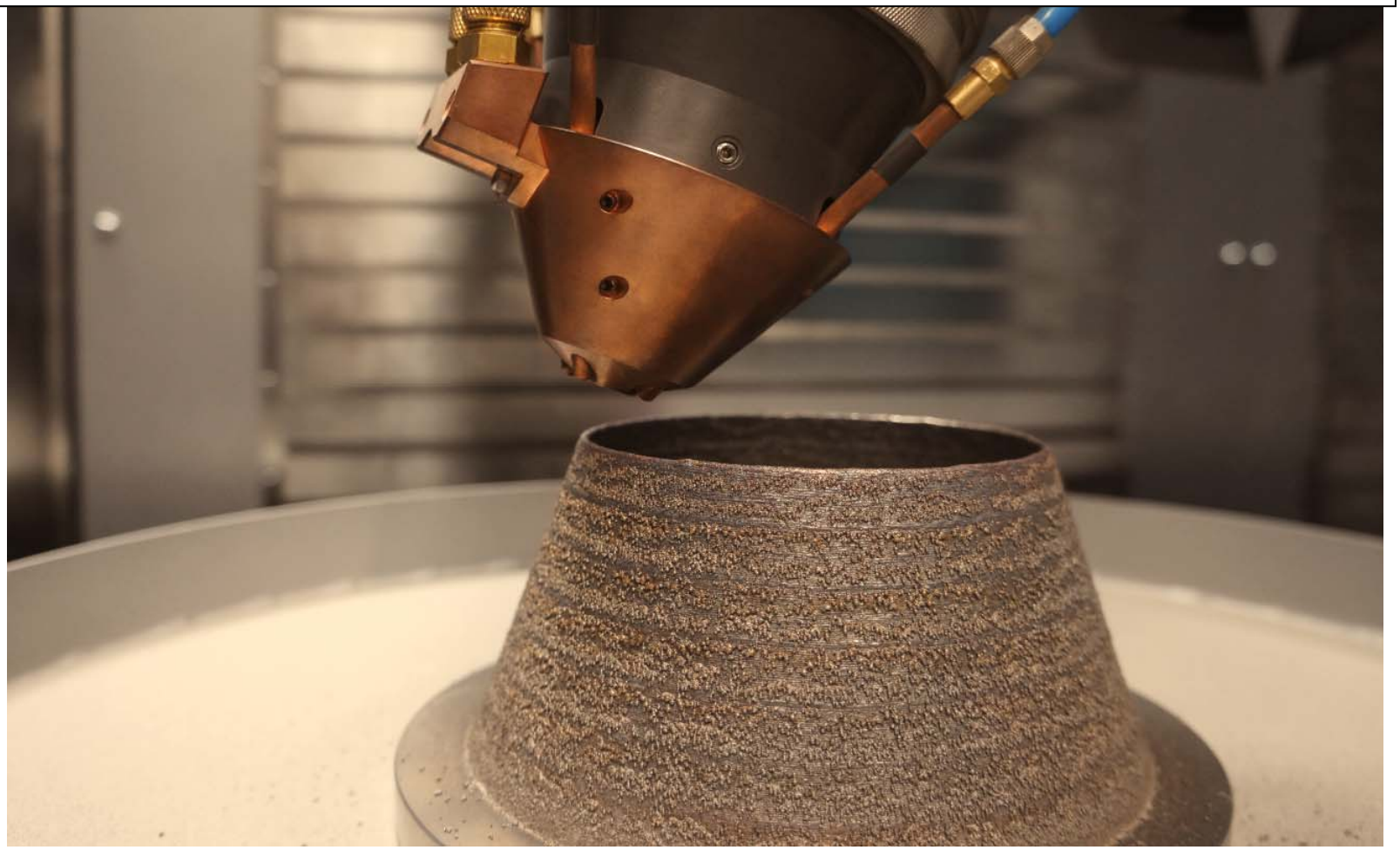
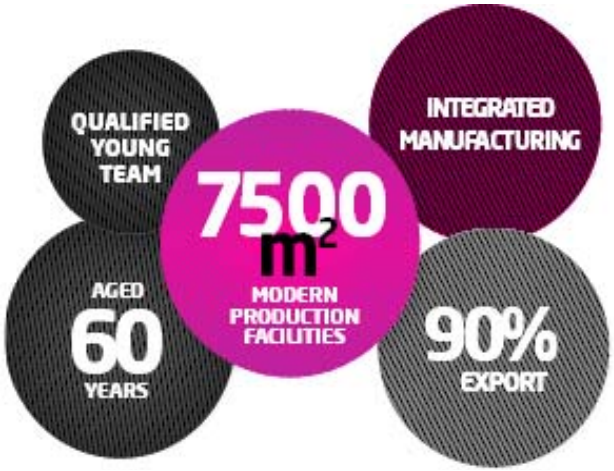
ADDITIVE MANUFACTUTING CONFERENCE

ADD&PROCESS

The Hybrid Machine Solution From IBARMIA



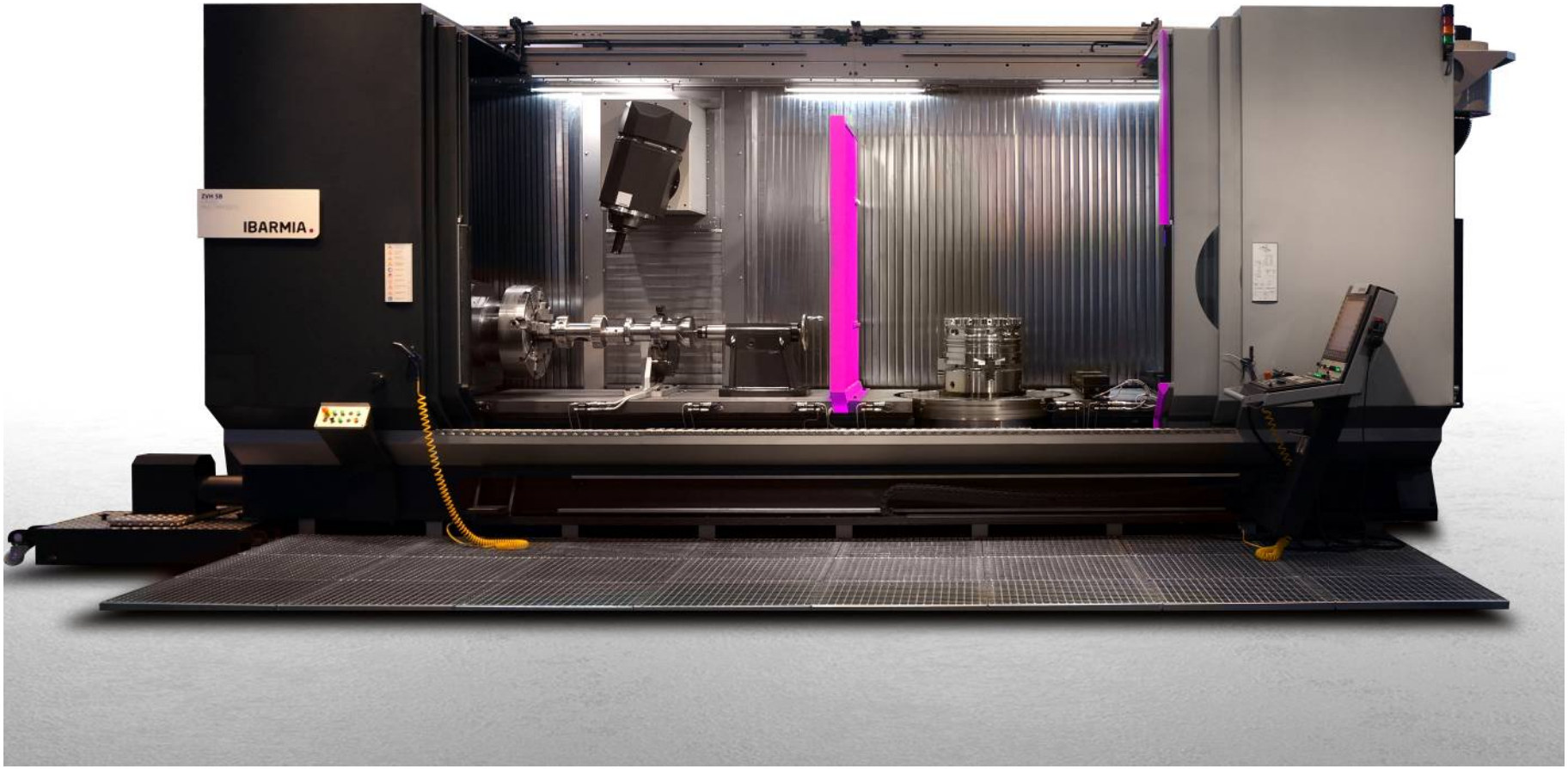
IBARMIA Who and where we are



IBARMIA.
your machine-tool point

IBARMIA Our product

MOVING COLUMN Machining Centres



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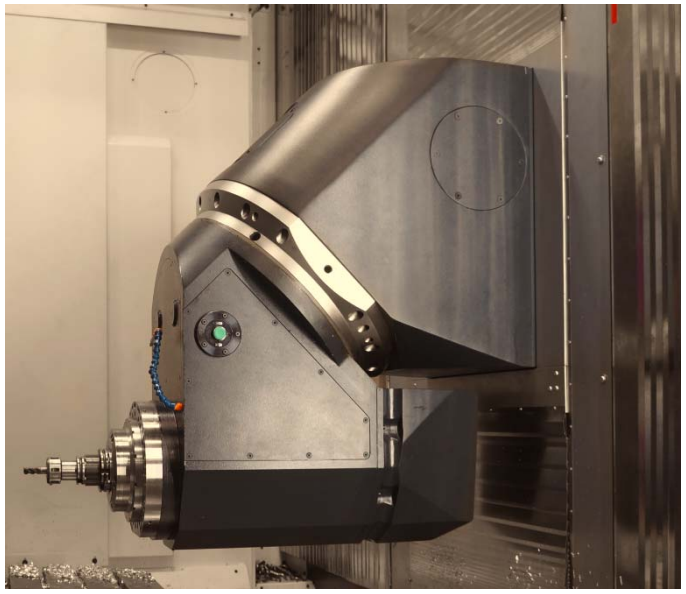
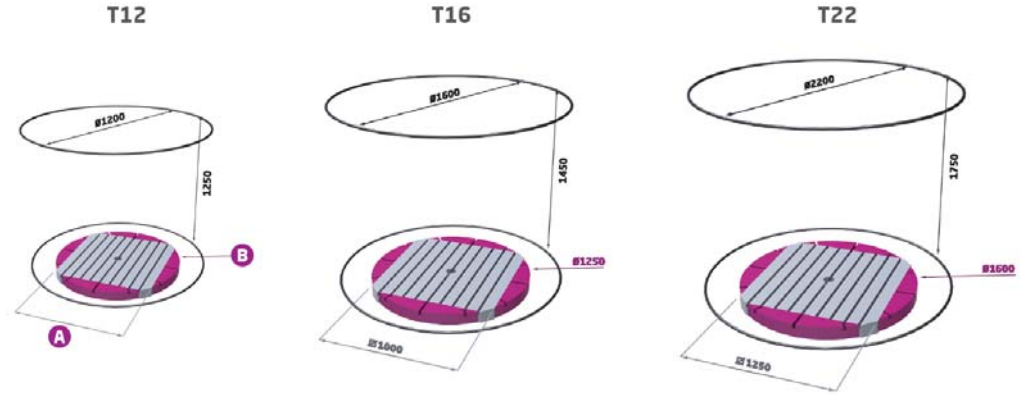
your machine-tool point

IBARMIA Our product
T series Machining Centres





A	ø800x800	ø1000x1000
B	ø1000	ø1250

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IBARMIA Our product

MACHINES FOR CIRCULAR PIECES

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Why IBARMIA develops a solution for additive manufacturing?

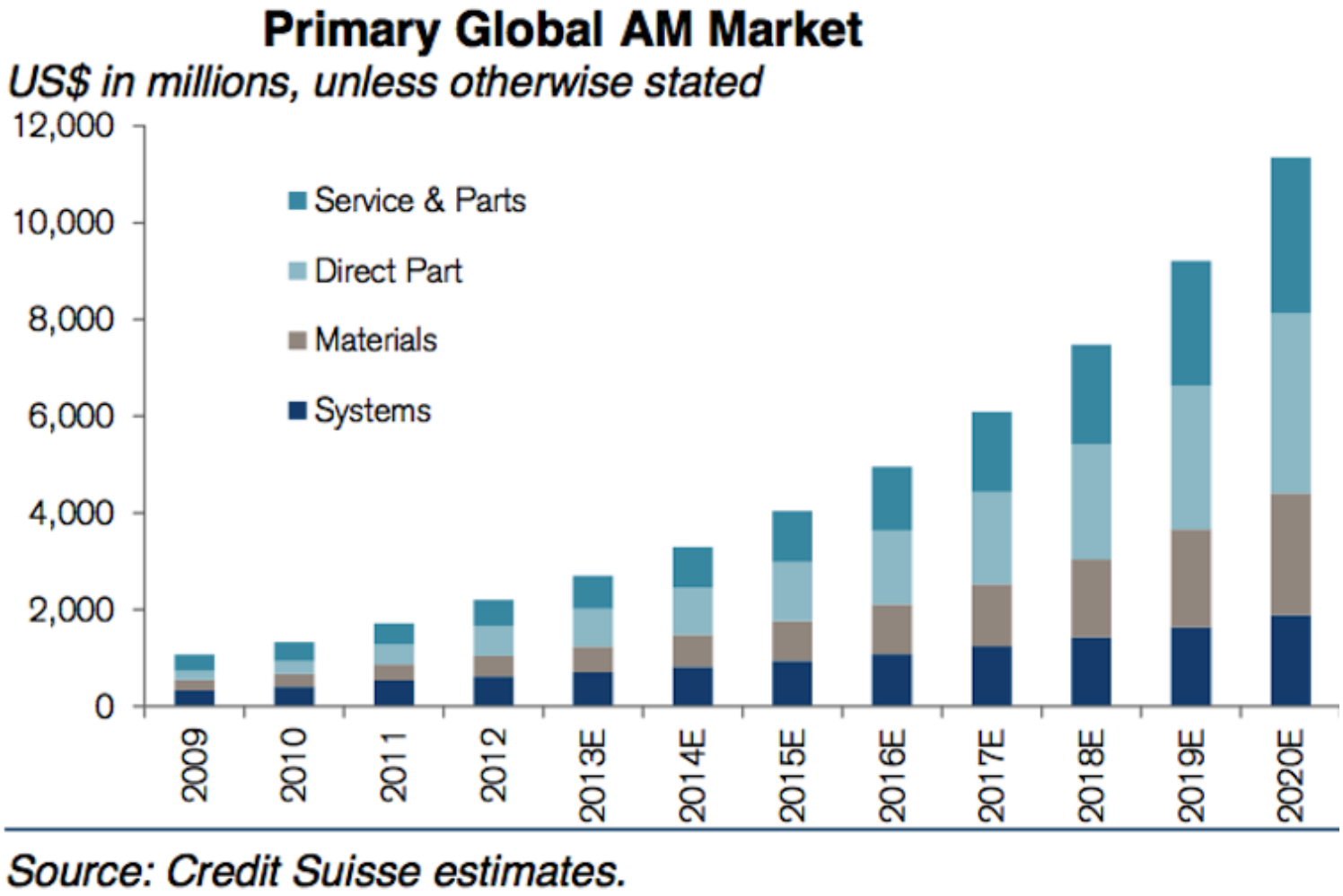
TECHNOLOGICAL PLAN OF IBARMIA.

- **Unmanned machine** — **Automatization solutions for T and ZVH series**

- **Multiprocess capabilities** — **Adding new functionalities:**
- **Smart machine. Industry 4.0** — **Intelligent functions**

- **Additive manufacturing appears as an opportunity??**
  - **General AM market**
  - **New potencial customers**

Additive manufacturing market is booming?

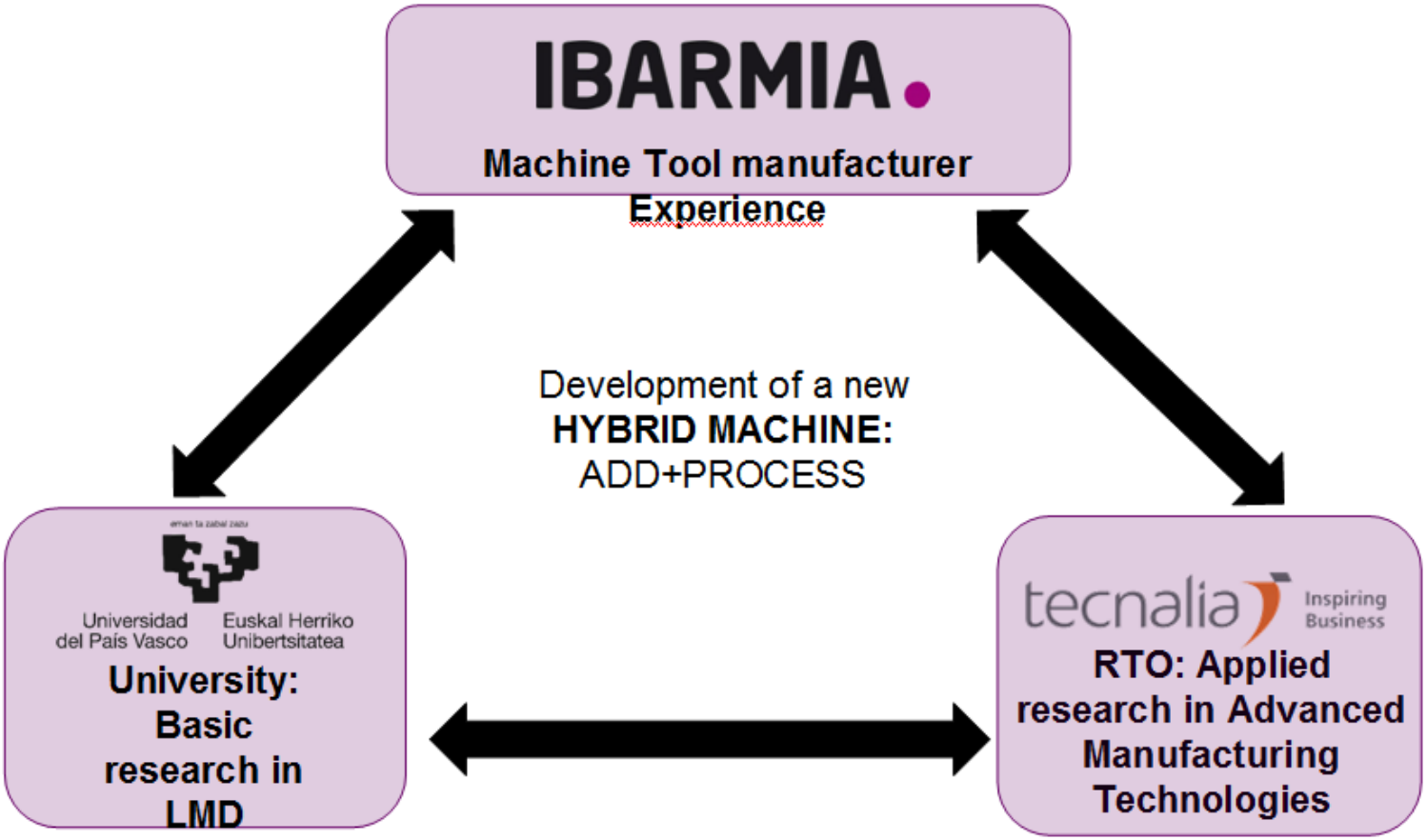


Source: Credit Suisse estimates.

NEW MARKETS FOR IBARMIA??

- **Aeronautic:**
  - Manufacturing of some specific turbine components.
  - Repairing of turbine blades.
- **Mould and Die:**
  - Repair of defects during machining or in-service.
  - Anti-wear coatings on tool steels.
- **Energy**
  - Manufacturing of some specific turbine components. **HYBRID MANUFACTURING**
  - Repairing of turbine blades.

Repairing of Damaged Impeller


IBARMIA.
Machine Tool manufacturer
Experience
Development of a new
HYBRID MACHINE:
ADD+PROCESS
Universidad del País Vasco
Euskal Herriko Unibertsitatea
University:
Basic
research in
LMD
tecnalia
Inspiring Business
RTO: Applied
research in Advanced
Manufacturing
Technologies

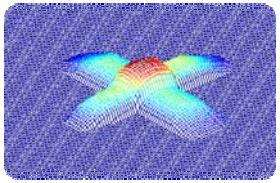
IBARMIA Working team. The Strength of Collaboration

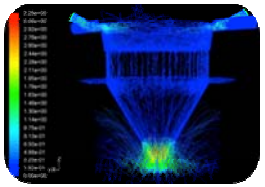
Basic Research

Commercial product

UNIVERSITY OF BASQUE COUNTRY, UPV/EHU

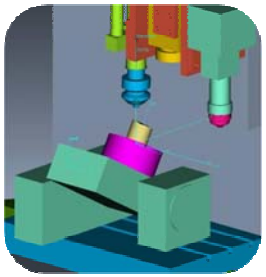
- Development of models for predicting the deposited geometry during LMD process for different materials.
- Development of thermal model for LMD process.
- Optimization of process parameters.
- Characterization of deposited material properties





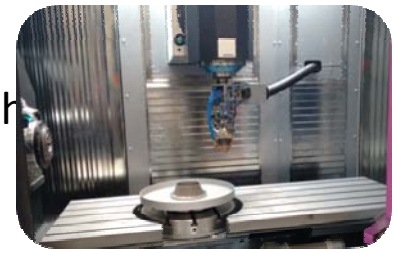
TECNALIA RESEARCH & INNOVATION

- Analisis of different AM Technologies and solutions
- Development of monitoring and control strategies
- Development of 5 axis strategies for AM + Machining



IBARMIA INNOVATEK, S.L.U

- Integration the LMD head and pheripheral accesories into th CNC machine
- Validation of the Hybrid machine into a real industrial environment
- Product Commercialization



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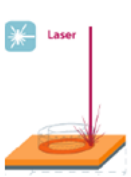
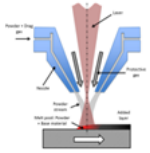
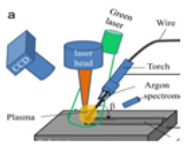
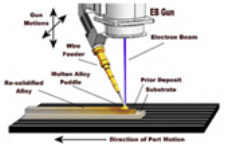
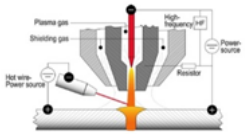
IBARMIA Analisis of differente AM technologies

	EBM/SLM	LMD-p	LMD-w	EBAM	WAAM
Integrable in M-T	No	Yes	Yes	No (vacuum)	Yes
Productivity	Low (0,1-0,2 kg/h)	Medium (~2 kg/h)	Medium (~2 kg/h)	High (~8 kg/h)	High (~8 kg/h)
Material efficiency	High	High (~30%, if recycled 90%)	High (90% with finishing)	High (90% with finishing)	High (90% with finishing)
Part integrity	Porosity	High	High	High	High
Part complexity	Very High	Medium-high	Medium-high	Low-Medium	Low-Medium
Cost	High	High	High	Very High (vacuum)	Low
Part Size	Small	Big	Big	Big	Big
Simplicity	Simple (co-axial)	Simple (co-axial)	Need of wire orientation	Need of wire orientation	Need of wire orientation
Heat distortion	Low	Low	Low	High	High
Accuracy	Medium-High	Medium	Medium	Low	Low
					

ADITIVE MANUFACTURING TECHNOLOGIES

IBARMIA'S PRODUCT RANGE ZVH multiprocess

Analyze different technologies to choose the one fits better with our machine

Add additive capabilities not loosing machining capabilities

ADD+PROCESS maximun versAtility

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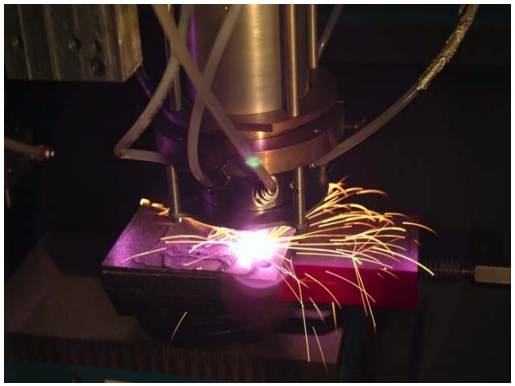
Why LMD-p (Laser Metal Deposition) Technology?



Advantages of LMD over other AM technologies:

- **Ease of integration** into a machining centre.
- **"Simple" programming** thanks to the use of powder: no need of wire orientation.
- **Low heat source** in comparison with AM processes based on arc welding: Lower thermal distortions.
- **Higher accuracy** than AM processes based on arc welding.
- **High part integrity.**

Docking Versus Fixed supply ducts

❑The **fixed supply ducts** solution brings the following **advantages over the docking option:**

- ✓ **ZERO intrusive** to machining
  - ✓ **Real 5 axis AD manufacturing**
  - ✓ **Easy adaptation to changes** in LMD equipment requirements
  - ✓ **Flexibility** to implement other laser based processes (surface treatment, cutting, welding…)
  - ✓ **Reliability**
  - ✓ **Quality/price balanced**

ZVH 45/L1600 MULTIPROCESS ADD+PROCESS

Milling / turning and laser cladding capacities in a moving column machining center

TURNING, MILLING AND ADDITIVE MANUFACTURING

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LMD Peripheral equipment

Main Equipment

- 3 kW power Fiber Laser Rofin FL 030
- Discrete coaxial nozzle Precitec YC52
- Powder feeder Sulzer Metco Twin-10C

Auxiliary equipment

- Chiller, shielding and carrier gas installation

Consumables

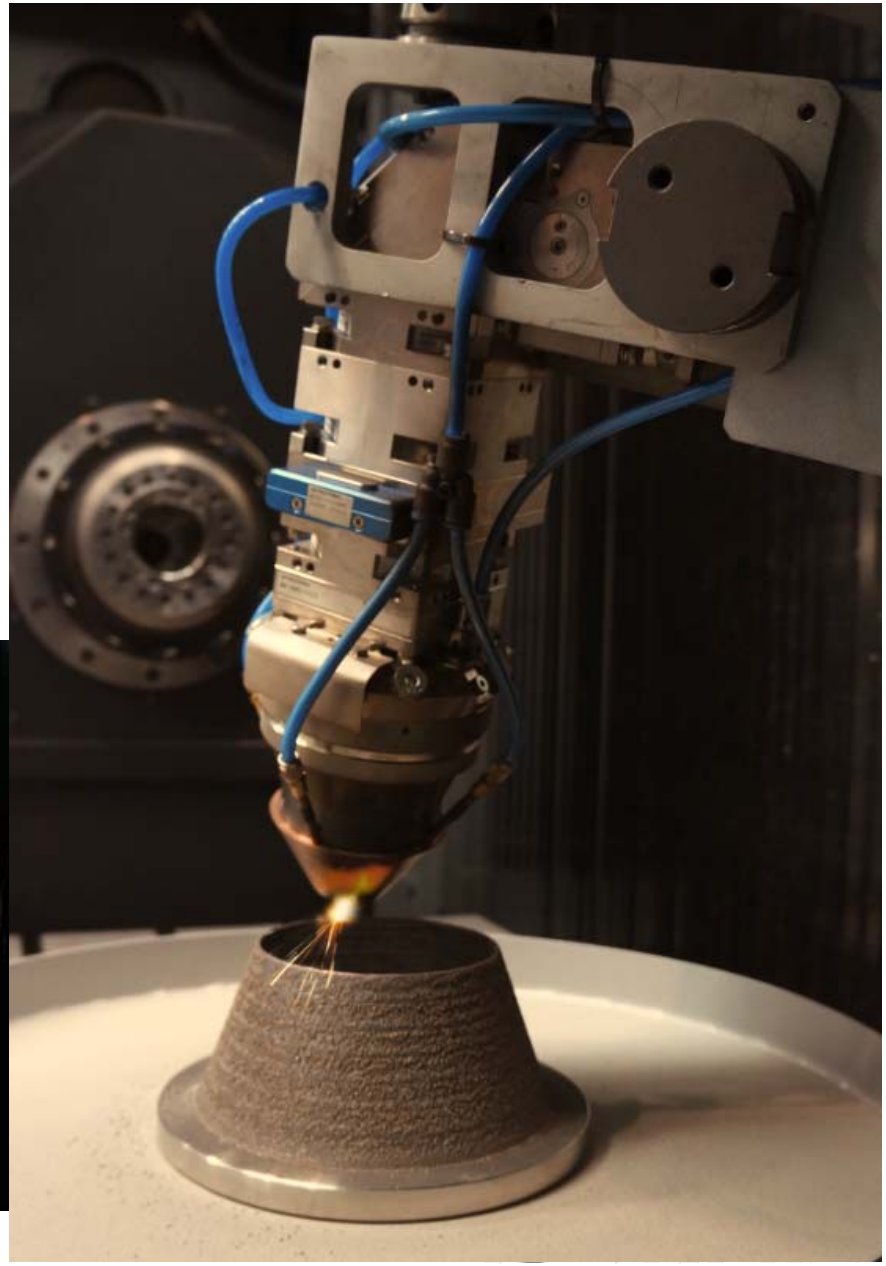
- Powders: Tool steel, Ni based alloys, ceramic, …
- Inert gas for shielding and carrier: Ar, He, Ni

IBARMIA Process research

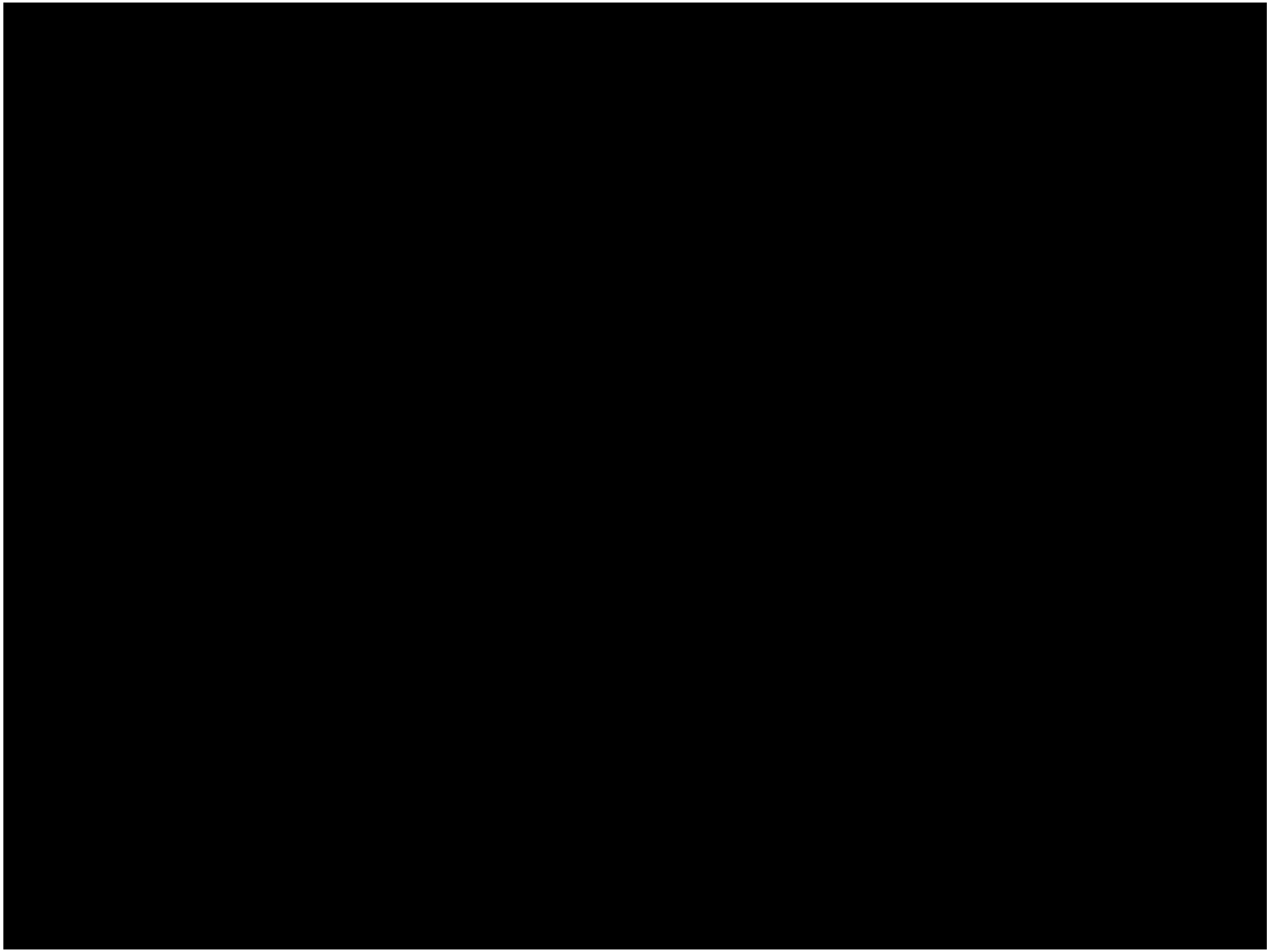
- Optimization of process parameters.

Development of control strategies

Development of 5 axis strategies for AM + Machining



Machine Video



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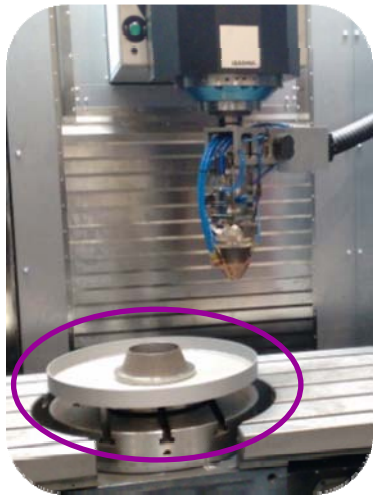
ZVH MultiPROCESS Machine + ADDitive LMD Equipment
=
ADD&PROCESS Hybrid Machine

- **Full 5 axis** in machining and LMD-p
- Multiprocess **machining performance respected 100%**
- Switching between LMD and Machining **totally automated** (HSK + Pick Up for LMD head)
- **LMD**, a completely integrated **modular option** of the Multiprocess machine
- Use of the whole machining volume for AM operations. **Available in our complete machine range. (1.100mmx1.300mmx12.000mm)**

- **Isolation and recovery of excess powder:**
  - Automated powder recovery system for recycling and reusing it and obtaining a 100% of material efficiency



Actual "manual" recovery solution

- **Development of control loops to control the process by introducing new sensors:**
  - Power/temperature control in order ensure evenly grow per layer deposited and consistency in micro structure.
  - Monitoring of deposited geometry by using 3D laser scanning systems.

- **Development of 5 axis complex strategies.**
- **Integration of databases to control with optimum process parameters for different materials.**

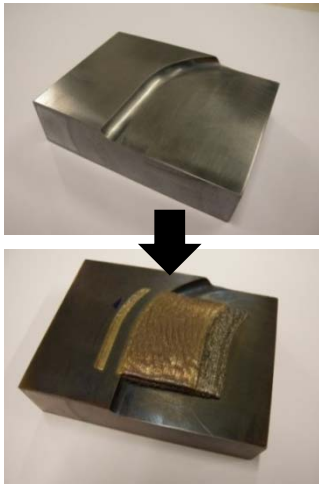
THANKS FOR YOUR ATTENTION!

See these parts and the Hybrid machine at

HALL 5, STAND C10-D07

(Live demonstrations every 2hours)

AISI 316L, P= 720W, f= 750 mm/min, $\dot{m}$=18 g/min



LMD test for die repair

Blade direct manufacturing

tecnalia Inspiring Business

Universidad del País Vasco Euskal Herriko Unibertsitatea

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