

INDUSTRIAL IMPLEMENTATION OF AM

Why is it still so slow?

What is the role of simulation?

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OPENING STATEMENT

SIMULATION | 3D Print



Prof. Dr. Jens Telgkamp

Conference

March 04th, 2021

2 pm – 6 pm UTC/GMT +2



"Additive Manufacturing is a fascinating technology, but still a bit weak when it comes to implementation. Let's have a closer look at what can be done to further improve!"

AM @ HAW HAMBURG

AM @ HAW Hamburg highlights

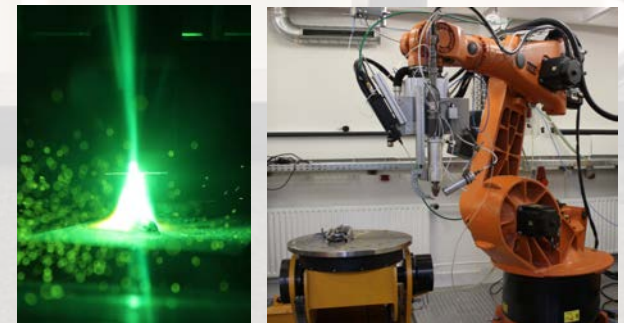
Teaching: Bachelor and master courses

- AM technology (polymer/metal)
- AM process chain
- Design for AM and optimization

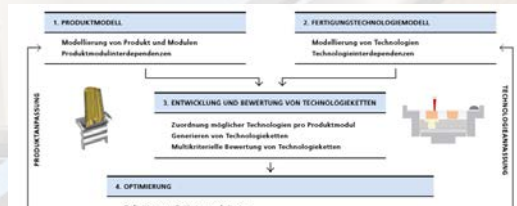
3Dspace (prototyping and part production for/with students, FFF / SLS / DLP)

Research

- Design and business case
- Hybrid processes, metal filled polymers
- Direct Energy Deposition Print Strategy
- Quality checks, process monitoring, NDI/NDT



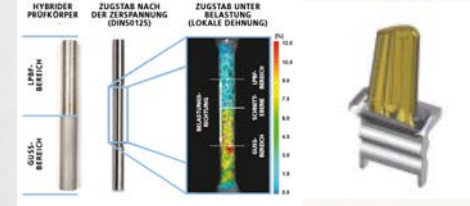
CURRENT GENERAL TRENDS IN AM



Incremental Development



Integration in Process Chains



"Hybrid Parts"

TECHNICAL COMMITTEES
ISO/TC 261
Additive manufacturing
AM-Standards



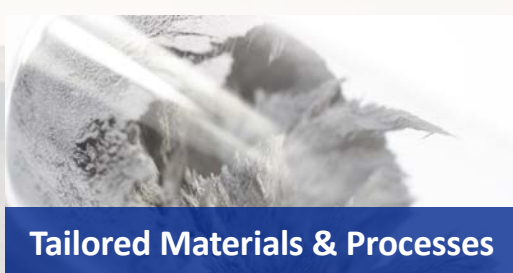
Digital Twin & AI



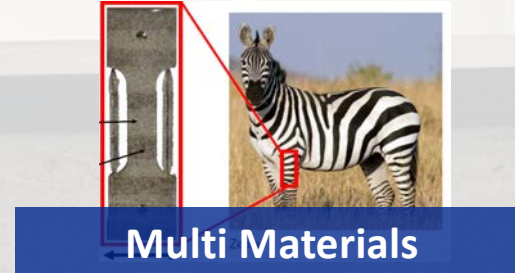
Education & Design Thinking



Ecological Footprint



Tailored Materials & Processes




Multi Materials

Source: <https://wp.wvu.edu>

WHY ARE WE SEEING LIMITED PROGRESS IN THE AEROSPACE AM IMPLEMENTATION?

Reason 1: We need to master the challenge in between single part and process qualification

Single Part Qualification

AM Blank  Supplier/Machine

Full Process Qualification

Process  Supplier

→ → Increasing value, also: more effort → →

- The complete manufacturing route is „frozen“ for THIS part (blank) at THIS supplier
- Good option if a limited number of parts is going to be produced with this technology
- Today: standard procedure for casting and forging parts

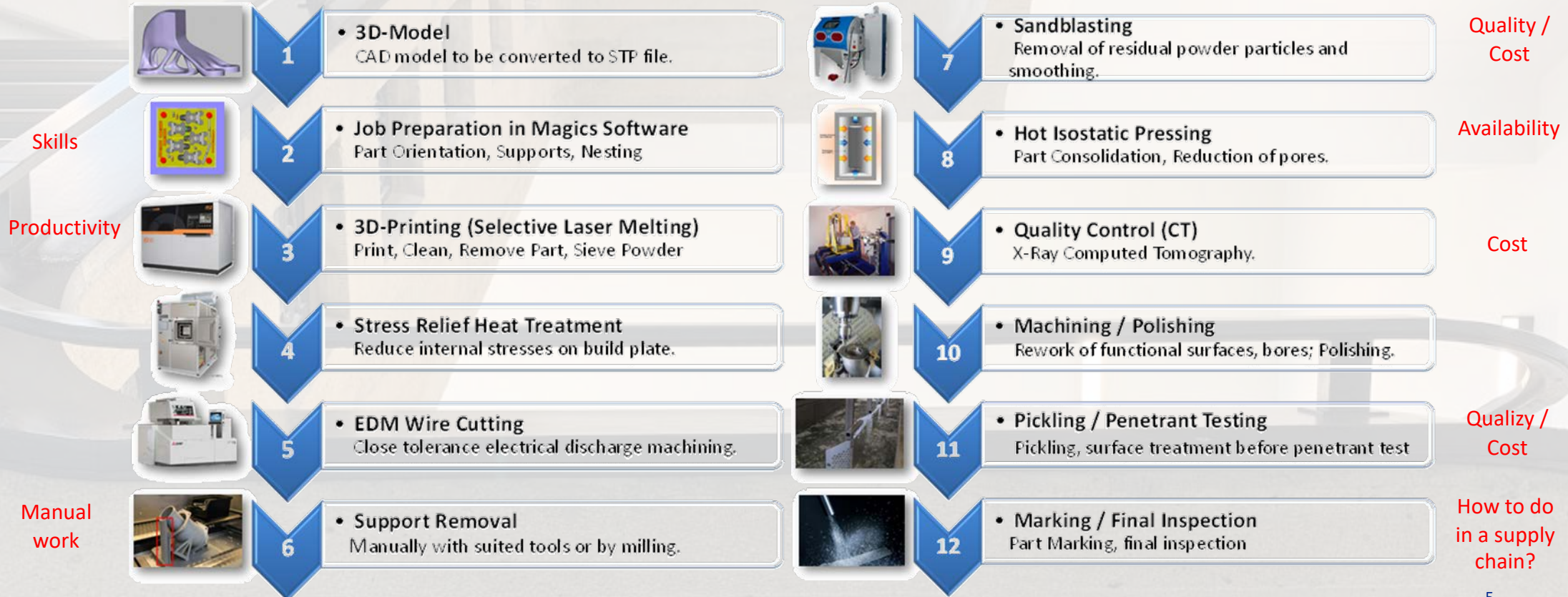
i.e. this is common for some state-of-the-art technologies

- Provides freedom to realize new geometries, part families, rapid changes / improvements, ...
- Good option if a high number of parts is going to be produced with this technology
- Today: standard procedure for sheet metal forming, peening, etc.

AM is more ambitious than that!

WHY ARE WE SEEING LIMITED PROGRESS IN THE AEROSPACE AM IMPLEMENTATION?

Reason 2: long process chain for safety critical (e.g. aerospace) parts **with its bottlenecks**

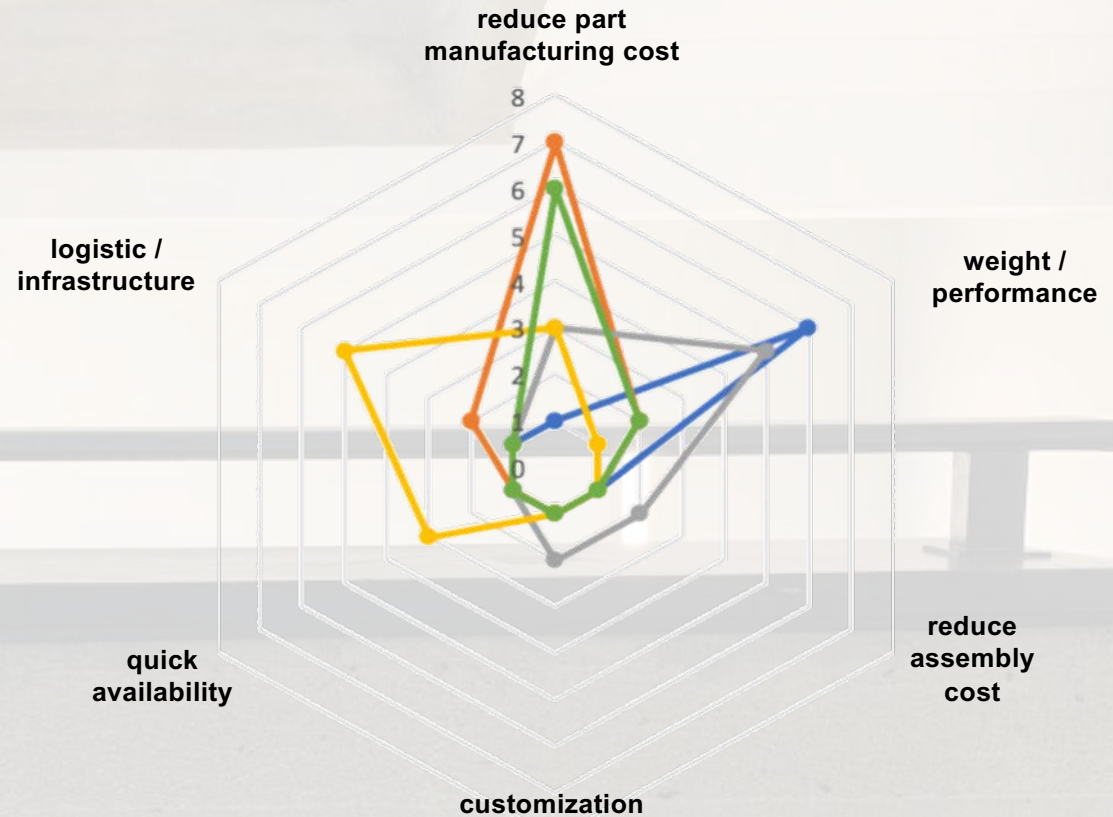


Source: BDLI

WHY ARE WE SEEING LIMITED PROGRESS IN THE AEROSPACE AM IMPLEMENTATION?

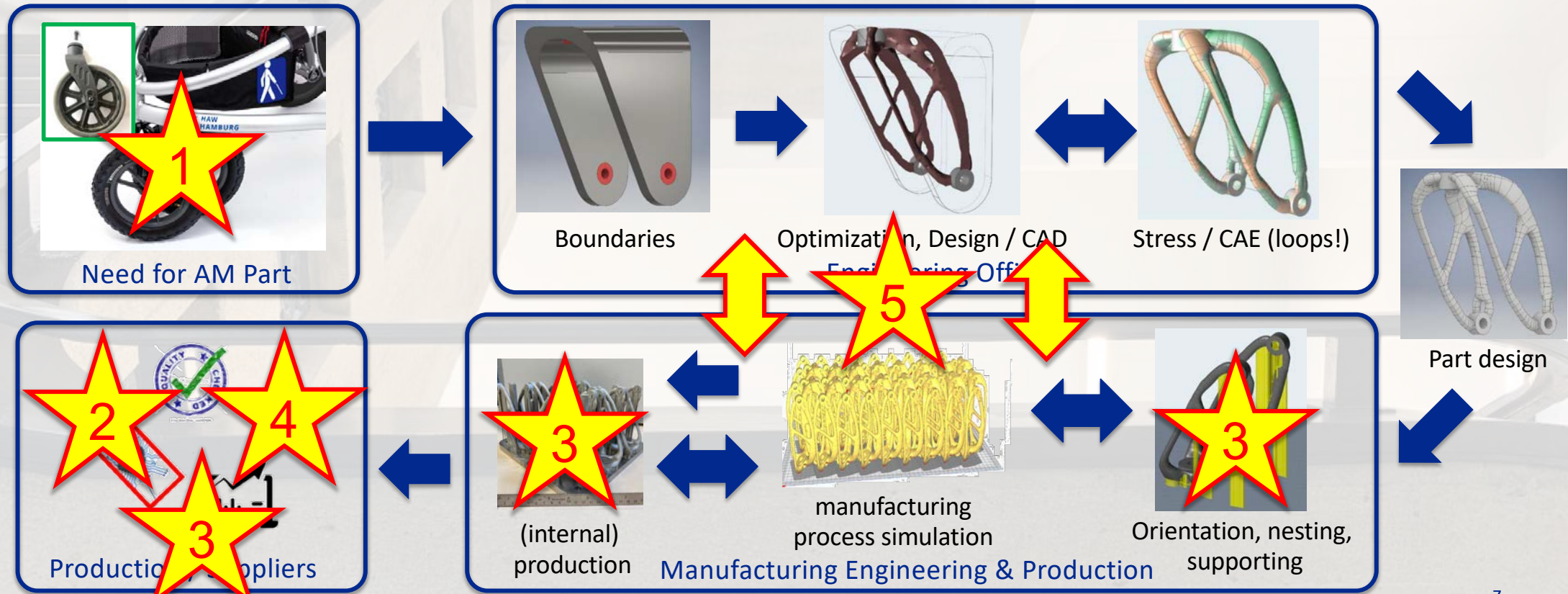
Reason 3: We have too many mono-disciplinary AM application ideas!

- Leightweight bracket (LBM)
- Major structure fitting (DED)
- Heat exchanger (LBM)
- Spare part after sales (FDM/SLS)
- Turbine blade (LBM)



THE ROLE OF AM PROCESS SIMULATION

A typical AM process chain and the role of manufacturing process simulation



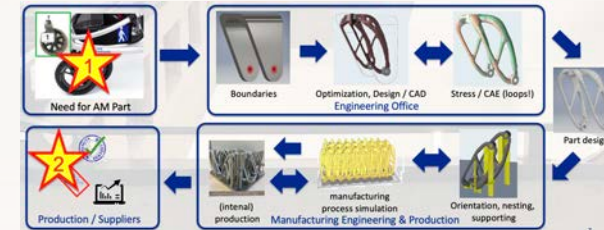
Sources: LIAM/Blindenhund Projects, HAW Master Module TDAF

THE ROLE OF AM PROCESS SIMULATION

Potential Business Cases for Manufacturing Process Simulation

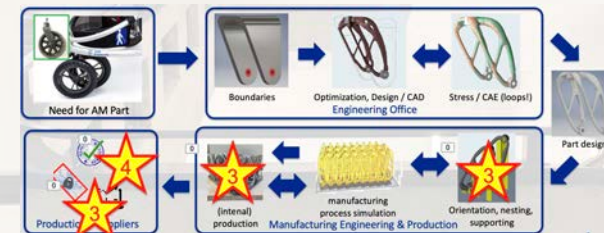
Generating parts with increased geometric accuracy through simulation

- Extending the applications of AM regarding the part selection or integration opportunities
- Minimizing post processing of functional surfaces if compensation of geometry is utilized based on simulation
- The **business case** here is mainly related to increase AM opportunities and increase efficiency in serial production



Modifying process parameters, part orientation, etc. through simulation

- Preventing AM build jobs from being destroyed by distortion and residual stress during the build job
- We assume that today's AM jobs are largely over-supported when supports are not simulation based
- The **business case** here is mainly related to increase efficiency (supports) and decrease of scrap rate for single parts and serial production



„First Time Right“ through simulation, reduce non-recurring cost

- Use of simulation during the development phase of new AM components and parts
- The **business case** here is production cost and lead time specially for single parts and small series



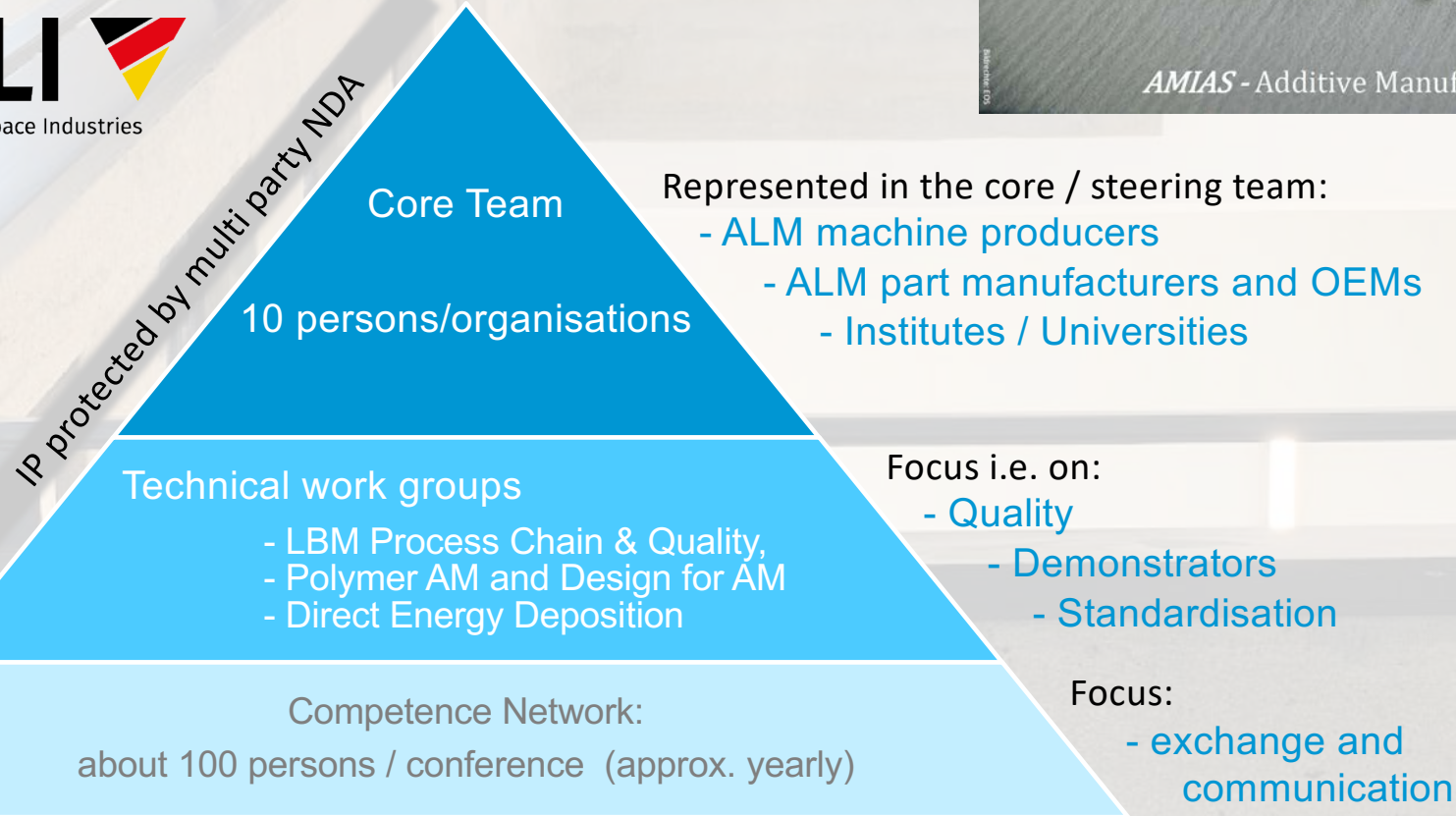
IN CONCLUSION

Some key points:

- AM parts are still expensive, so many industries focus on critical parts and applications
 - Then again, that's difficult, because with today's maturity we need a long physical process chain
 - More research will be needed to relax this disadvantage (e.g. on process monitoring, interacting process steps, ...)
- In addition, these industries expect the full benefit and geometric design freedom from AM
 - They go for a full process qualification rather than qualifying single part designs with a „frozen“ process chain
 - This is very ambitious, but requires in-depth understanding and long-term experience of the whole process
- More multi-disciplinary thinking is necessary to exploit the full potential of AM
 - Not „only thinking in the product“, but also question application, system architecture, combine benefits, ...
 - A role for education and training
- When it comes to the role of manufacturing process simulation, there are several types of business cases, e.g.:
 - from increasing geometrical accuracy
 - from modifying the way we build AM parts, based on simulation
 - from the „right first time“ idea
- Strong networks are needed to master the challenges, we can do it!

NEED FOR NETWORKS AND COOPERATION TO MASTER THE CHALLENGE

The BDLI / AMIAS network at a glance



3D-DRUCK NETZWERK

in der Metropolregion Hamburg

+++ CONNECT – DISCUSS – COLLABORATE +++

Objectives

- Platform for inter-disciplinary exchange / dialog
- Stenghtening the AM topic in the metropolitan region Hamburg

Ways of work

- Network and exchange
- Competence, Trainings, Skills
- Knowledge and technology transfer

Work groups

- AM process chain
- AM materials
- AM business models

Information

...News, dates, players, registration:

www.3d-druckhamburg.de



#3DDHH



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THANKS FOR YOUR ATTENTION...



... AND I'M LOOKING FORWARD TO MEET YOU PERSONALLY ONE DAY!

PROF. DR. JENS TELGKAMP

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