ADDITIVE MANUFACTURING + ROBOTICS

MORE SUSTAINABLE THROUGH REPAIRS AND NEW AM DEVELOPMENTS

+ Uwe Schulmeister

10 May, 2024

Pace Maker for
High-End
Precision Parts

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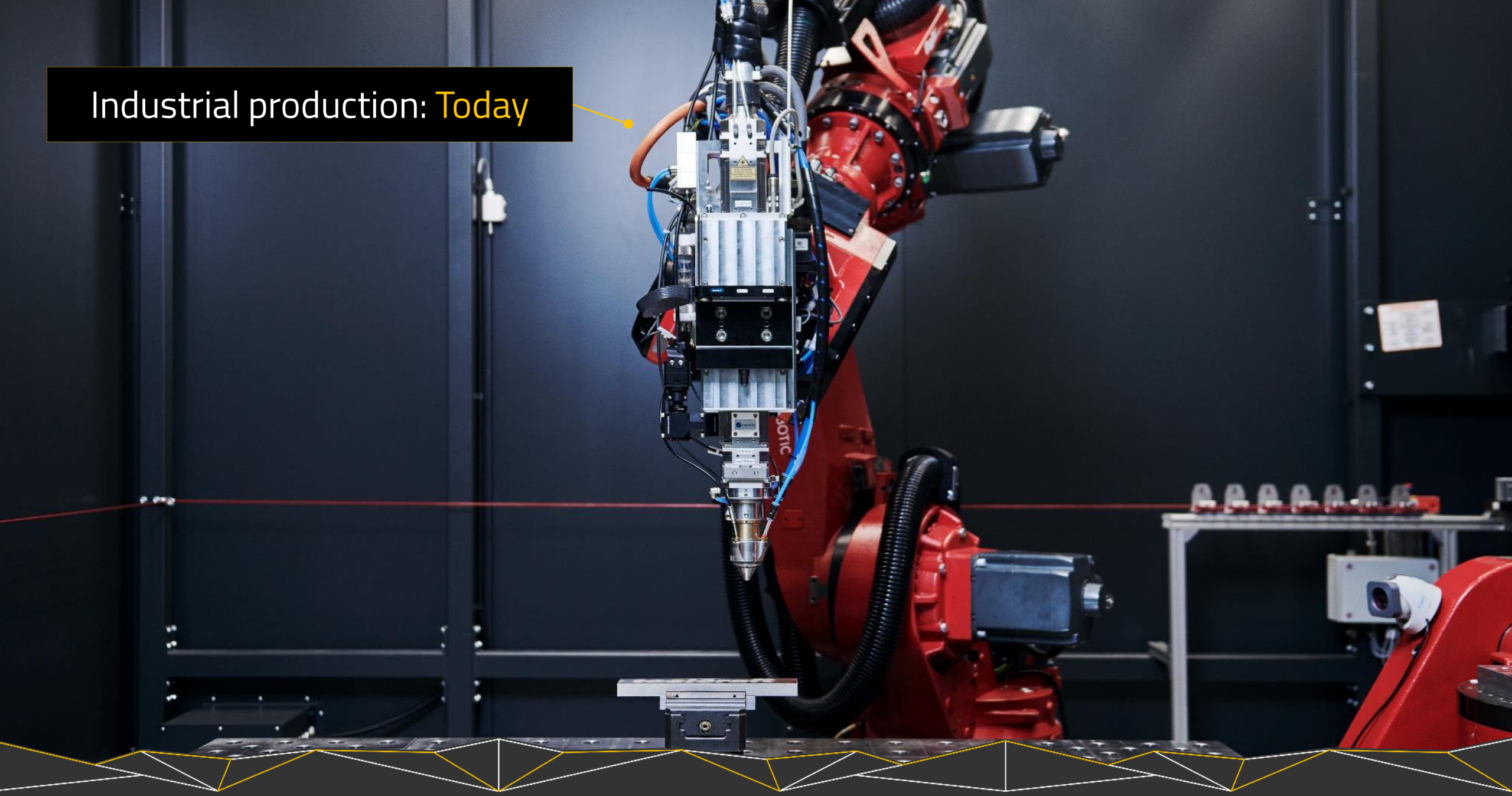
Communication: Yesterday

Communication: Today

Industrial production: Yesterday

Industrial production: Today

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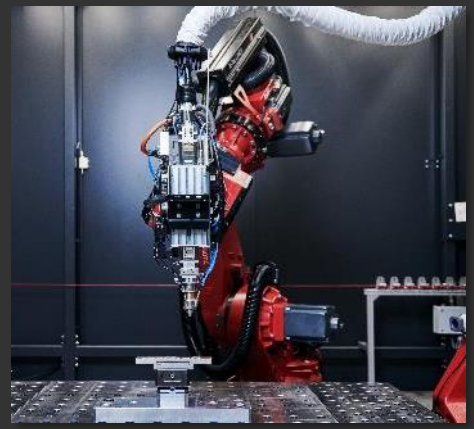
THE INDUSTRIAL EVOLUTION

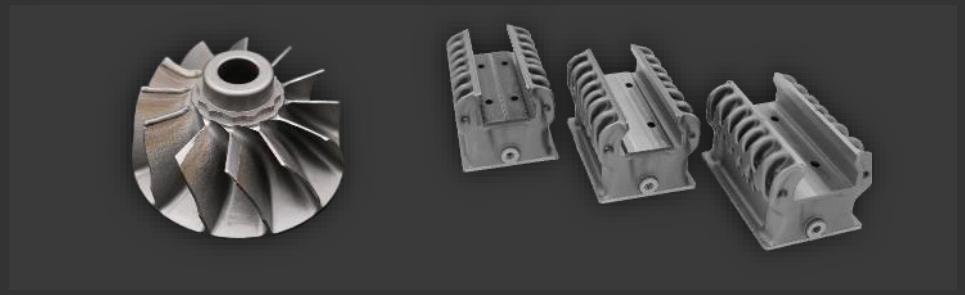
Sustainability as the driving force for change in industrial production

+ Flexible and decentralized production
+ Time-to-market and reaction speed
+ Transport costs
+ Lightweight design
+ CO_2 emissions
+ Spare parts management of tomorrow
+ Repair instead of new production

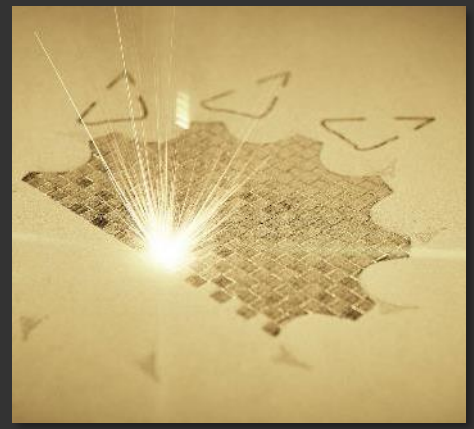
SUSTAINABILITY WITH AM AND ROBOTICS

+ Repair, remanufacturing of components instead of new production, coating, cost reduction



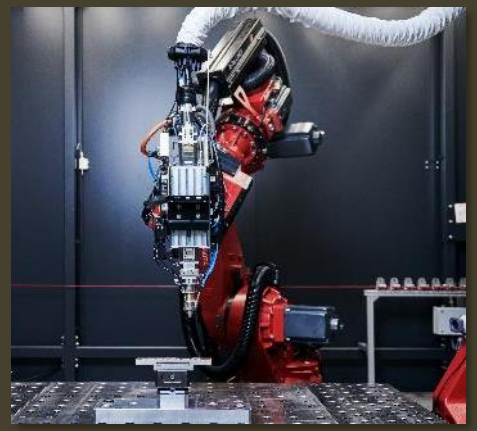


+ Lightweight design, weight reduction, assembly integration, predictive design, functional integration

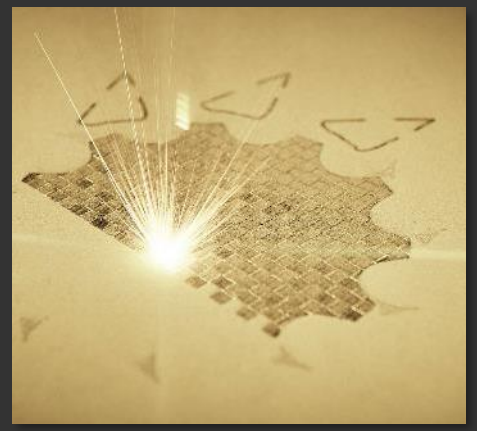


SUSTAINABILITY WITH AM AND ROBOTICS

Repair, remanufacturing of components instead of new production, coating, cost reduction



Lightweight design, weight reduction, assembly integration, predictive design, functional integration

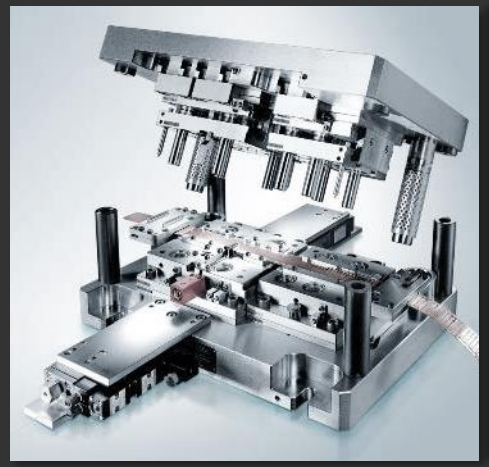


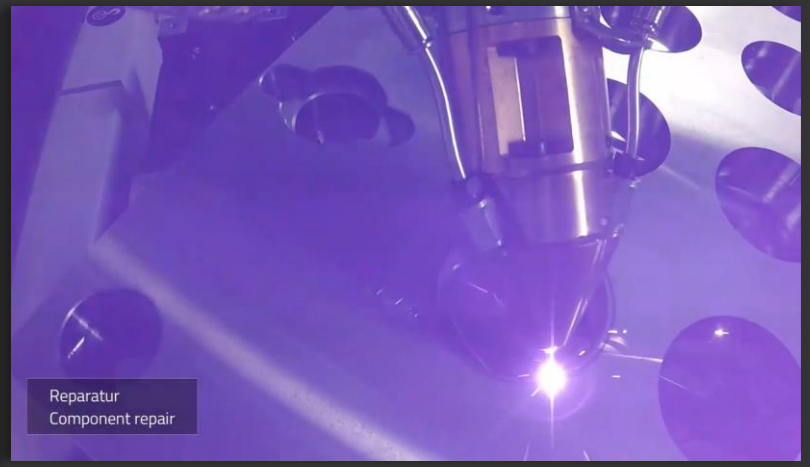
POTENTIAL HYBRID MANUFACTURING

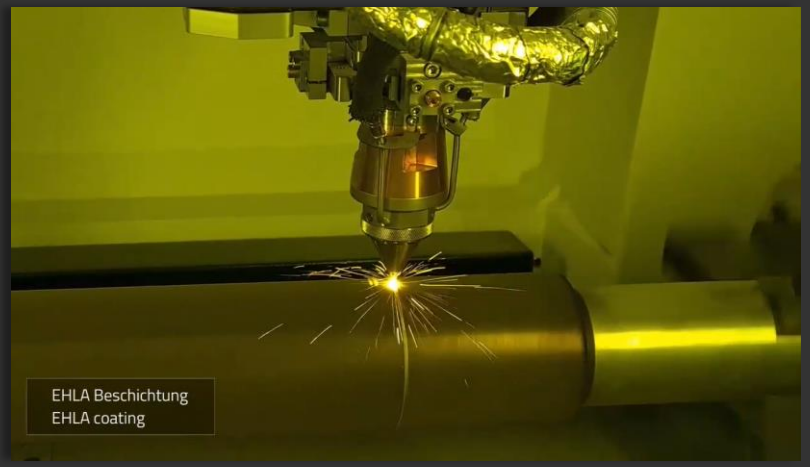
LMD, MACHINING AND ROBOTICS

Repairs and technical coatings for all types of production tools:

+ Injection molds and die casting molds (precision molds, ...)
+ Punching tools (punch, die, ...)
+ Bending tools (bending mold, ...)
+ Rolling tools (rollers, ...)
+ Cutting tools (cutting plates, blades, ...)
+ Punching tools and more







SELF-DEVELOPED ROBOT CELL

FOR HYBRID ADDITIVE MANUFACTURING

TECHNICAL DATA – ROBOT CELL

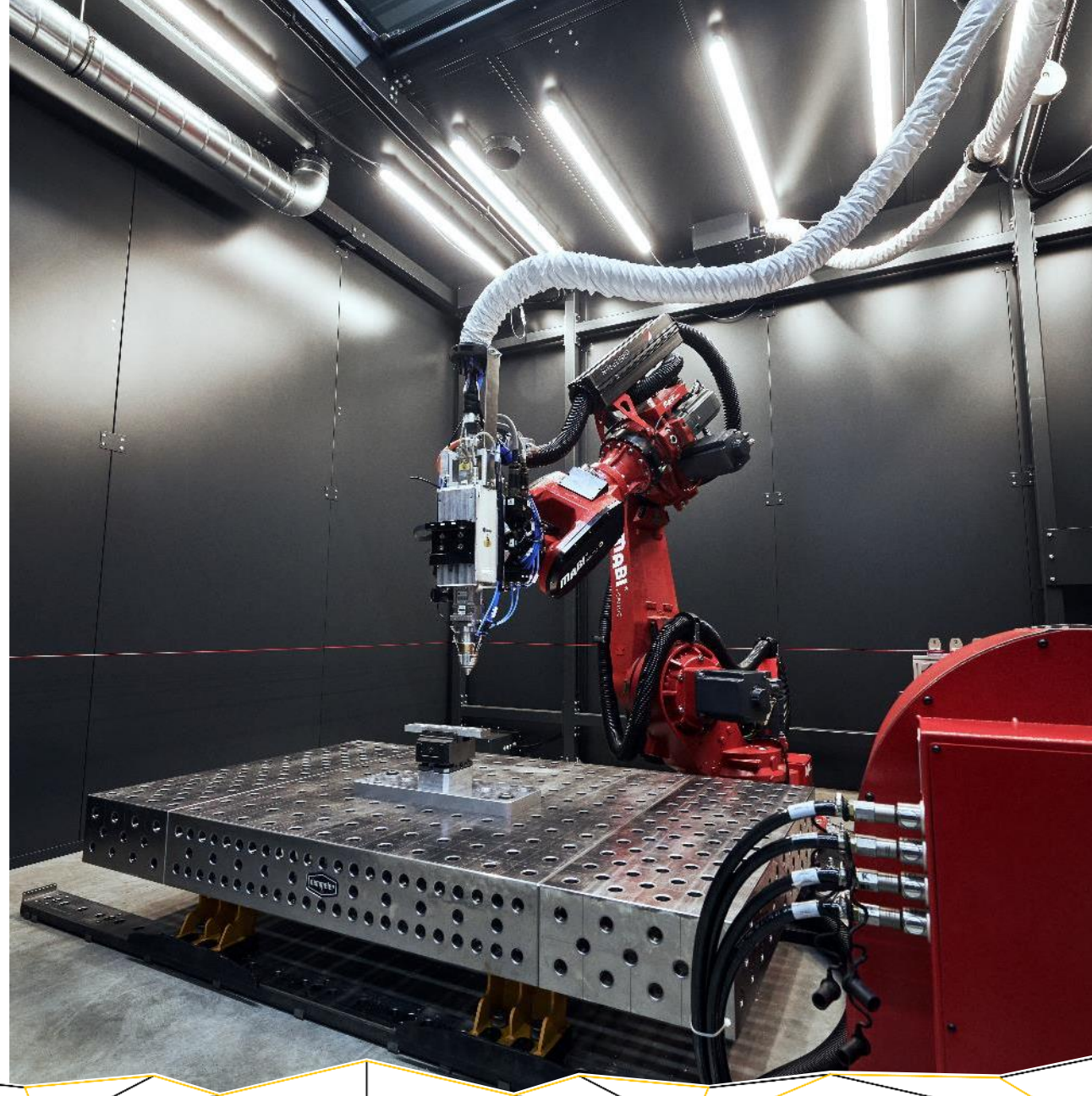
- Robot manufacturer: **MABI Robotic AG** (load capacity: 100 kg)
- **Adaptive spindle**
  - Spindle fixture: HSK63 E
  - Spindle speed: 16,000 rpm
  - Number of tools: 7
- **Adaptive laser head**: Laserline OTZ-5-VC
  - Laser power: 8 kW
- **Rotary tilt table** - load capacity: 500 kg
- **Machining table** (heavy load): 2000 x 1200 mm
- Exhaust system, laser protection cabin, multifunctional construction

PROS AND CONS – ROBOT CELL

+ Multifunctional: **Additive and subtractive**
+ Large machining radius
+ Good accessibility due to **8 axes**
+ Expandable
+ **EHLA process** for rotary components
+ For small and large components (**up to 1.5 m in length**)

- **Accuracy**:
  - Machining center: ± 0.01 mm

    vs.
  - Machining with robot: ±0.20mm

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SUSTAINABILITY WITH AM AND ROBOTICS

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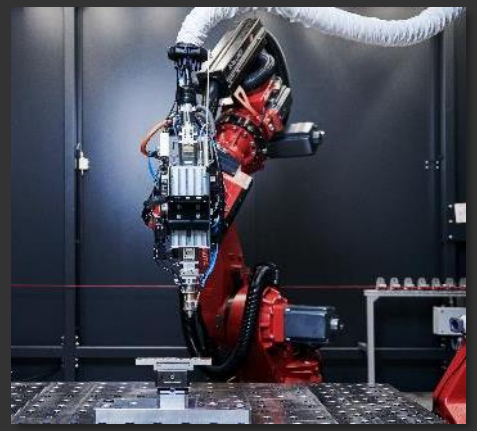

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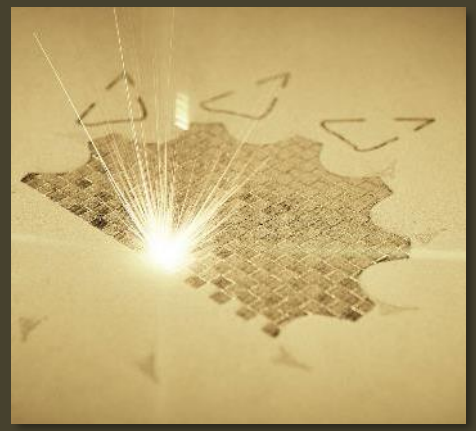


WHAT IS THE MOST THANKLESS JOB

IN THE L-PBF PROCESS CHAIN?

MANUAL SUPPORT REMOVAL

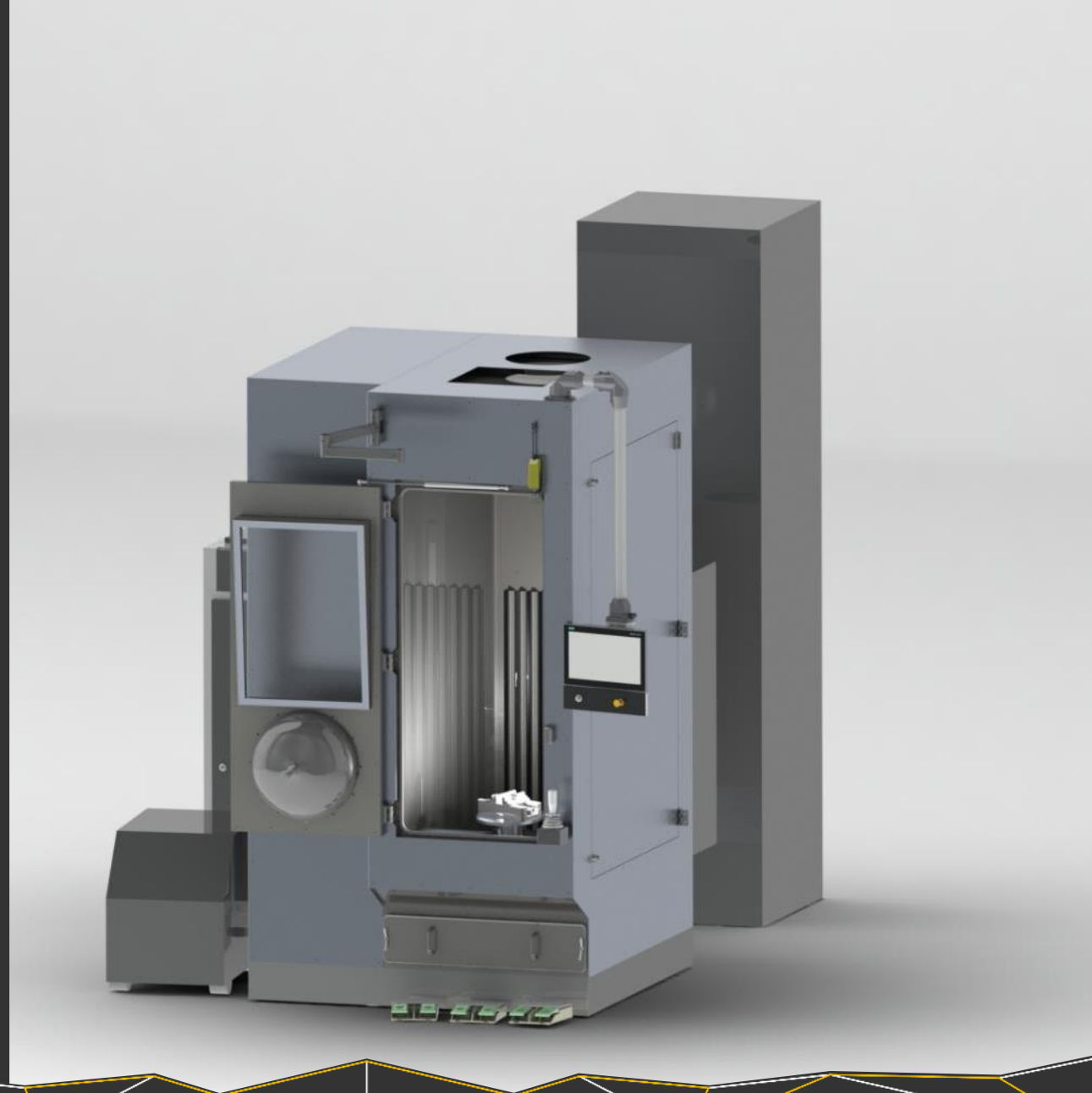
- Often "state of the art"
- Tools: Hammer and chisel
- **Human** factor:
  - Work safety
  - Effort and ergonomics
  - Risk of component damage/deformation
  - Reproducibility
  - Process instability
- **Economic** factor:
  - Very time-consuming process
  - Bottleneck in ongoing, efficient productions
  - Costs

SUSTAINABILITY THROUGH PROCESS AUTOMATION

SELF-DEVELOPED DRY ICE BLASTING SYSTEM

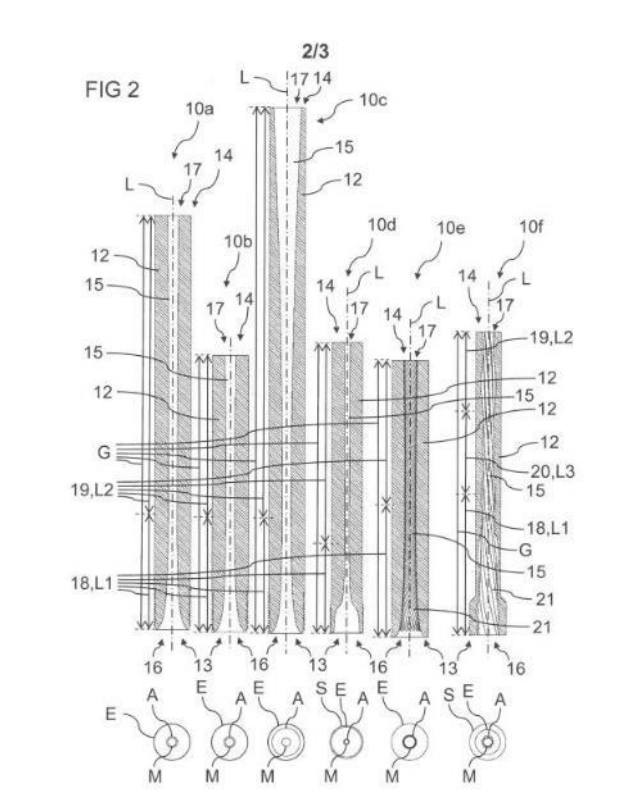
SEMI-AUTOMATED SUPPORT REMOVAL

- Registered utility model
- Functional principle: **Dry ice blasting**
- Currently processable materials:
  - **Aluminum, titanium, stainless steel**
  - **Inconel** (in final development)
  - More in development
- Footprint: 3000 mm x 4200 mm x 3000 mm
- Cabin interior dimensions: 800 mm x 1490 mm
- Clamping surface: ∅ 280 mm
- Maximum part weight: ~16 kg

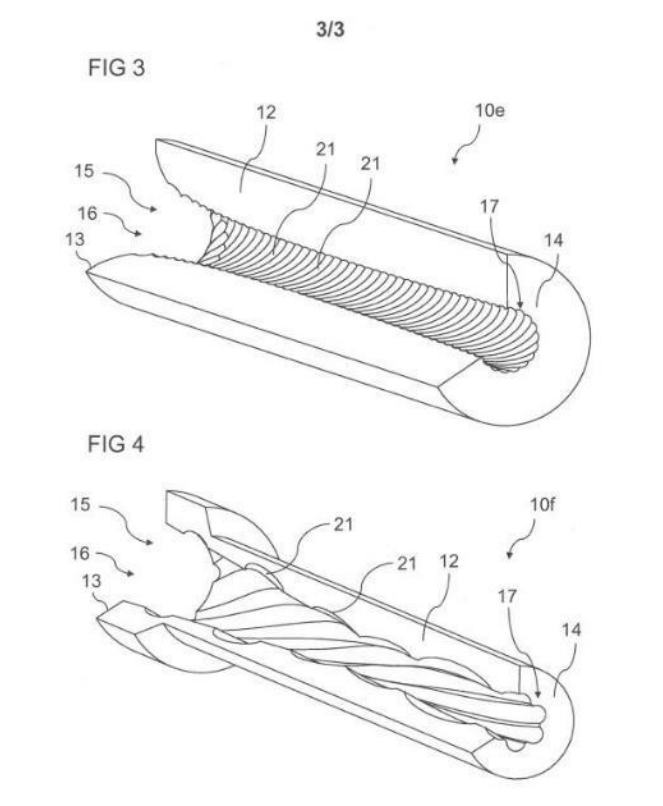


DRY ICE BLASTING: REGISTRATION OF UTILITY MODELS

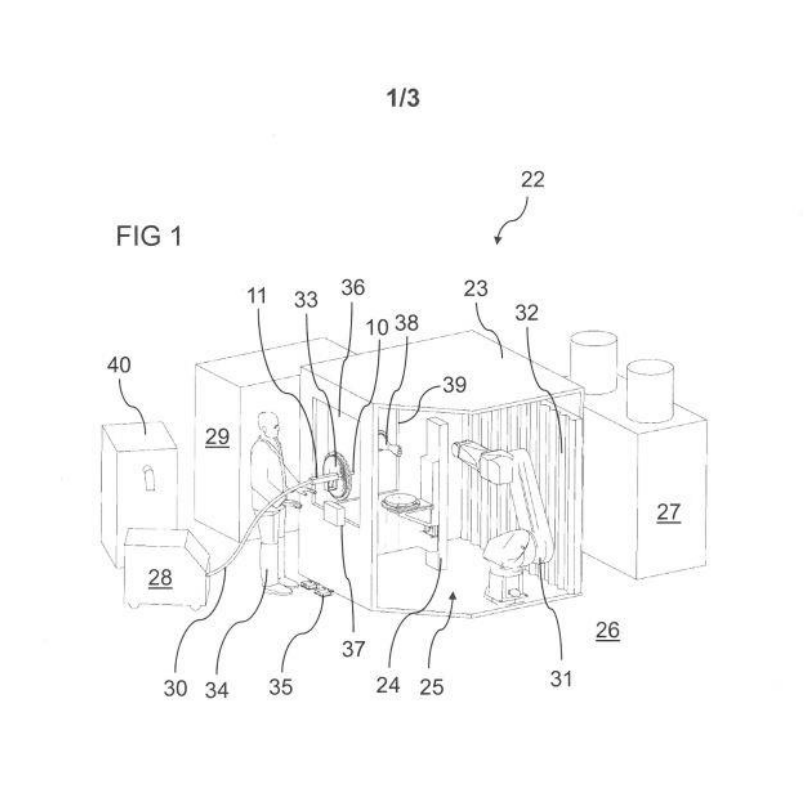
Internal nozzle geometry



Surface structure



Automation



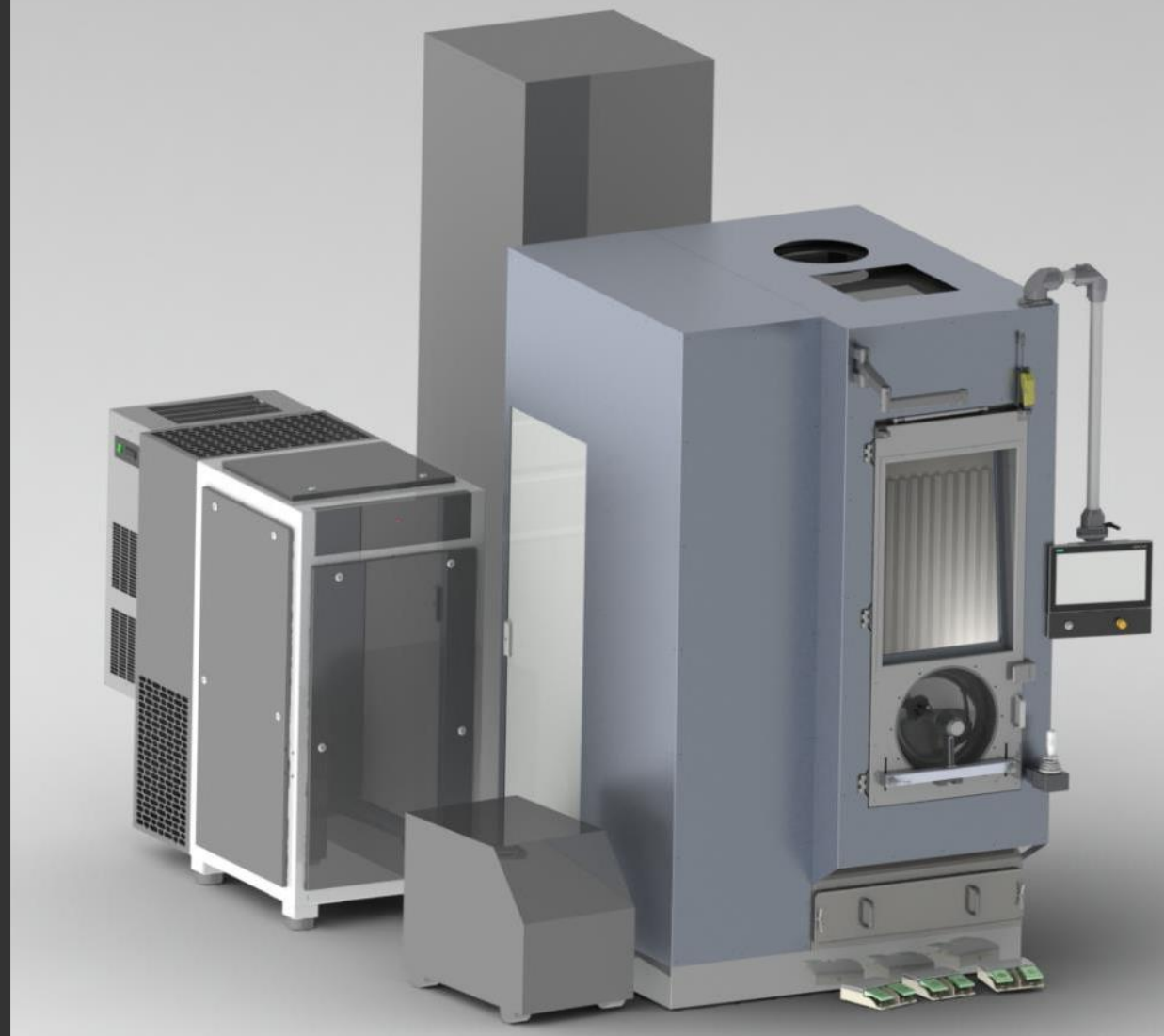
SEMI-AUTOMATED SUPPORT REMOVAL

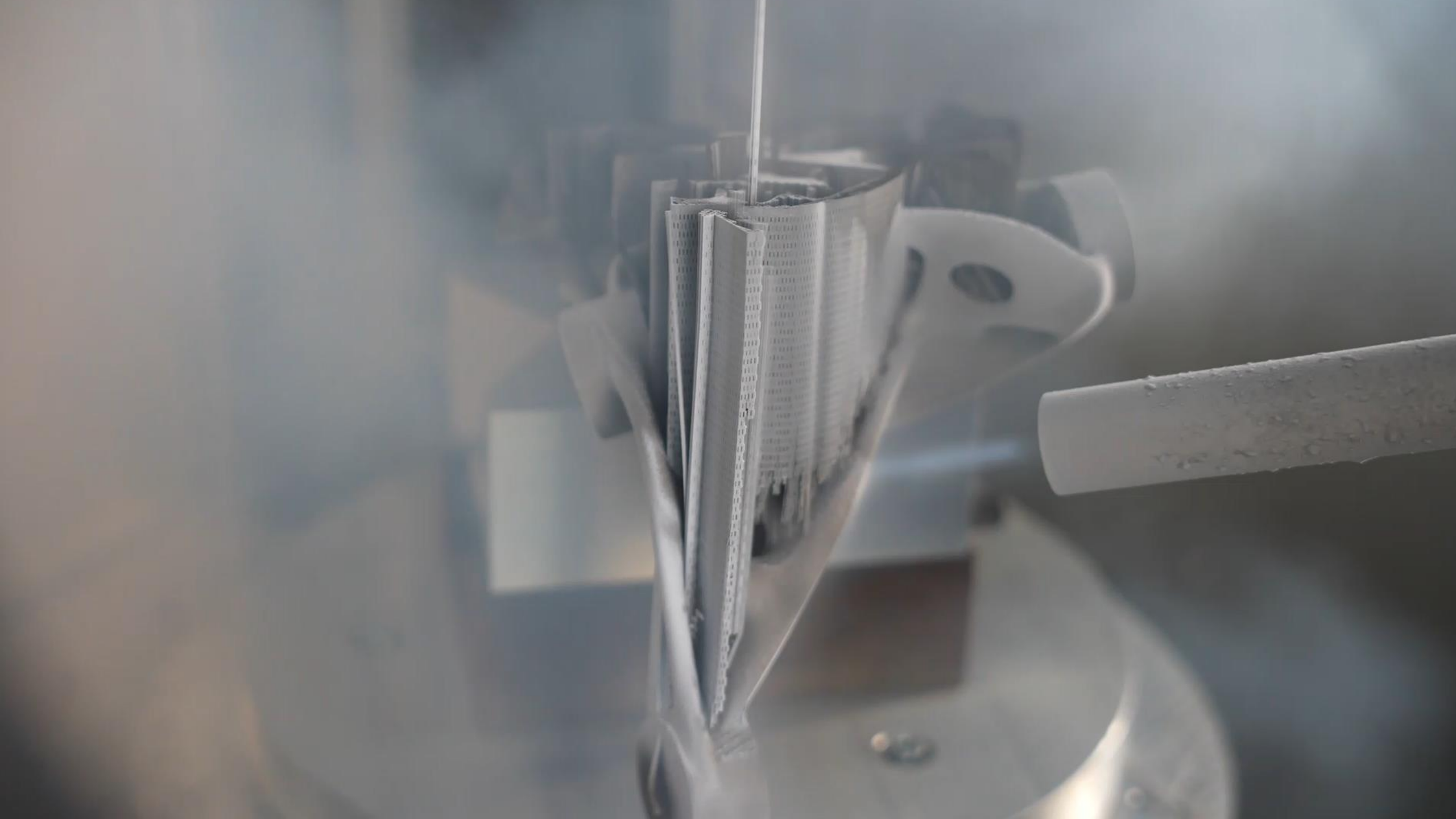
- Manual blasting:
  - Operation of the 3-axis with foot switches or joystick
  - Gun is held and operated by trigger
- Or **semi-automatic**:
  - Execution of stored table movements
  - Gun is operated manually by trigger

\+ Advantages
  - **Ergonomics, process stability, time and cost savings**

– Disadvantages
  - Availability and fast processing of dry ice (own dry ice production)
  - Adjustment of the support parameters may be necessary

- Outlook: **Fully automated using robots**





Knowledge transfer: Yesterday

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Knowledge transfer: Today

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ADDITIVE FERTIGUNG
Knowledge transfer: Today
Animation Timelline
1x
00:04
TÜREN ENTRIEGELN
KAMMERTÜR ABSAUGEN
TÜRSCHWELLE ABSAUGEN

Exhibition presence: Today

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Exhibition presence: Tomorrow

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Exhibition presence: Yesterday

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SYSTEM & PERIPHERAL

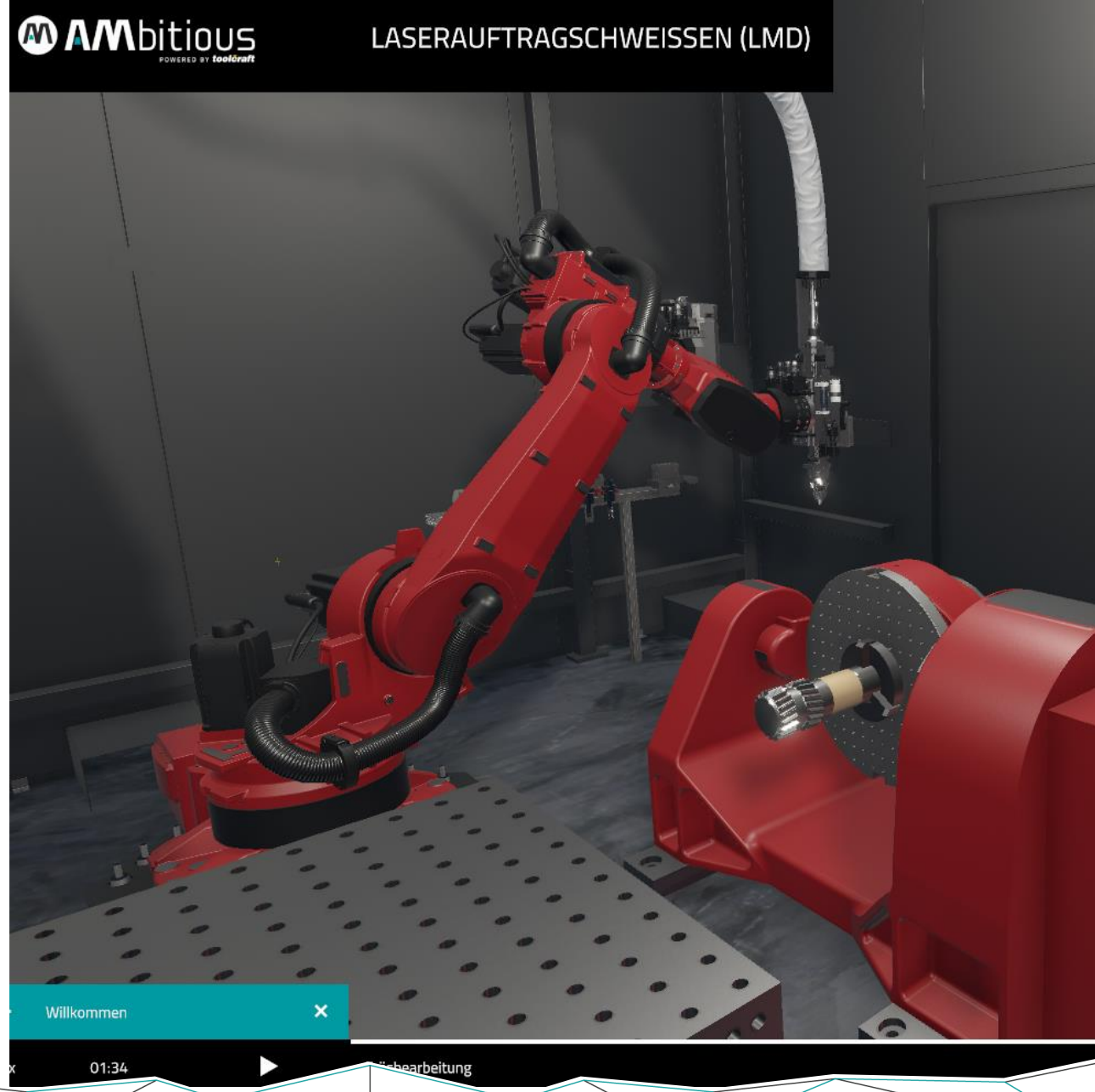
VIRTUALIZATION

Added value for **Marketing & Sales** purposes:

- Trade fairs: VR glasses instead of a physical machine
- On-demand (for quick sales pitches)
- Flexible access in terms of time and location, international
- Individual expansion stage: animations, information fields

Added value for **training purposes:**

- Training machine/peripheral devices
- Digital/virtual operating instructions
- Digital/virtual commissioning



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WE LEVERAGE 13 YEARS OF EXPERIENCE IN AM

FOR YOUR PROGRESS

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2011

Additive manufacturing of high-end components

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2019

Consulting, training and software
for additive manufacturing

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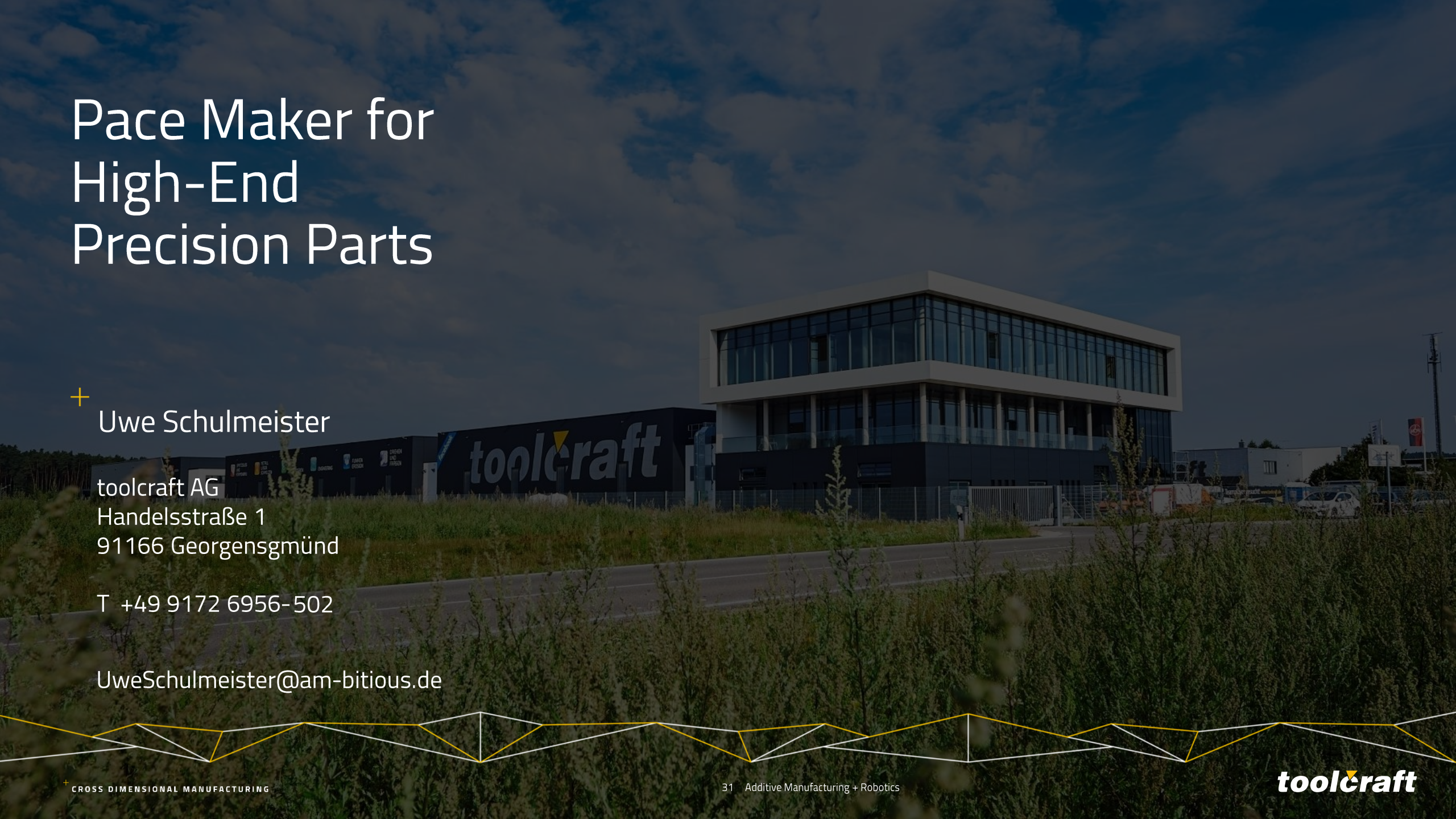
Pace Maker for High-End Precision Parts



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