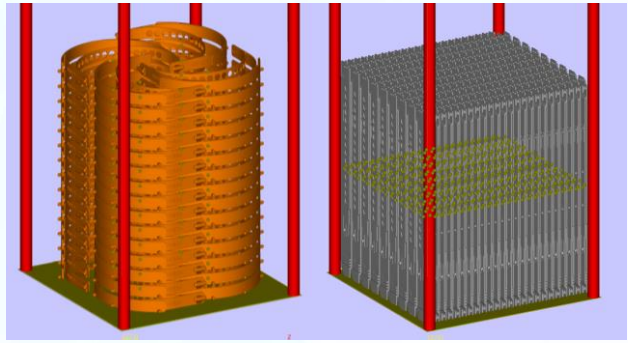
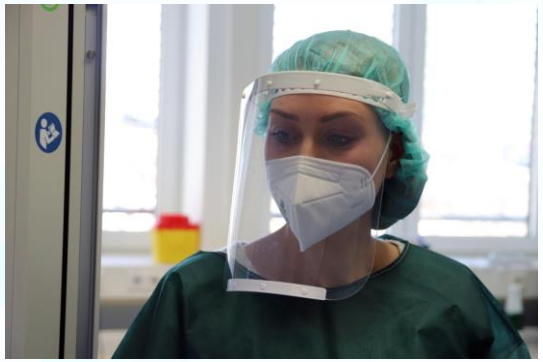
Fraunhofer vs. Corona: Providing 3D printed face shields to first responders

- Fraunhofer IML re-engineered open source file for face shields to optimize it for polymer laser sintering
- Production increase from 60 to 500 face shield components in one print job
- Production of clear visors with laser
- Fraunhofer IML manufactured (in cooperation with FH Dortmund) 1500 face shields for local hospitals and doctors





Sources: Fraunhofer IML, Ruhrlandklinik Essen

Fraunhofer IML
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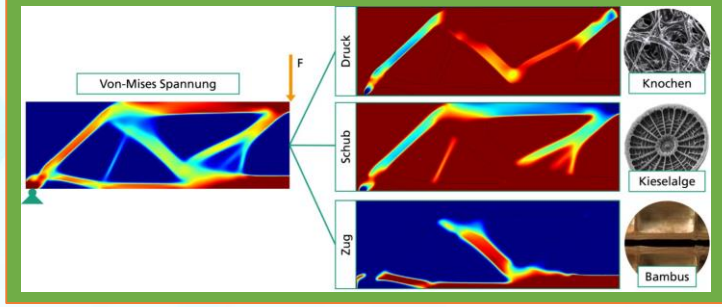
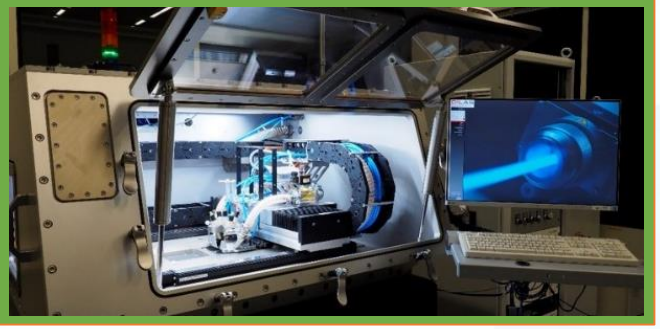
Lighthouse Project Future AM: Project overview

Digitization of additive manufacturing along the entire process chain



Increase of build rate and component size and in-process monitoring



Extensive automation of post processing

Increase of material diversity and multi-material processing

Fraunhofer IAPT

Fraunhofer ILT

futureAM

Fraunhofer IWU

Fraunhofer IWS

Lighthouse Project Future AM: Project Challenges in post processing

Process chain of additive manufacturing of metal components

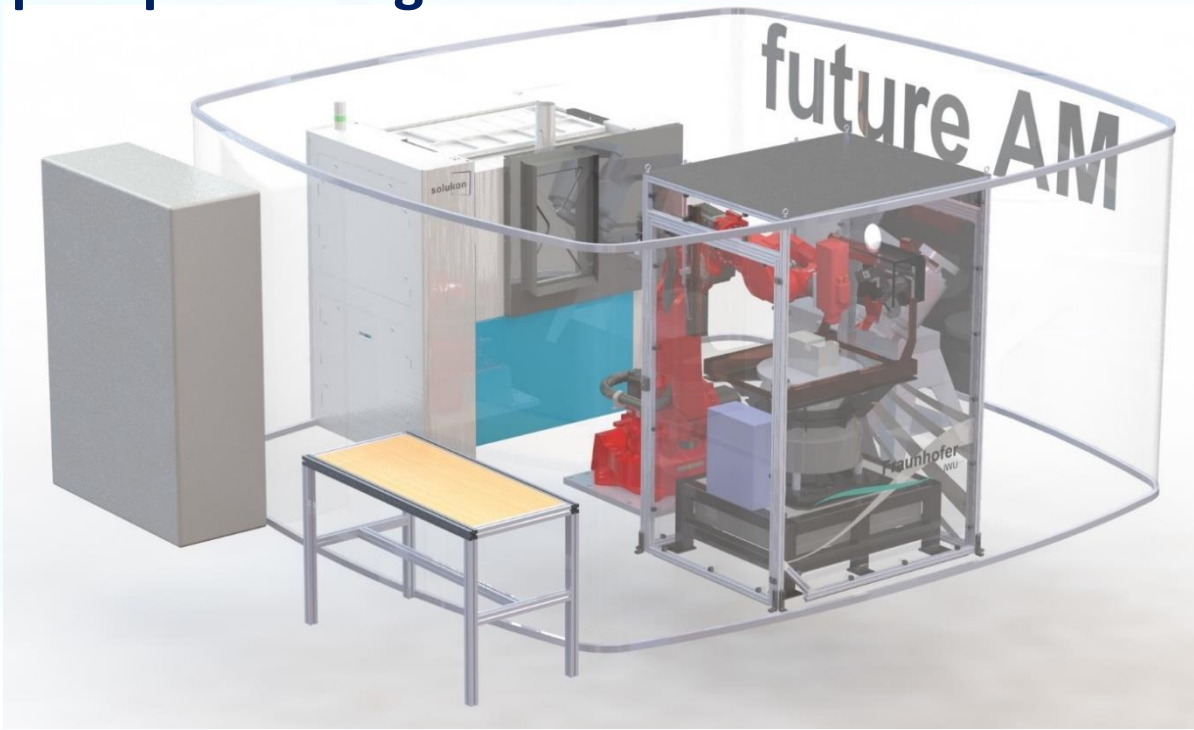
Post processing causes up to 70% of the overall component costs

- High percentage of manual work
  - for component removal
  - for removal of support structures
  - for mechanical post processing
- Missing integration in industrial manufacturing environments and process chains

Lighthouse Project Future AM: Automated post processing

Aim

- Reduction of personnel costs by 50 %
- Reduction of production time by 50 %
- Reduction of post processing costs by 70 %



Modular autonomous manufacturing cell with technology modules for

Process chain

powder removal → handling with robotics → component identification → cutting → optical dimensional measurement → mechanical post processing

Fraunhofer IWU
Contact: Florian Lehmann
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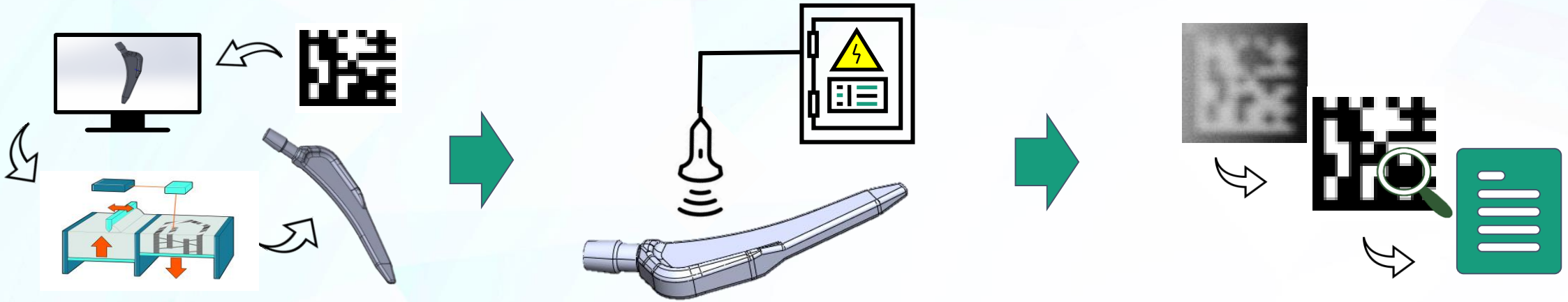
Lighthouse Project Future AM: Component identification

Motivation

- Disbanding rigid process chains requires clear allocation between component and production parameters
- Traceability in different industry sectors required or mandatory
- Clear identification protects from product piracy

Solution approach

- Use of manufacturing possibilities to integrate a codification inside the component



Process Planning and codification

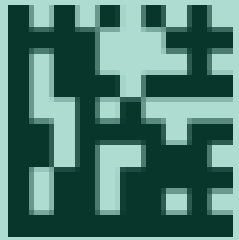
Reading of the code by different non-destructive measurement methods

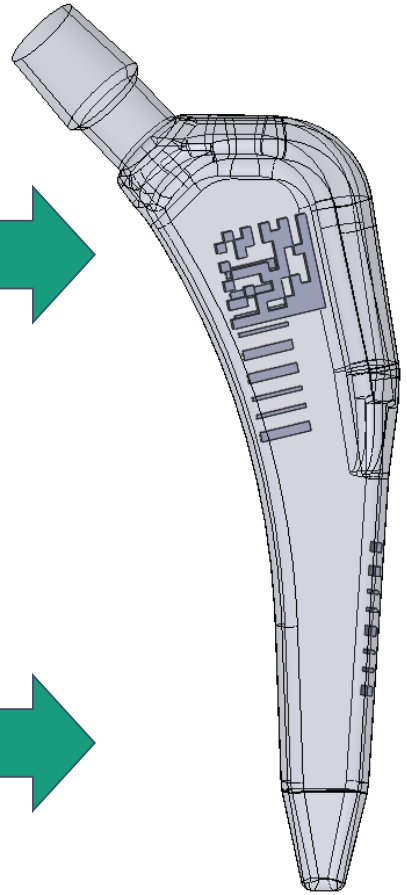
Signal evaluation, decoding, data assignment

Lighthouse Project Future AM: Chosen identifiers and non-destructive readout methods

1D Barcode,
Pharmacode [**456**]

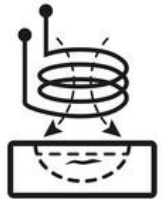
2D UDI Barcode,
Datamatrix [**658942**]





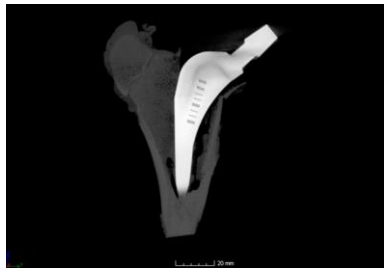
Demonstrator

Hip stem long



- Eddy current (EC)

- Ultrasound (US)



- X-ray (Micro CT)

Contact: Markus Oettel
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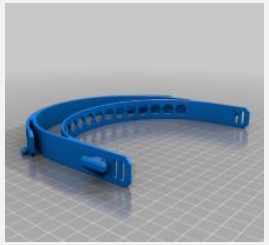
Fraunhofer vs. Corona: MobiMed – Development of a mobile production line for medical equipment and facilities in crisis regions

Data management

- Easy to use ordering system
- Order catalogue for common medical products
- Provision of variants

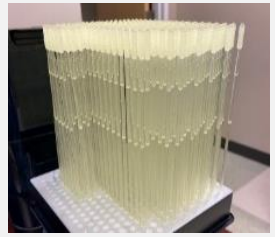


On-site production

- Process chain for plastic components
- User support by Augmented Reality (AR)
- 20ft container format for maximum versatility

Quality assassurance

- Part traceability by QR-codes
- AR-supported part check
- Sterilization and packaging



Supply chain for medical equipment with high criticality

»This work was supported by the Fraunhofer Internal Programs under Grant No. Anti-Corona **179-640001**«

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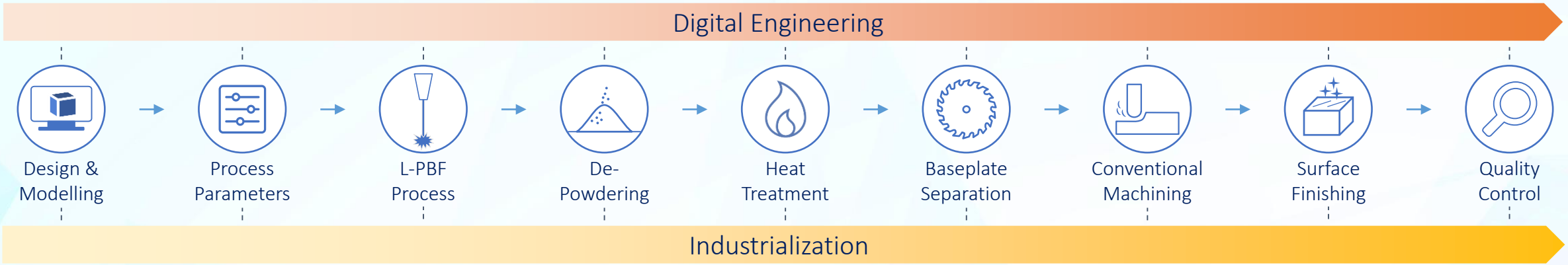
IDEA – Industrialization of Digital Engineering and Additive Manufacturing



Consortium

IDEA

EOS · LIEBHERR · Fraunhofer IPT · TRUMPF · ALLMATIC Spannsysteme JAKOB · Fraunhofer ILT · MTU Aero Engines · BCT · dap Digital Additive Production · RWTH AACHEN UNIVERSITY · SIEMENS · JENOPTIK · WZL RWTH AACHEN UNIVERSITY · toolcraft · ModuleWorks Get There Faster.

Description

- In the additive process chain, individual process steps are currently mostly isolated and associated with a large number of manual operations
- In the project, the basics of industrialization (data preparation, machine setup, etc.) are developed for all process steps, so that individual process steps can be integrated in one production line

Focus of Fraunhofer IPT

- Concept for automated component handling
- Software tool for CAM planning for removing support structures
- Software for process chain evaluation depending on the component design

Target

- Realization of a fully integrated, automated production line

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Support Code: 13N15001

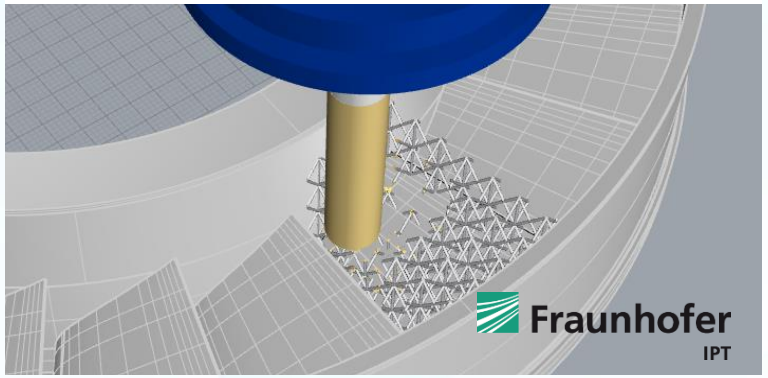
IDEA – Focus of Fraunhofer IPT

Automation

Automation concepts for component handling

- Analysis of the existing processes and hardware
- Development of a holistic methodology
- Generation and simulation of automation concepts

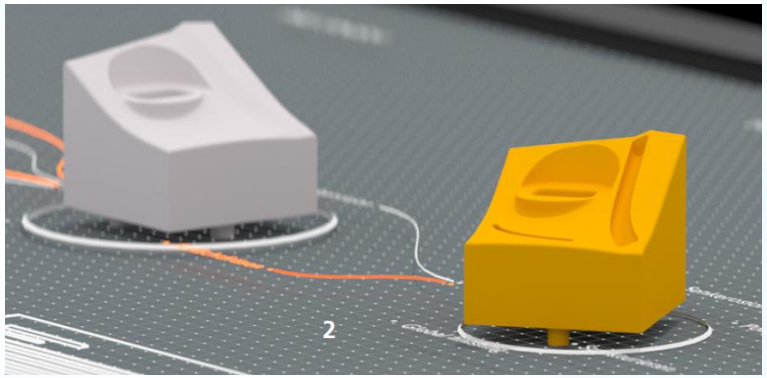
Support structure removal



Software for removal of support structures

- Simulation of contact conditions
- Execution of physical milling investigations
- Development of material removal simulation

Process chain evaluation



Software for automated process chain evaluation

- Formal description of tech-nologies and parameters
- Development of framework for data acquisition
- Development and imple-mentation of decision logic

Source: Fraunhofer IPT

Fraunhofer IPT
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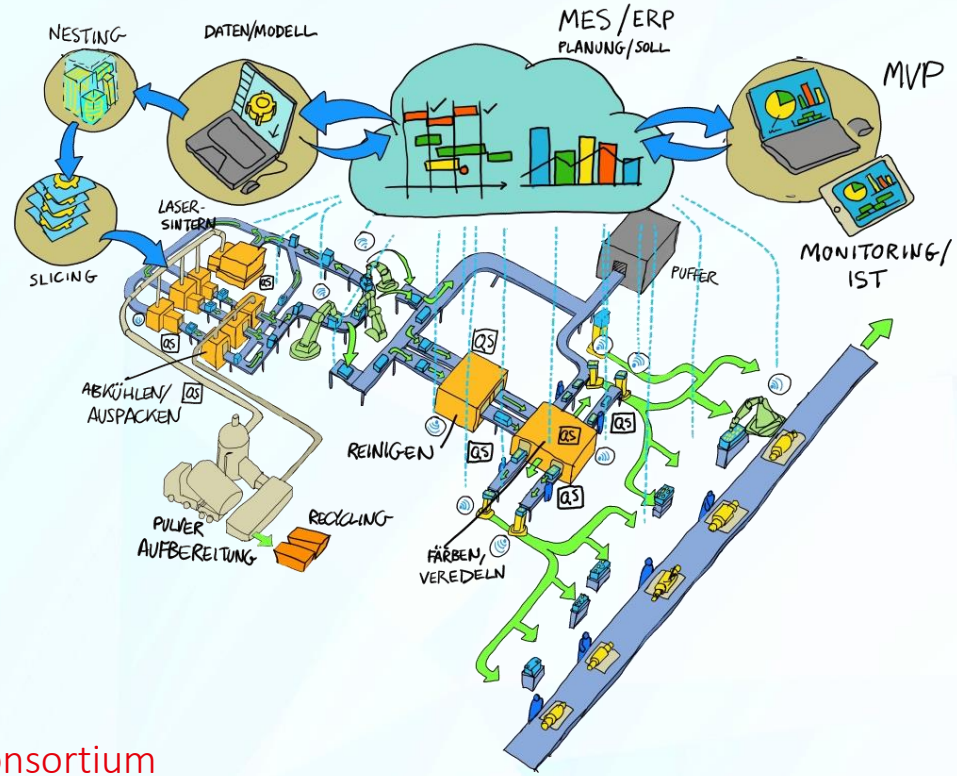
POLYLINE – Integrated line application of polymer-based AM technologies



POLYLINE
Integrated production line of polymer-based AM applications

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Description

- Vertical and horizontal integration of AM processes in conventional lines can only be implemented to a limited extent due to the lack of standards across process chains
- Reason: AM-specific production steps ("batch process") and low level of automation of the physical handling and transport processes
- Digital data chain is not continuous, which currently leads to intransparency, error-proneness and limited monitoring

Target

- Equivalent to the IDEA project with its focus on metal-based AM, the POLYLINE project focuses on the automation and integration of laser sintering of polymers along the entire process chain

Source: Fraunhofer IML

Consortium

EOS, BMW Group, Grenzebach, DyeMansion, Additive Marking, Krumm tec, 3YOURMIND, optris, Fraunhofer IML, Fraunhofer IGCV, technische universität dortmund, Universität Paderborn, Universität Augsburg Fakultät für Angewandte Informatik, Universität Duisburg-Essen

POLYLINE – Focus of Fraunhofer IML and IGCV

Fraunhofer IML

POLYLINE
Integrated production line of polymer-based AM applications

Fraunhofer IGCV

Integration:

- Development of an integration concept:
  - Integration of all process steps into an optimized AM process
  - Integration of the AM process into conventional production environments

Digital process chain:

- Focus on digital process chain in additive order processing
- Concept for optimal production planning and control of the POLYLINE is being developed
- Concept will be tested for scalability in a simulation

Material flow:

- Flexible linking of process steps is a prerequisite for successful automation of an AM-line
- The entire material flow is considered
  - transport of exchangeable frames, components and powder
- Implementation of concepts in cooperation with consortium partners

Quality and technical cleanliness:

- Analysis and optimization of the areas of component cleaning and finishing
- IGCV develops cleaning process chains to close process-related gaps
- Target is to increase resource efficiency and product quality

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Thank you for your attention!

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