POLY-SHAPE

addiCtive manufacturing

Let's shape the future together

Poly-Shape introduction

Dr. Stéphane Abed
CEO

I- Introduction of Poly-Shape and collaborative strategy

- Founded in France in 2007 as a Spin off of ILT Fraunhofer

- **Collaborative strategy and Core business** :

  - Accompanying and Managed change impacts of additive Manufacturing (AM) in the business of our customers (Partnerships and Open innovation)

  - Identify business cases and demonstrate the added value of AM

  - Design for AM, Qualify AM processes for serial production with adapted quality standards

  - Do serial production and /or partnership for production at the customer site (Make or/and buy strategies)

- **Total Turnover 2016** : 23 Millions Euros

- **Organized in 2 divisions** : Poly-Shape (AM) and Poly-Shape Industry (Machining)

I- Introduction of Poly-Shape company

Our core competencies :
Internal Complete integration of the know how

Design optimisation for ALM
(for Cost, performance and production)

Quality management

Quality control
Chemical, Mechanical
and dimensional

Production
(process optimisation and
qualification)

Post processing
Heat treatment ,
Milling and finishing

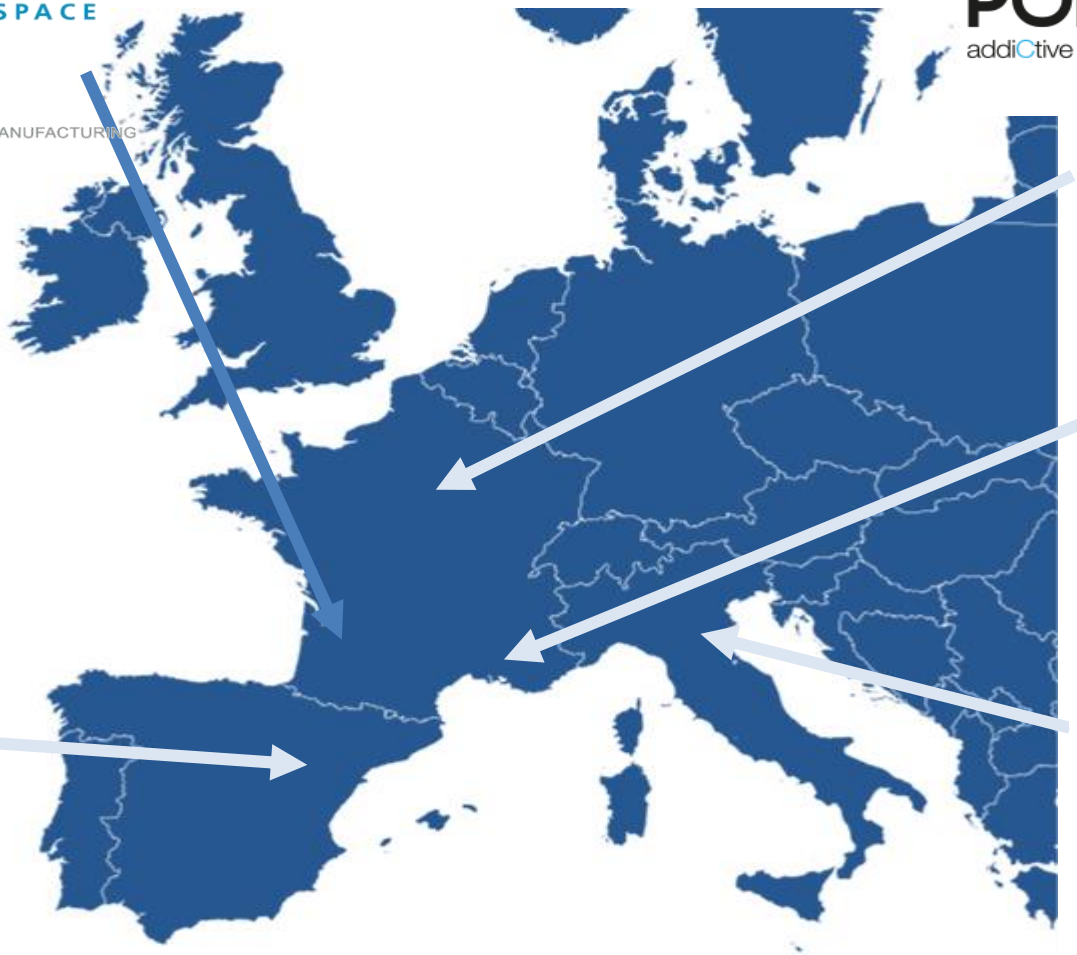
Poly-Shape companies and subsidiaries in Europe AM capacities

Additive Manufacturing team : 105 employees and 4 production sites

lisi AEROSPACE
ADDITIVE MANUFACTURING
POWERED BY POLY-SHAPE

POLY-SHAPE
addiCtive manufacturing

Aerospace and Aeronautical parts production
ISO 9001:2008 and EN 9100:2010



Aerospace and Engine parts production
ISO 9001:2008 and EN 9100:2010

Medical, Aerospace and Engine parts production
ISO 9001:2008 , EN 9100:2010
EN 13485 :2003

POLY-SHAPE Iberia
Madrid (Spain)
Medical parts production

POLY-SHAPE G-N
Motorsport addiCtive manufacturing

Automotive parts production

Metal ALM Department :

Powder bed deposition capacities

- **31 Metal Machines** from 5 different suppliers (EOS, Concept laser, SLM Solution, Trumpf and ARCAM)

- **16 different models of machines** :
  - Mono, twin and quad laser systems
  - Small to very large manufacturing chambers
  - Laser or Electron Beam melting process
  - With integrated quality monitoring systems
  - Machines dedicated per material
  - Large production capacity (17 500 middle size parts produced in 2016, 10% prototypes and 90% serial production)

- **2 machines dedicated to new materials and parameters developments**

- **1 test machine equiped with special quality sensors (Gas analysis, …)**

…

ConceptLaser : Xline 2000R, 1000R, M2 Dual, M2, M1 and Mlab
SLM Solution : SLM 500 4 lasers, SLM280 2 lasers and SLM 250 2 lasers
EOS : M400, M290, M280 and M270
Trumpf : Trumaform 250 and Truprint 1000
Arcam : Q20 plus and Ax.

Metal ALM Department :

Laser Metal deposition capacity (DMG Lasertec 65)

Hybrid system :

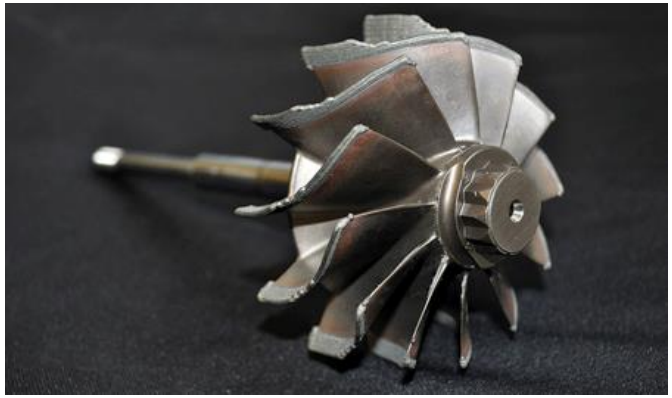
Additive and machining in the same machine

Multi material system :

Switch or gradient of material in the same machine

Adding features on existing parts

Repairing used or damaged parts

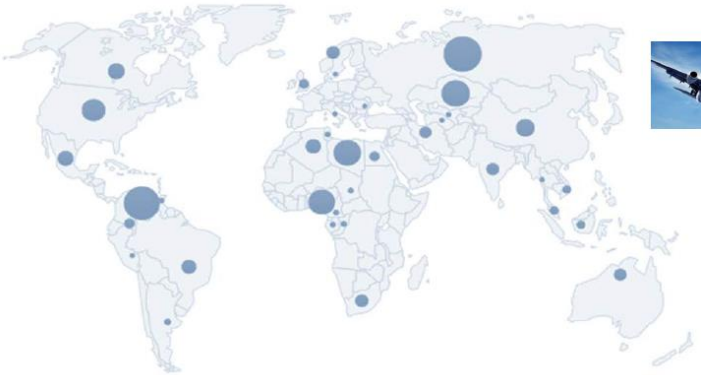


Poly-Shape companies and subsidiaries in Europe
Machining capacities

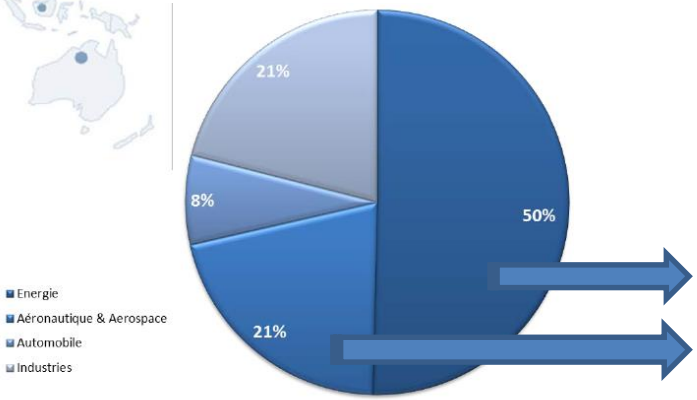
Machining team : 106 employees and 5 production sites

Poly-Shape Industry

- **Botia Mécanique,**
- **Usinalp,**
- **Criballet**
- **A3M**
- **GMP**



Main markets



71% in Energy and Aerospace
(including Turbomachines components)

Poly-Shape companies and subsidiaries in Europe
Machining capacities

POLY-SHAPE INDUSTRY

Manufacturer of Generator Components

Usinalp is a CNC manufacturing company and a part of Poly-Shape Industry.

afaq ISO 9001 Qualité AFNOR CERTIFICATION

The Parts of Turbomachinery :

- Gas, Steam and Hydraulic Turbines
- Industrial compressors of alternative gas and centrifugal,
- High power alternators (above 20 MW),
- Industrial pump.

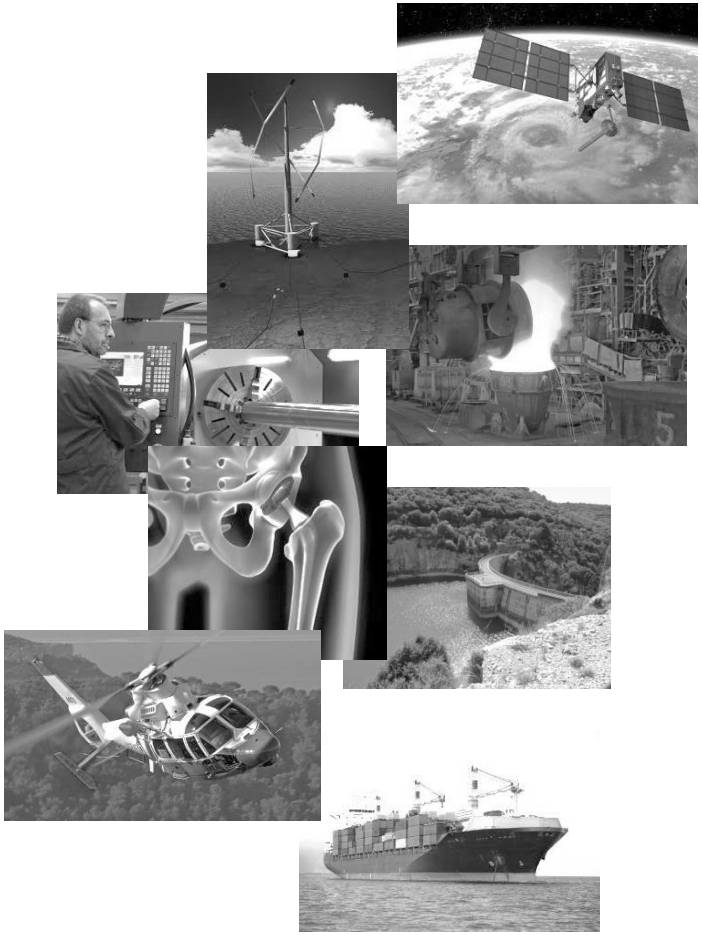
Poly-Shape companies and subsidiaries in Europe
Machining capacities

POLY-SHAPE INDUSTRY

Skills and Know-how

- Flange Coupling and Shaft Coupling for alternator
- Trays of flanges holder for alternators
- Body Cylinder
- Shaft seal ring
- Steam intake assembly (Grid and Valves)
- Steam Control unit (Cast Cylinder liner – Piston body – Spacer – Pallet)
- Nozzles and Coupling
- Grid Valve and Assembly
- Steam Diaphragms (Ø 2000 mm Max)
- Rotor Turbine
- Spacer ring
- Bearing for Turbine
- Servo Cylinder
- Slide for Turbine
- Wheel and shaft for Pump
- Blades for Turbine (Moving and None Moving)
- All special Thread

Our main markets



French Aerospace best SME 2014 Award

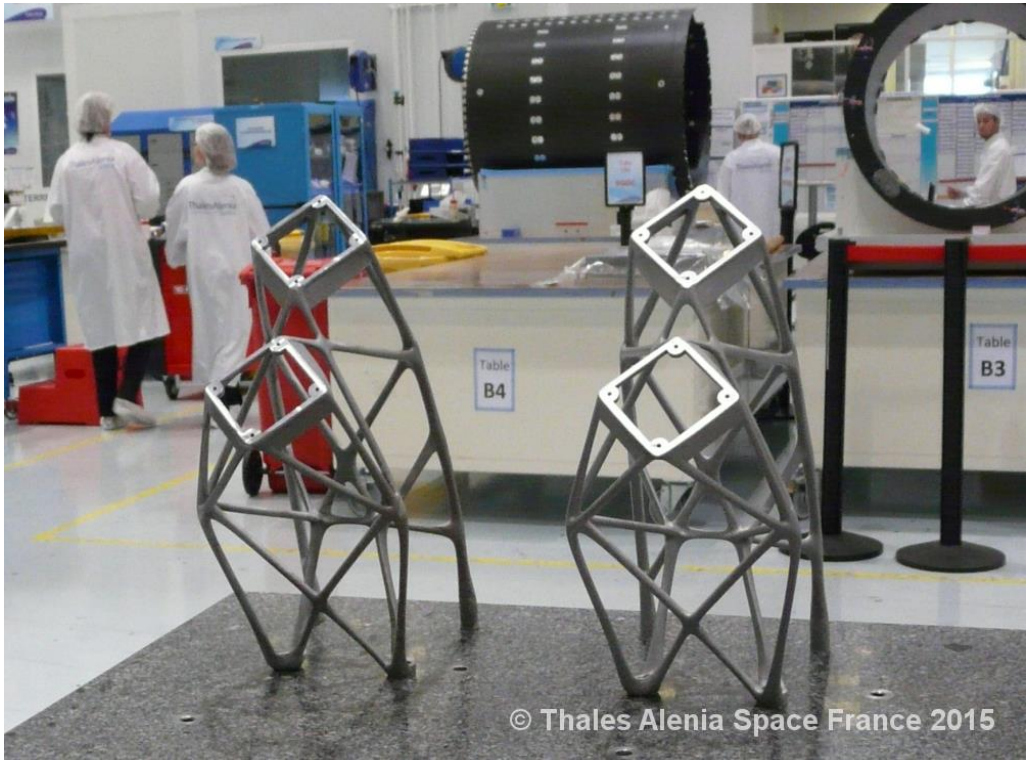
- Medical
- Automotive
- Aerospace
- Power generation
- Tooling…

Example of an industrial collaboration and AM application

Design optimisation by Poly-Shape using FEA on lattice structures

Weigth reduction in an Aerospace application

Design optimisation by Poly-Shape using Topology optimisation



Example of an industrial collaboration and AM application (Space field)

Design For Additive Manufacturing :

2 aspects : Innovative concepts and adapted Design tools (Guidelines, Softwares,…)

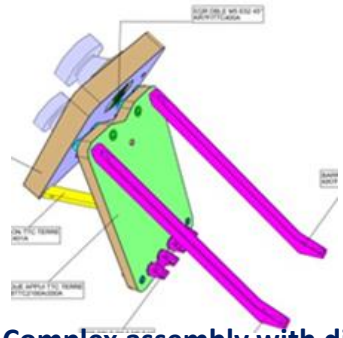
Creativity

Lattice structures, Topology, features and mecanisms integration,…

Open Innovation

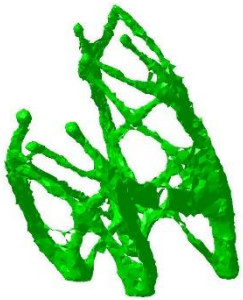
Largest European LBM parts qualified for space flight (2015)

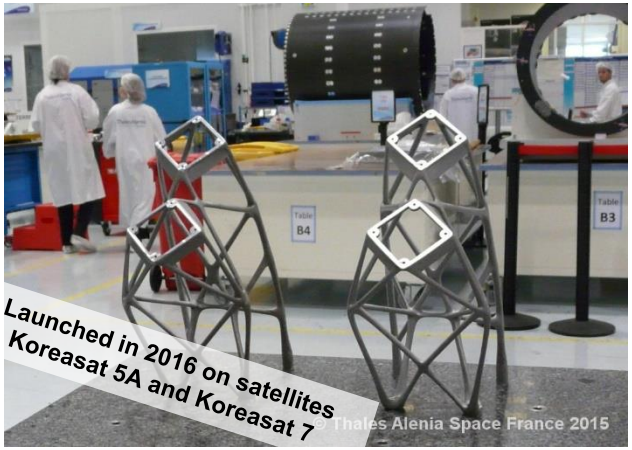
Original design



Complex assembly with different technologies

Topological optimisation



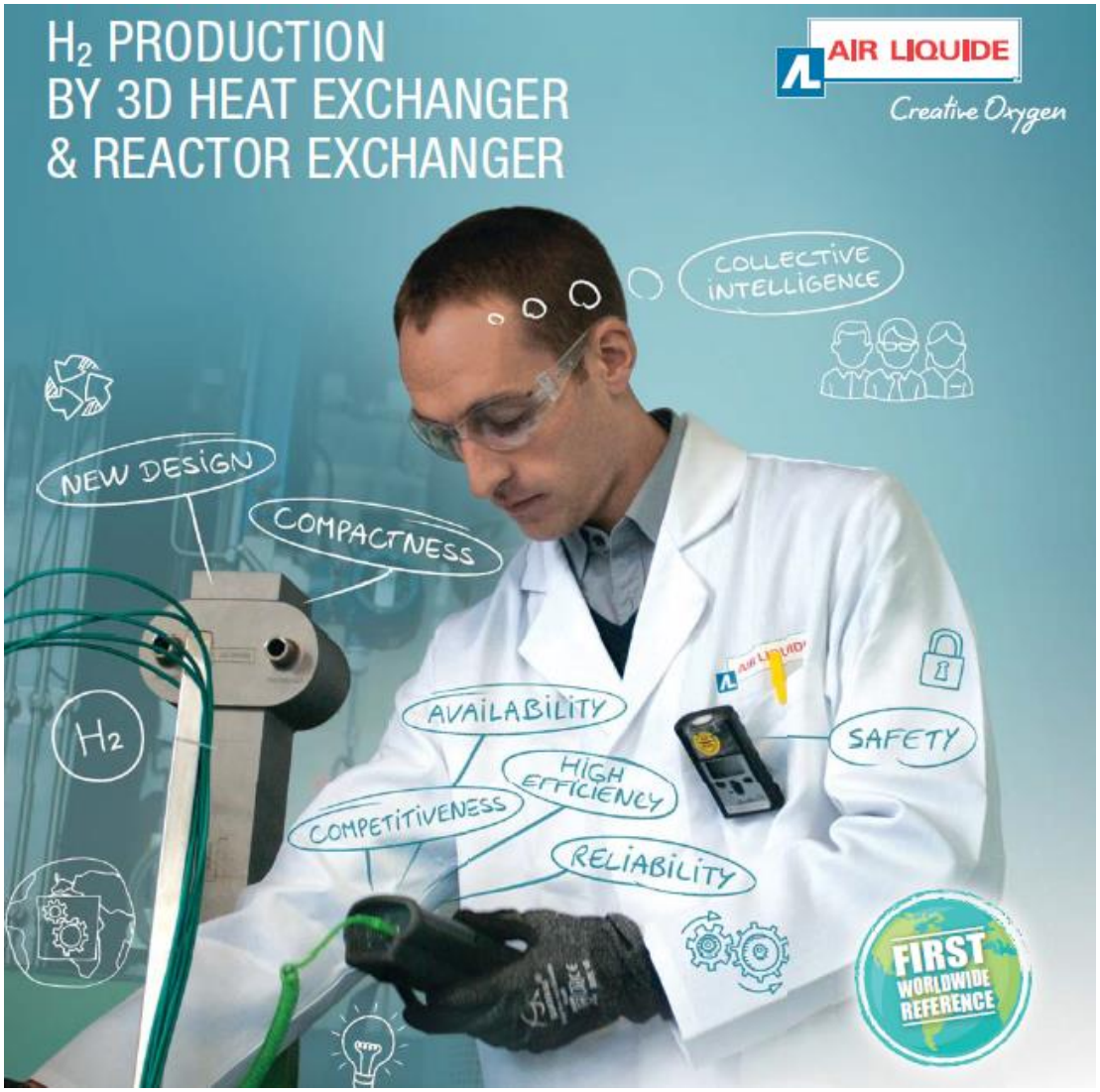


- **Mass saving :**

1,46 kg → 1,13 kg -22%

- **9 parts replaced by 1**
- **Design & Manufacturing cost savings demonstrated**

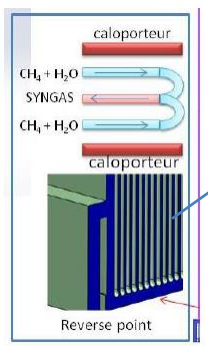
Example of an industrial collaboration and AM application (Energy field)



Example of an industrial collaboration and AM application

First Hydrogen generator produced by AM in the World (2015)

- Large and complex components (over 120 kg, 500 x 400 x 500 cm)
- DFAM brings to higher performances and cost reduction during the AM process
- Ni based alloy
- High temperature (up to 900°C) and high pressure (up to 20 bars)
- Complex and long qualification process

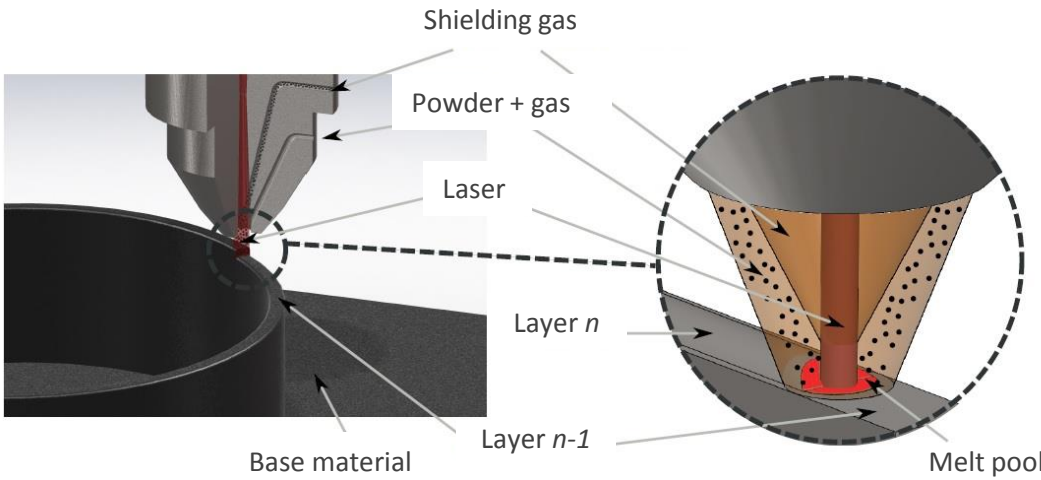


2 tonnes of H2 generated in 2016

Laser Metal Deposition process

LMD Process specificities

- Hybrid 5 axis cladding/milling machine
- Working area:
  - Machining : 735 x 650 x 560 mm^3
  - Cladding: Ø500 x H400
    - Build rate (cm^3/h) : 20-200 (typically 100)
    - Surface roughness (Ra, µm) : 5 – 30 (typically 15)
    - Layer thickness (mm): 0.2 – 1.5 (typically 1.0)
    - Density: ≥ 99.5%
- 1st machine in France



Source : Rémi Ponche, 2013, PhD thesis

LMD – impeller production with case 2

- Step 1: hub cladding on a blank shaft

- **Parameters**
  - Ø spot ≈ 3,0 mm
  - Adaptative Process Control (keep the melt pool size constant)
  - Layer thickness ≈ 0,9 mm

➔ Excellent thermal stability

⇒ Dimensions post production : 1.5 mm stock

⇒ Blank compliant for hub finishing

LMD – impeller production

- Step 4: Blades milling

Thank you for your attention !

An European leading company in Additive Manufacturing