БЪЛГАРСКА ТЪРГОВСКО-ПРОМИШЛЕНА ПАЛАТА
BULGARIAN CHAMBER OF COMMERCE AND INDUSTRY

Technical University of Sofia

The significant problems we face, cannot be solved at the same level of thinking we were at when we created them.

Albert Einstein

Innovations and Smart Industry

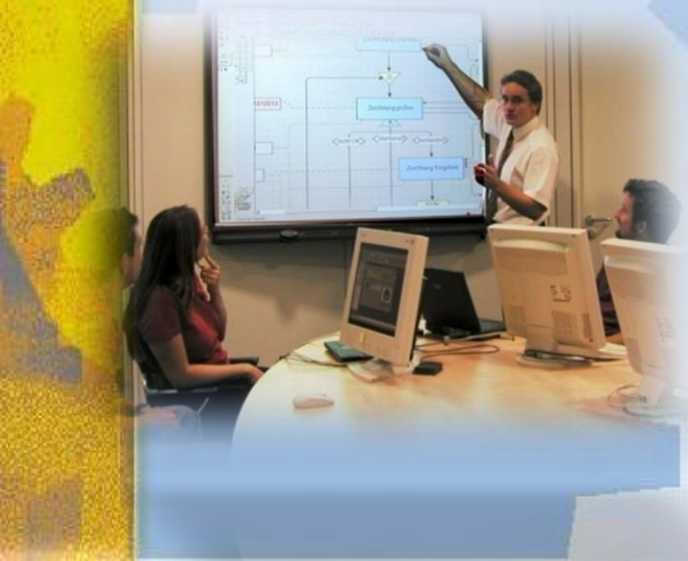
BCCI conference

09.07. 2018

Who we are ?

The Technical University of Sofia is :

- The biggest Bulgarian Technical University with more than 11 000 full-time, and a lot of PhD and post-graduate students.
- The academic staff of the TUS is more than 780 professors, assistant professors and researchers.
- The Research and Development Sector (R&D) of the TUS organizes, administrates and services of the research activities of TUS.



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Trends and Challenges of the Innovations

RESEARCH

CONSULTATION

Interdisciplinary,
praxis-oriented
research and education

Science meets Industry and Society!

TRAINING

Innovative
engineering solutions
and qualifications

ENGINEERING

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R&D Impact to Innovations and Tallents Inspiration

IMPLEMENTATION

Education and Research level improvement

EDUCATION QUALITY

INDUSTRY

INNOVATION

KNOWLEDGE

Scientific consulting, technology validation, execution and transfer

KNOWLEDGE GENERATION

R&D TU Sofia

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Challenges of the Innovations –
UNIVERSITIES TO INDUSTRY COLLABORATION

Industrial Partners and Universities look together for:

- New solutions
- New products
- New services
- New business models/IP management

- New curricula for modern engineering professions
- Individualized education and new competences
- Space for visions, communication and knowledge exchange with industry and society

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Strong R&D Activities Reflect to Cooperation in Innovations with a World Leading Companies as:

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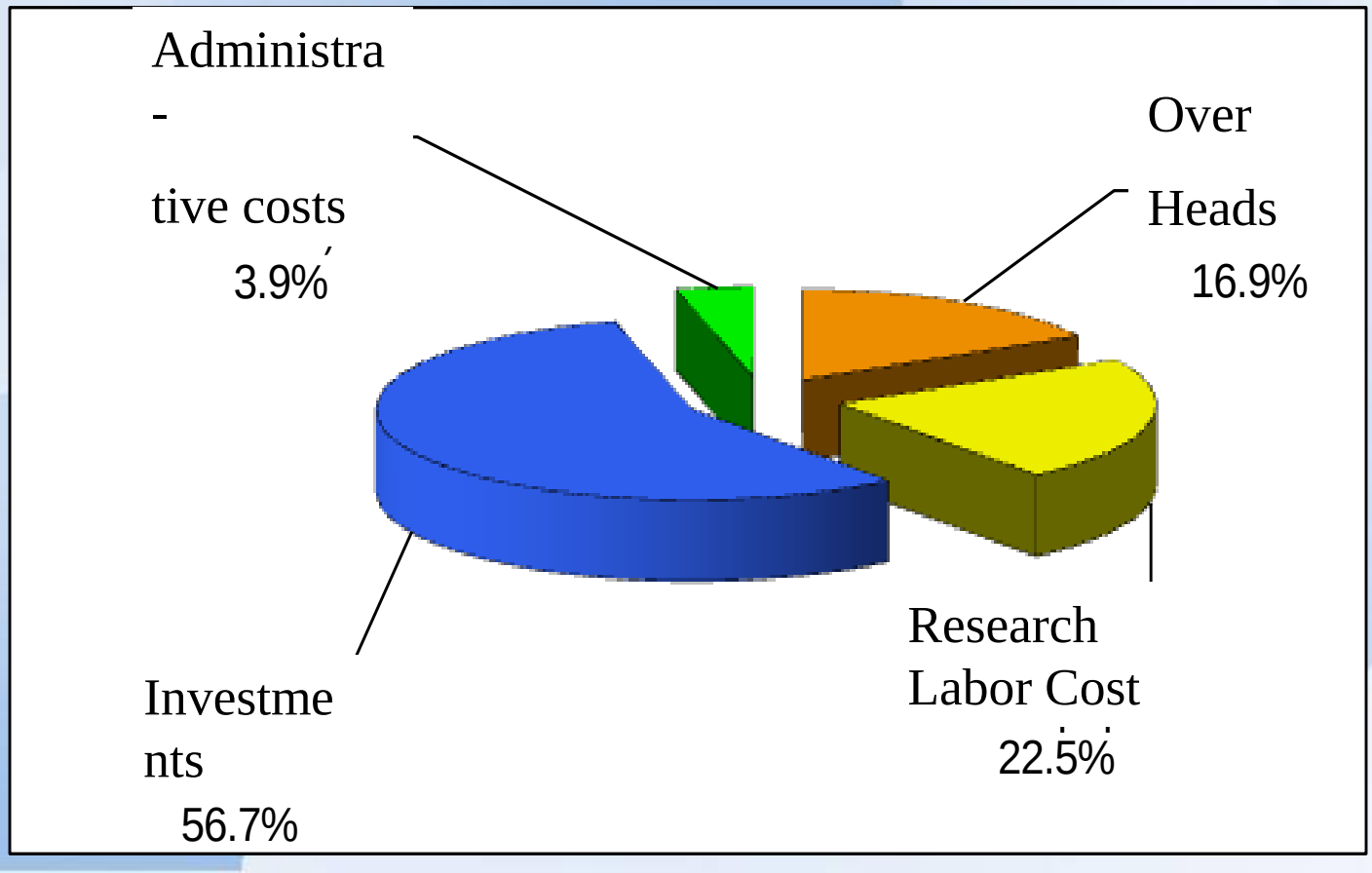
The Research and Development Sector (RDS) -Type of Expenses Distribution



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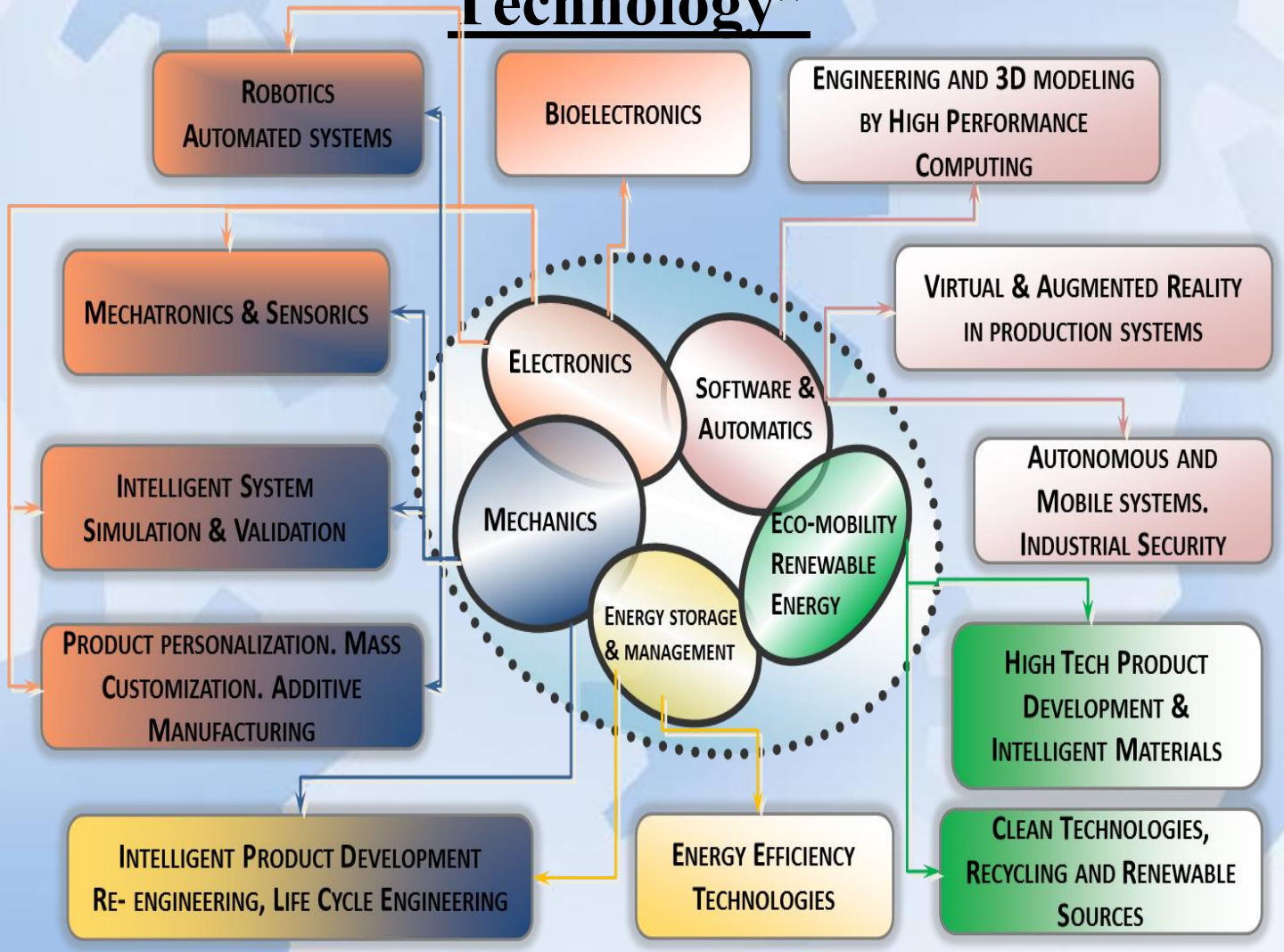
Centre of Excellence "Mechatronics, Smart & Clean Technology"



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CoE "Mechatronics, Smart & Clean Technology" goals:

- To develop innovative potential and technology level of researchers and business structures;
- To establish a basis for SMEs to research, develop, validate and test new ideas and products;
- To intensify dynamics processes of industrialization;
- To increase the economic effectiveness of innovative processes and creativity in Bulgaria;
- To increase private investments in these processes.

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Challenges of the Innovations :

Example of GOOD PRACTICES

R&D Laboratory "CAD/CAM/CAE in INDUSTRY"

www.3CLab.com

From the Idea to the Prototype …

Member of

CENTRE OF EXCELLENCE

www.ce-tus.eu

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Example of GOOD PRACTICES

R&D Laboratory "CAD/CAM/CAE in INDUSTRY“ was established on 1993.

Since 1995 Laboratory was grow up by collaboration and Projects with Industrial Partners from West Europe and USA.

Over 110 successful subcontracted projects with West European and USA Companies was developed in Laboratory.

In 2009 was established “ Centre of Ecxellence” , based on Synergy of 5 TUS R&D Laboratories

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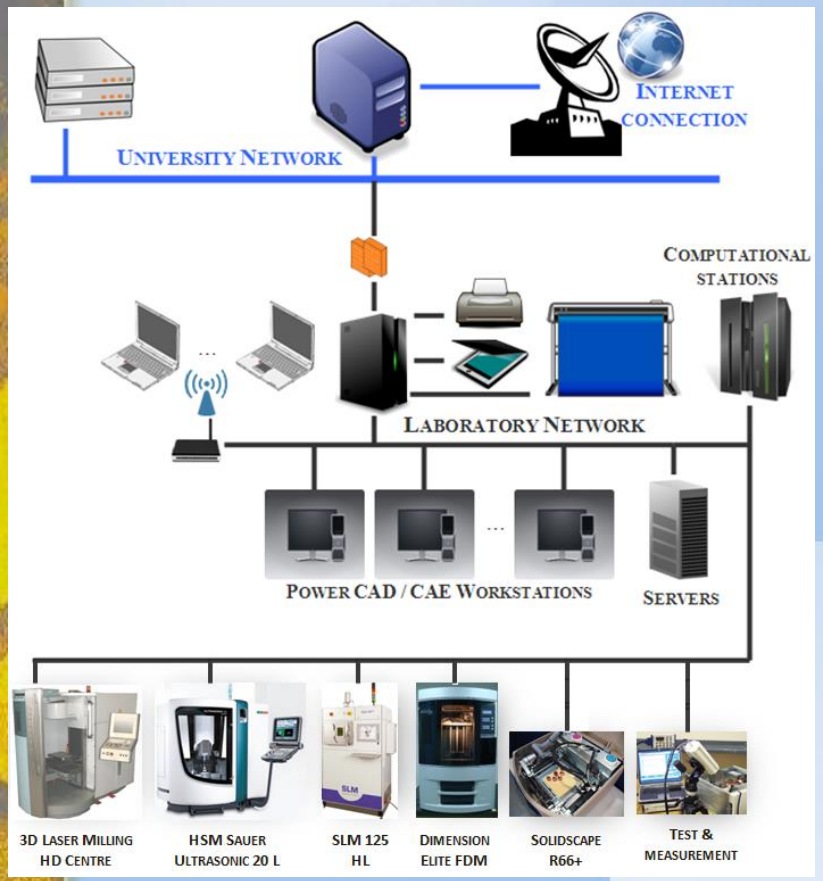
Hardware



Software

CAD/CAM

PTC: Pro|ENGINEER WILDFIRE, creo A PTC Product

DASSAULT SYSTEMES: CATIA, SOLIDWORKS

SIEMENS NX

CAE

ANSYS, MSC Software Simulating Reality, Delivering Certainty

BETA CAE Systems SA ANSA

Moldex3D MOLDING INNOVATION

Windchill Quality Solutions

Mathcad, KISSSOFT Calculation programs for machine design

3CLab Activities

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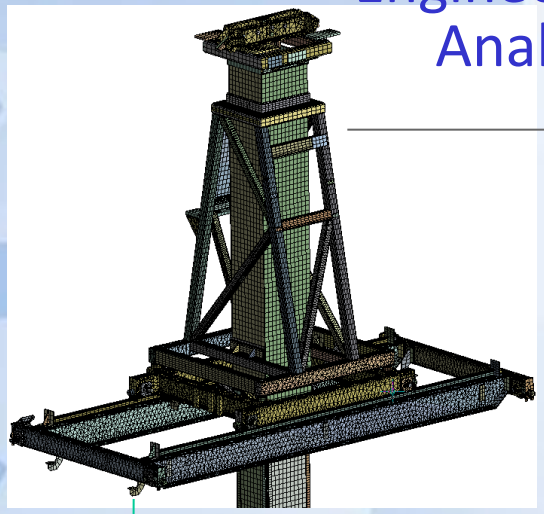
R&D Laboratory"CAD/CAM/CAE in INDUSTRY“

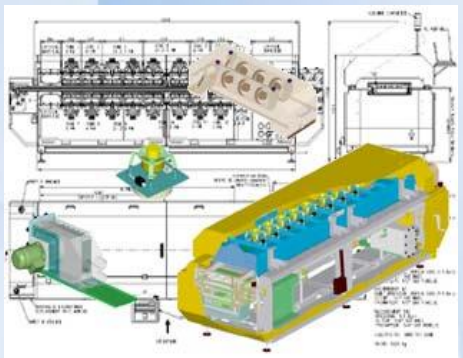
New Product Development

Physical & Virtual Prototyping

Engineering Analyses



Consulting



3CLab Activities

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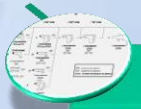
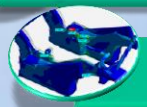
New Product Development


Research & Technical Specification


Engineering Analyses & Simulations


Conceptual Design


Detailed Design & Documentation


Physical Prototyping


Testing & Measurement


Production support

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Industrial Partners

Over 90 International projects are successfully finished in the Laboratory

- ViTECHNOLOGY - France
- SIGUREN Ingénierie - France
- ASSETIUM - France
- IndustrieHansa - Germany
- MANTOVANIBENNE - Italy
- GLOBAL DESIGN sas - Italy
- CMS- Italy
- SPARKY M&T - Germany
- GENMARK Automation - USA
- SENSATA, Holland
- DELTICA - USA
- Badestnost Jsc. - Bulgaria
- SPESIMA GmbH - Germany
- VISTEON - Germany

and many others.

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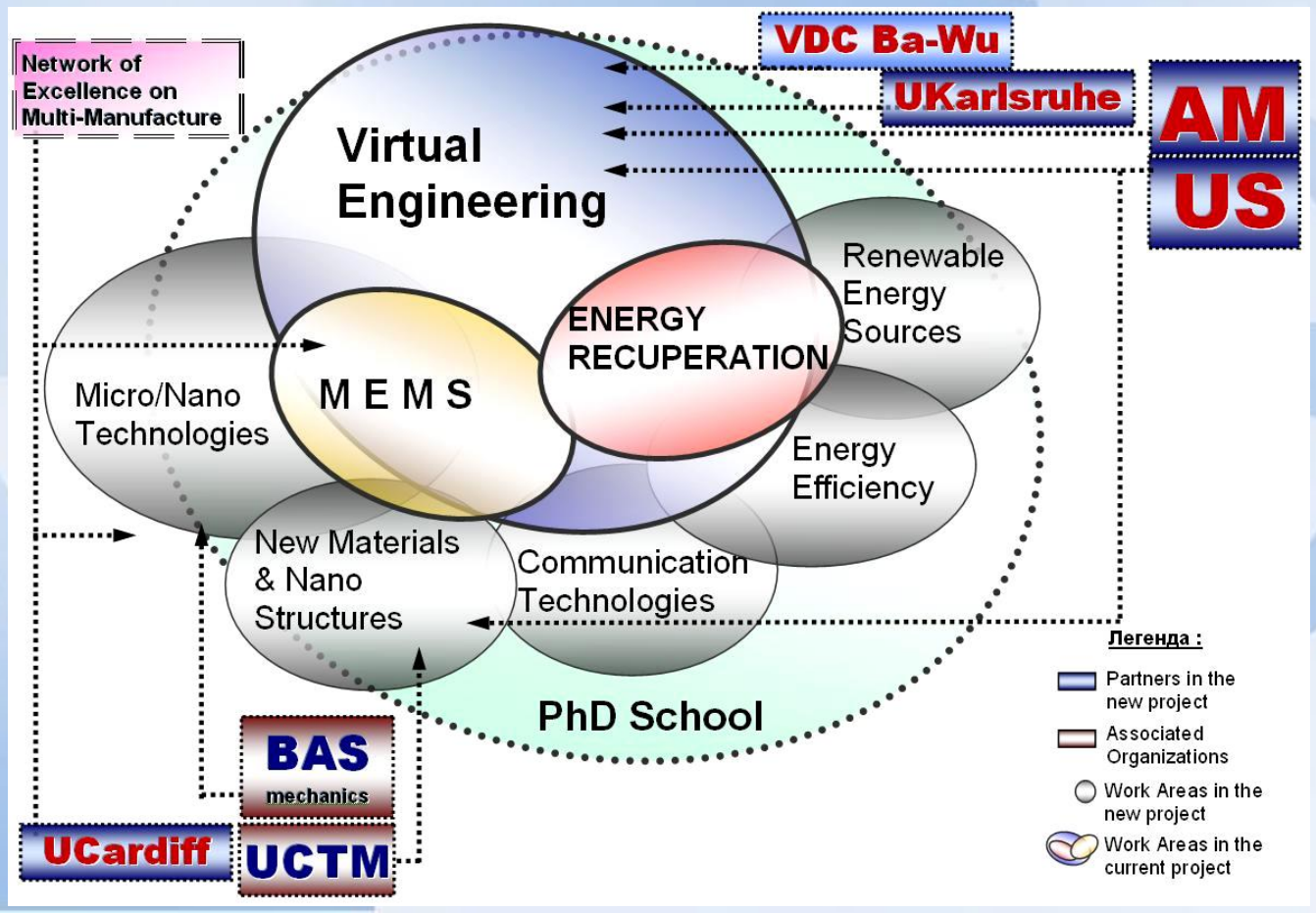
Establishment of "University Scientific & Research Complex"

Challenges of the Innovations – way to Accelerate Start Up Companies as Incubator in the Fields of:



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Establishment of "University Scientific & Research Complex"

USRC aims to expand and deepening the synergy of the research capacity in research areas:

- Virtual engineering innovations;
- Development of micro/nano objects and systems;
- New materials and nano structures;
- Research of energy recuperation systems and their integration in energy systems;
- Management of innovations in building, processing and industrial energy efficiency;
- Development and management of renewable energy sources;
- **Raising the qualification level of the research fellows and teaching staff and creative and innovation environment for Incubator as Start Up .**

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Two Ready to industrialization Innovations– on prototype stage

A) Innovative articulated forklift operated in extremely narrow spaces

B) Robot ContactlessEnd Effector's Family for Wafers Handling

A) Ready to industrialize Innovation:

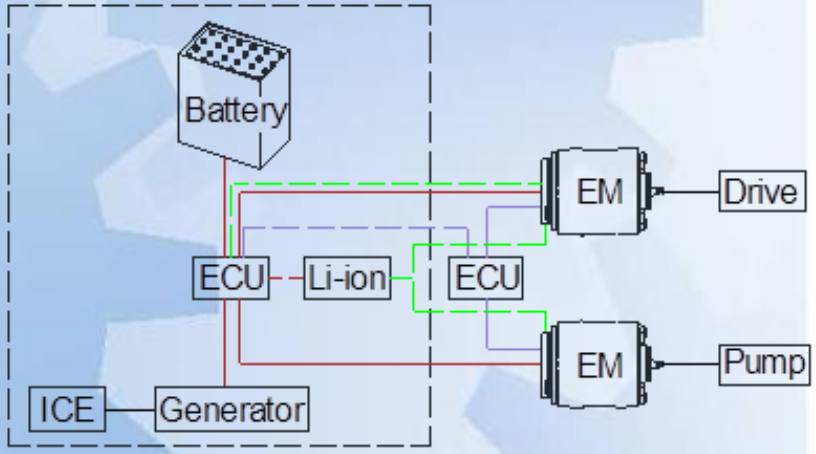
An innovative articulated forklift operated in extremely narrow spaces– on prototype stage

Virtual prototyping based NEW design

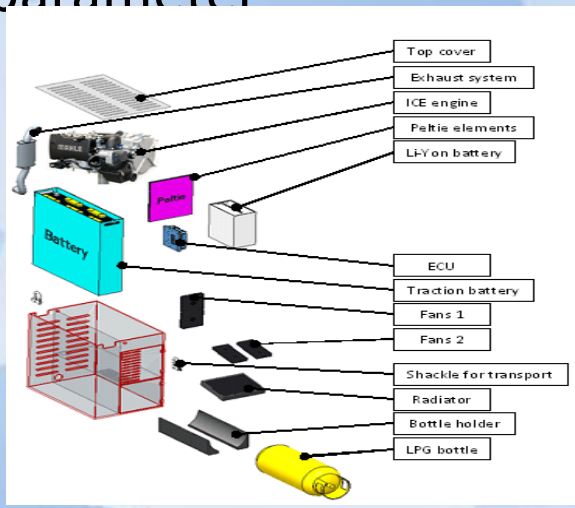
Innovative cornering system in tight spaces

Physical prototype

Work with a conventional battery and an innovative hybrid package



Standard size and parameter hybrid package



Environmentally friendly hybrid package with reduced LPG fuel consumption and multi-shift operation without battery change

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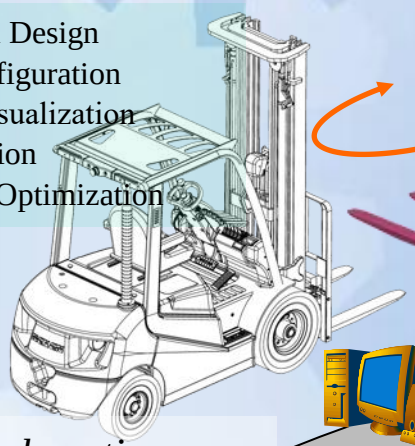
Product Development: A family of forklift trucks

Virtual Product

Product Life Cycle

- Context driven Design
- Prototype Configuration
- „High-end“ Visualization
- Virtual Validation
- Feedback and Optimization



Team Collaboration

Engineering Network

- CAx
- PLM
- VR/AR
- Web Portals
- Telecommunication Services

Best Practices

Information and Communication

- Iterative Work Tasks
- Workflow & Workload Management
- Quality Gates
- Deliverables & Progress Management

Product Creation Process

3CLab Activities

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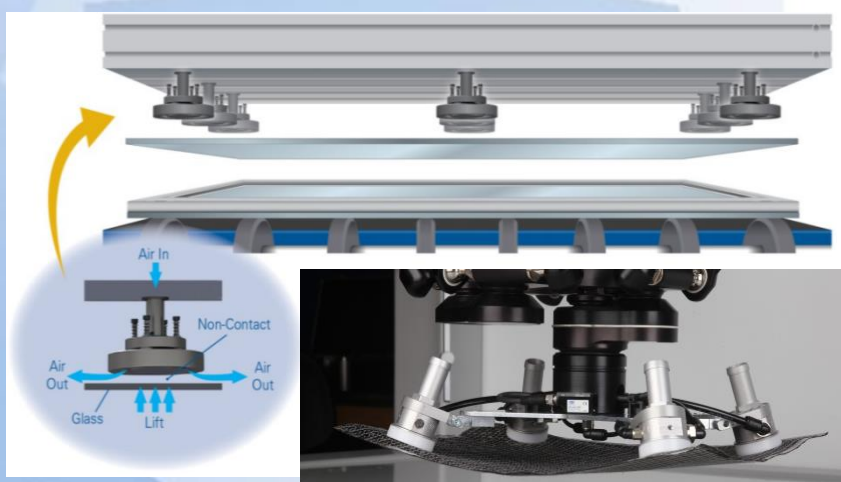
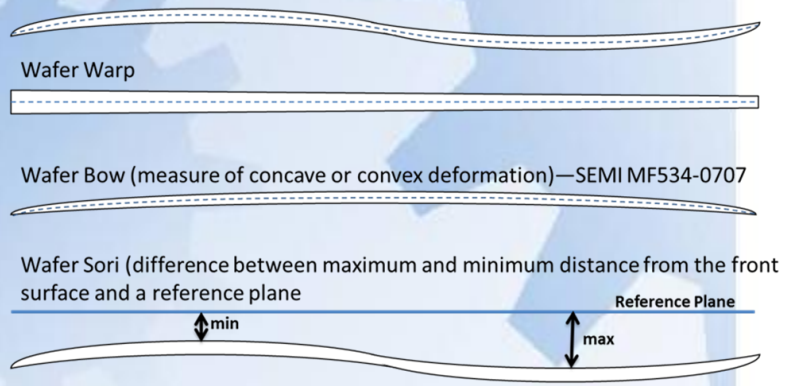
- ✓ **Product Development: Physical prototype**

B) Ready to industrialize Innovation: Robot ContactlessEnd Effector's Family for Wafers Handling

Automated handling of non-rigid parts is a challenging field of industrial automation.
Bernoulli principle based end effector allows:

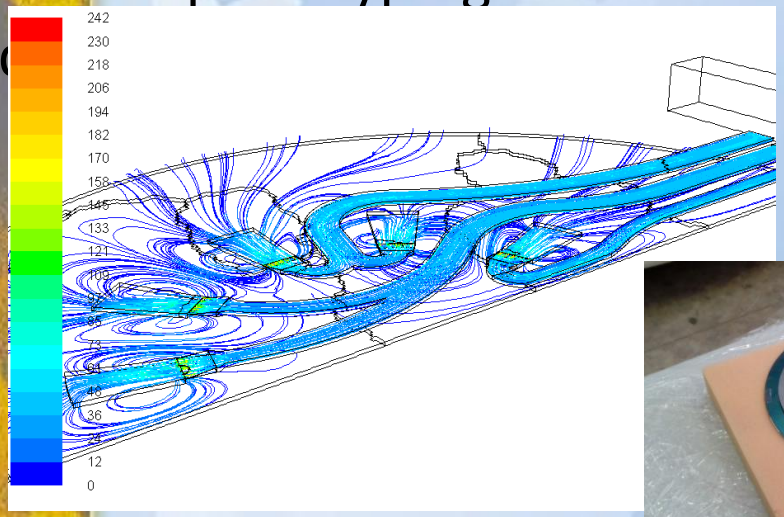
- to handle contactless non-rigid wafers/substrates;
- Effective use of silica bars (more than 200%) – NEW extremely low thickness of wafers (0.25mm instead of 0.75mm);
- Thinner wafers leads to increase of allowable CPU thermal loads, i.e. new generation of electronics.

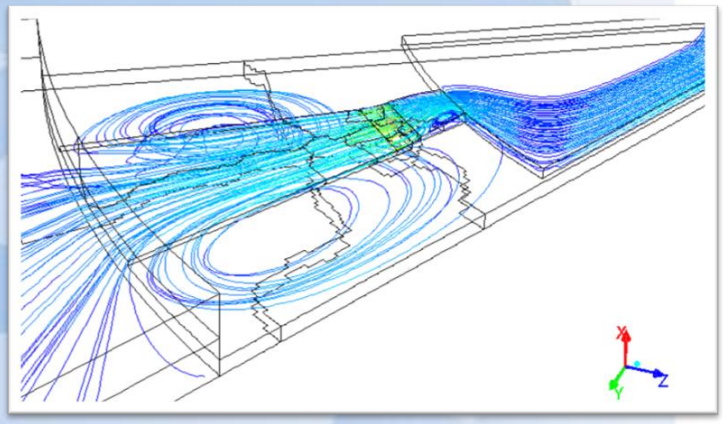




Ready to industrialize Innovation: Robot End Effector for Wafers Handling

Virtual prototyping based NEW





Physical prototypes and testing

Bernoulli End-Effector

Technical University of Sofia

3D Creativity Laboratory”

Industry 4.0 - ***Additive manufacturing***

Faster way to innovate

The project is implementing with the financial assistance of Operational program “Development of the competitiveness of the Bulgarian economy” 2007-2013, co-financed by the European Union through the European Regional Development Fund and through the national budget.

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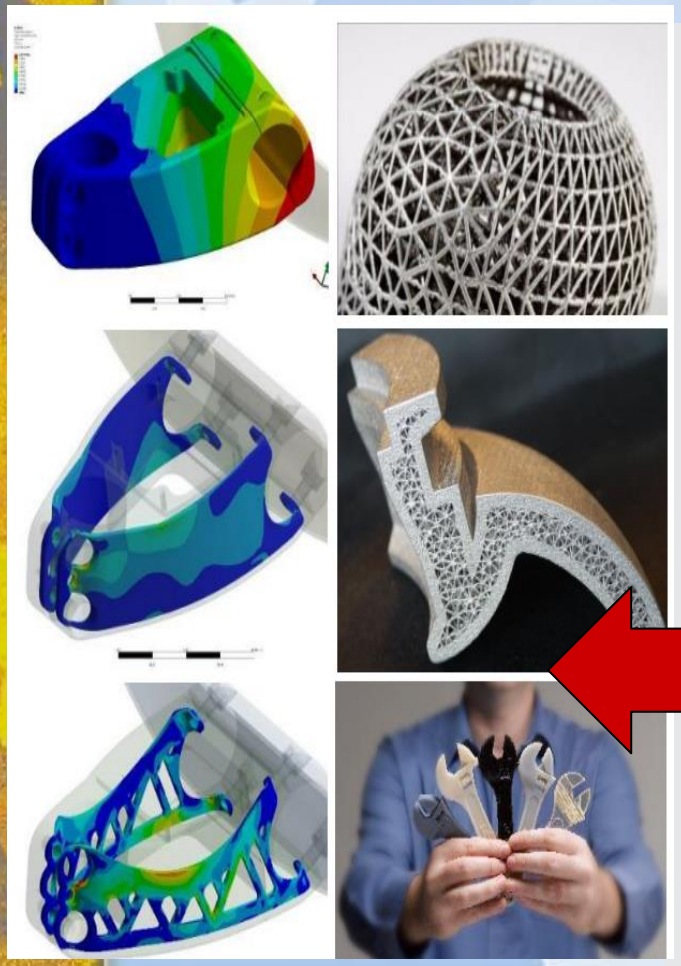
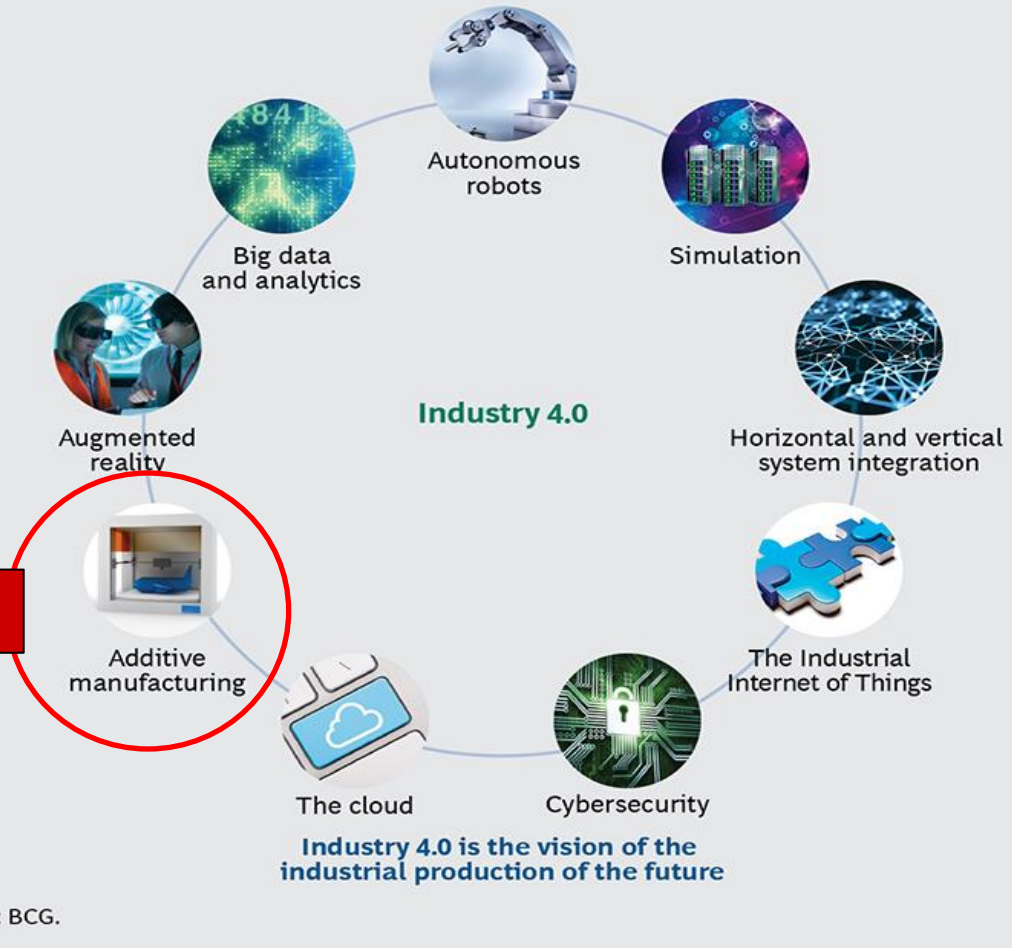
Industry 4.0 – Future Today





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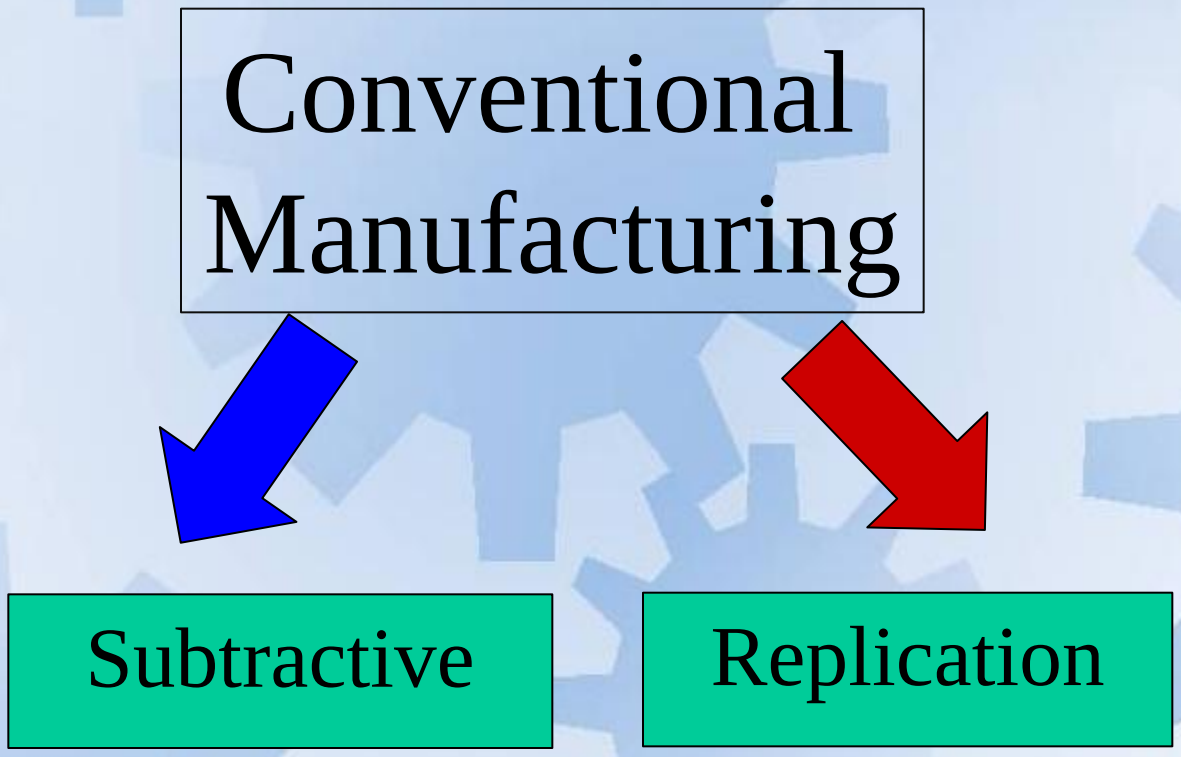
Manufacturing technologies



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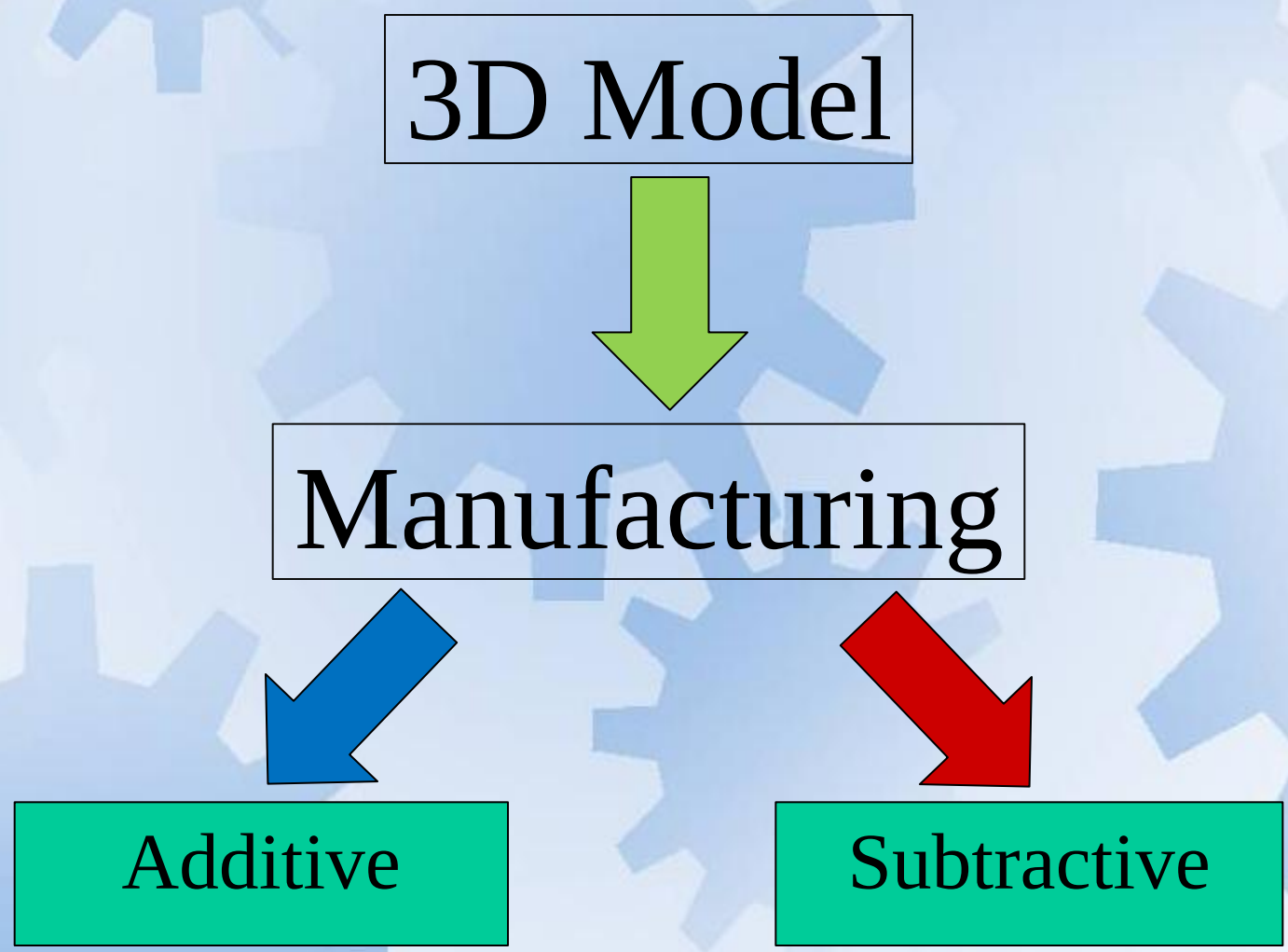
Digital manufacturing



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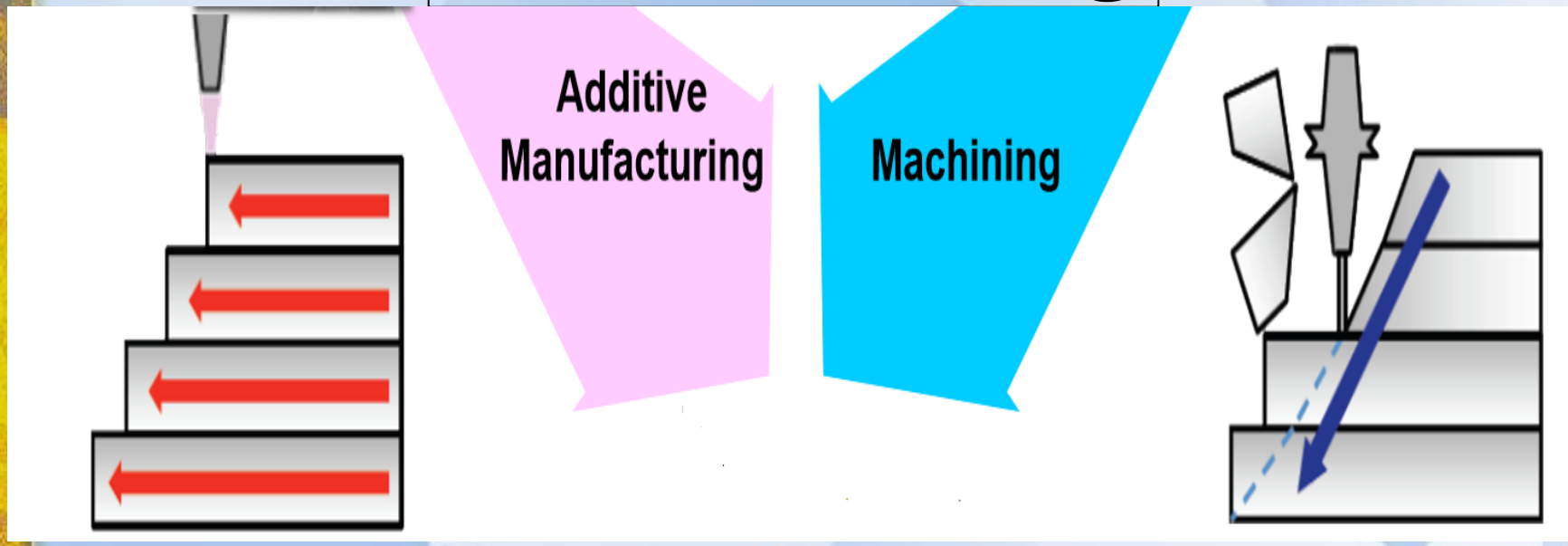
Digital Manufacturing

3D Model

Manufacturing



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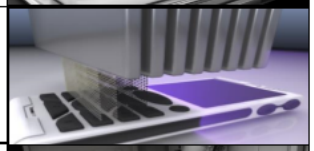
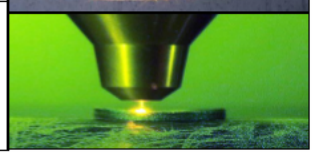
Additive Manufacturing Methods

1	**SHEET LAMINATION**	*Sheets of material are bonded to form an object.*	
2	**MATERIAL EXTRUSION**	*Material is selectively dispensed through a nozzle or orifice.*	
3	**MATERIAL JETTING**	*Droplets of build material are selectively deposited.*	
4	**BINDER JETTING**	*A liquid bonding agent is selectively deposited to join powder materials.*	
5	**VAT PHOTOPOLYMERISATION**	*Liquid photopolymer in a vat is selectively cured by light-activated polymerisation.*	
6	**POWDER BED FUSION (PBF)**	*Thermal energy selectively fuses regions of a powder bed.*	
7	**DIRECTED ENERGY DEPOSITION (DED)**	*Focused thermal energy is used to fuse materials by melting as they are deposited.*	

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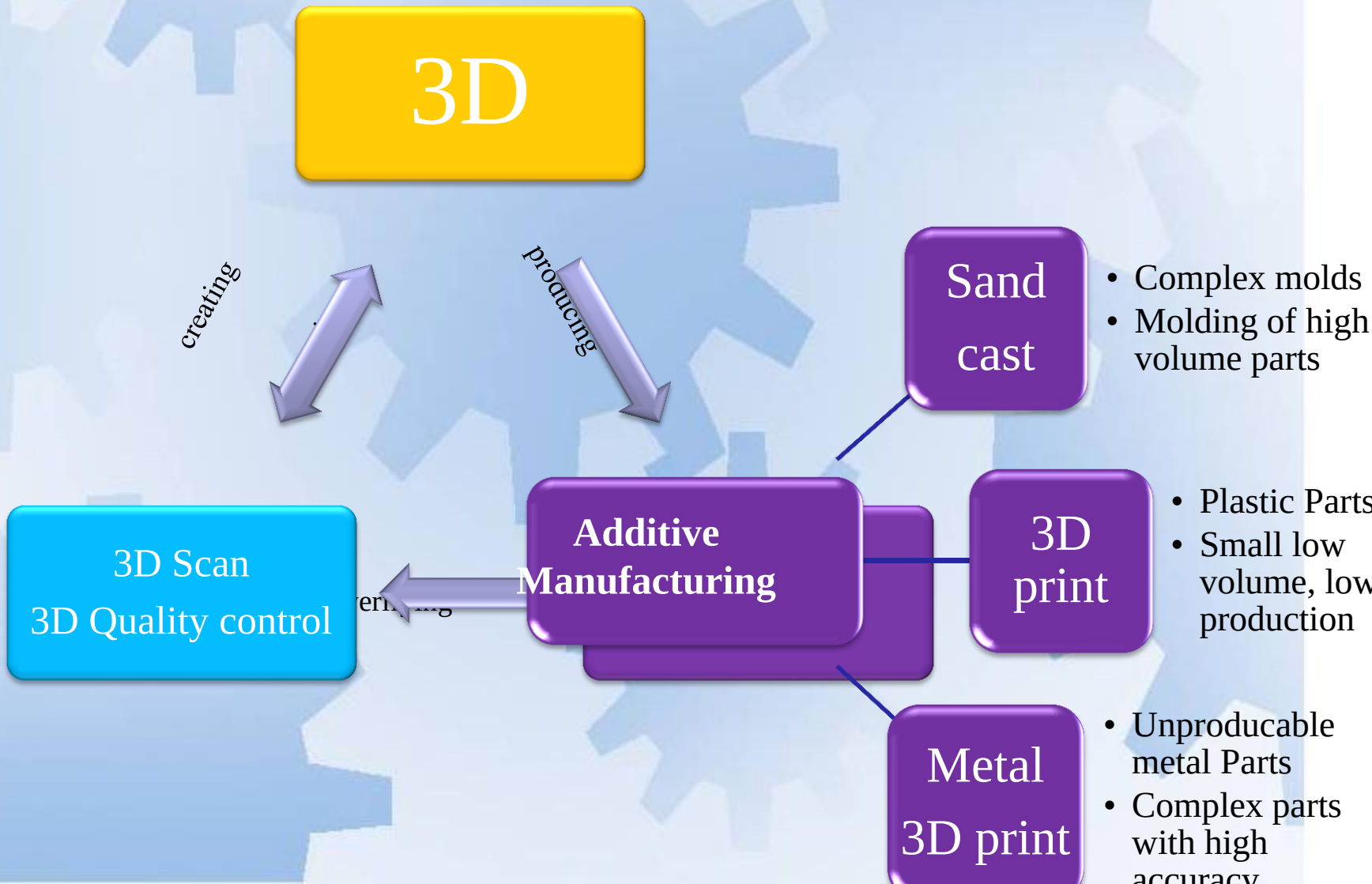
Laboratory Process Workflow



technology + innovation network

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Sand and Ceramic Additive Manufacturing

Production of complex ready to use molds


voxeljet VX500

3D Creative Lab

Digital Manufacturing of Metals

CNC Machining

Repeatable
Precise
Good surface finish
High productivity
Waste material
Limited work piece figure

V's

Additive Manufacturing

Less material wastage
Geometrical freedom
Material options
Long cycle-time
Poor surface finish

Light-Weight Automotive Components – EOS GmbH
http://www.eos.info/en

F1 Roll Hoop – 3T RPT Ltd.
http://www.3trpd.co.uk/portfolio/titanium-f1-roll-hoop-proves-concept/gallery/metal-additive-manufacturing-case-studies/

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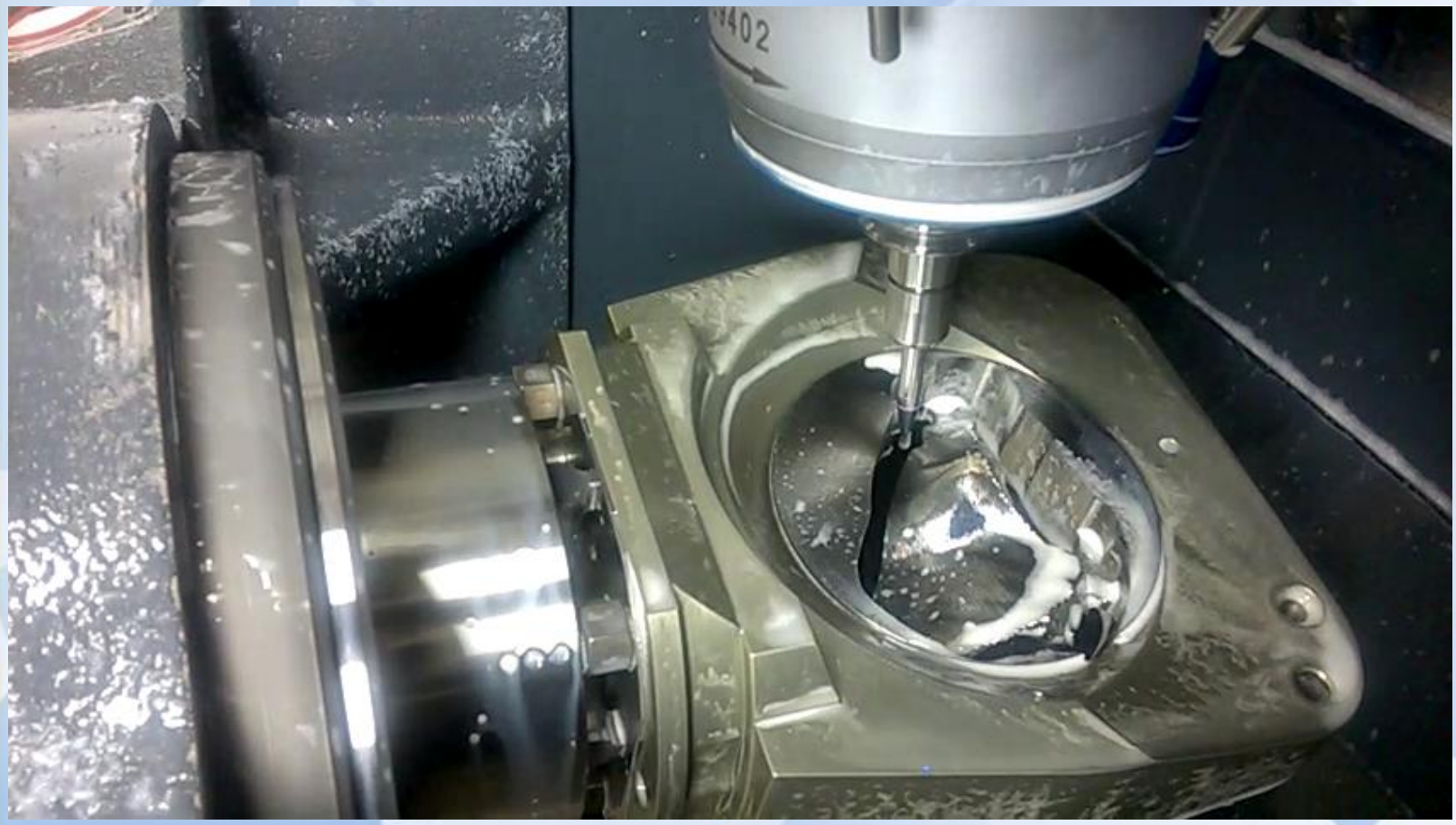
Subtractive manufacturing - CNC Milling



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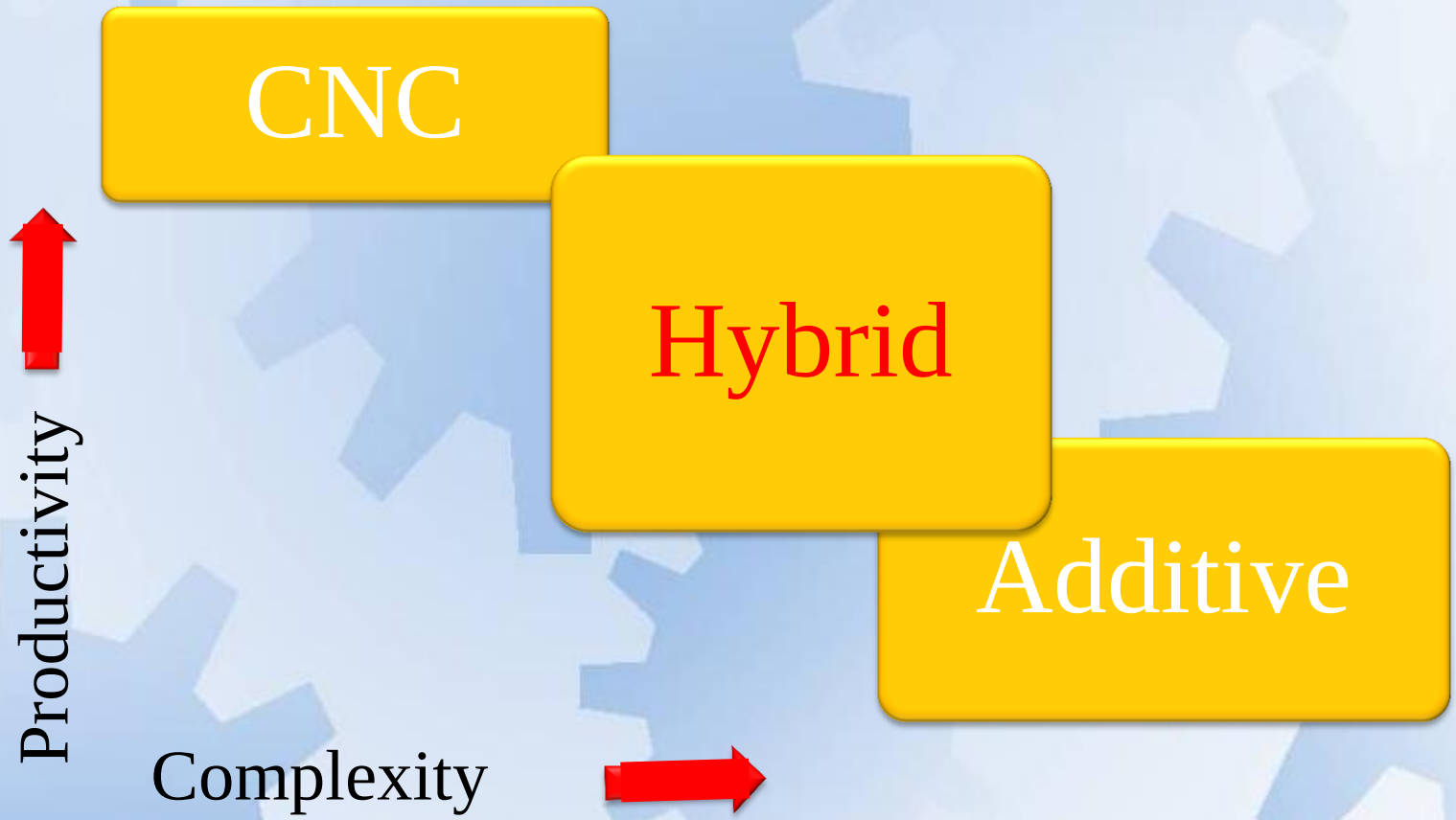
Additive v/s CNC Machining



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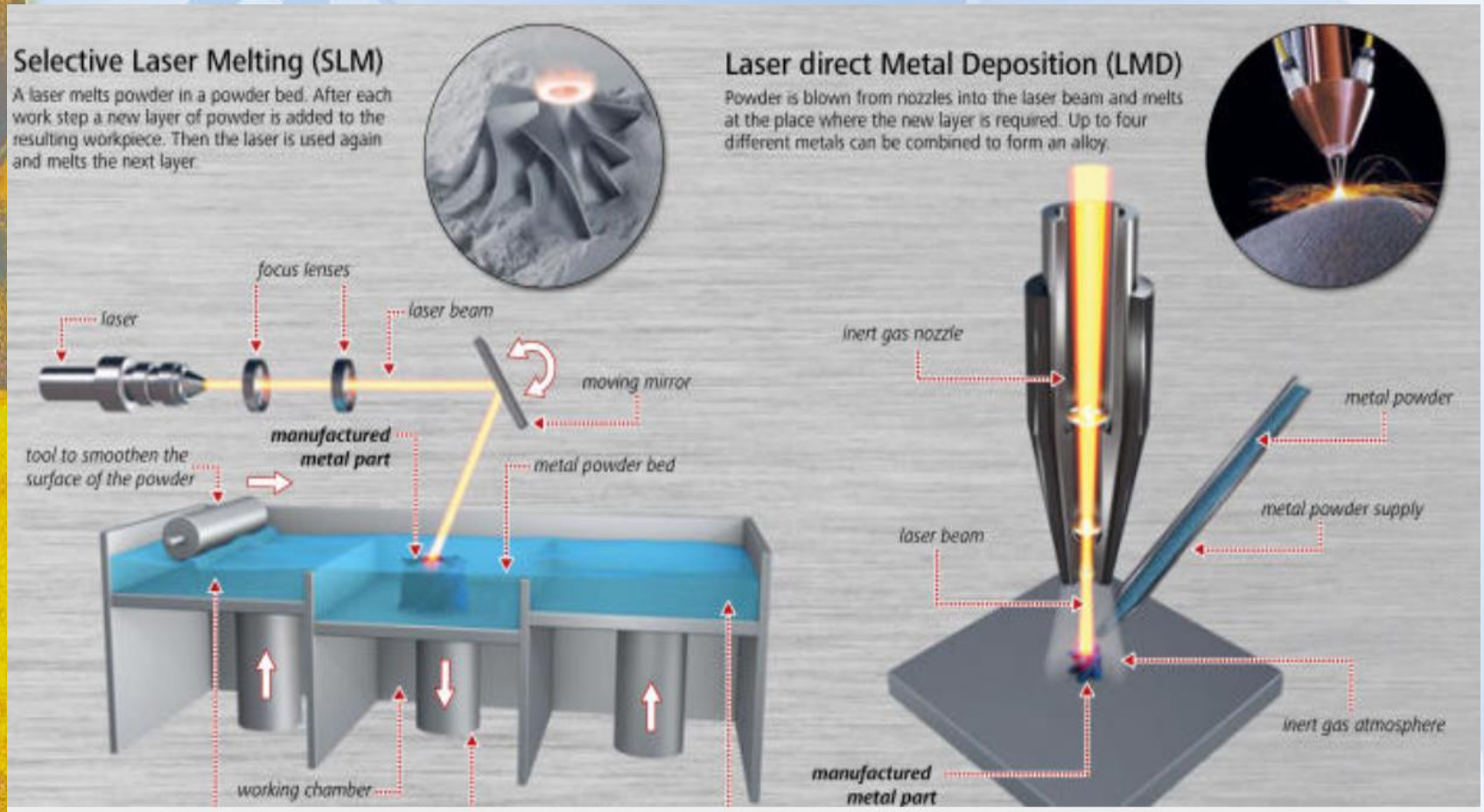
Metal Additive manufacturing



Info graphics—Additive Manufacturing. Credit: Empa

technology + innovation network

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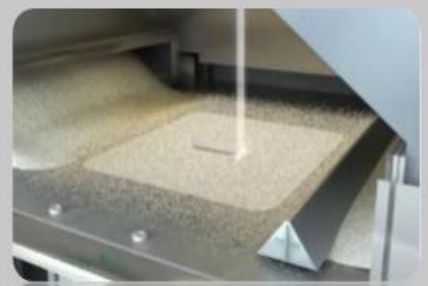
Additive manufacturing - Requirements

Powder Bed



Required Functions

- Part Orientation
- Support Creation
- Exposure Strategy
- Nesting & Slicing

Direct Metal Deposition

Required Functions

- Trajectories (Additive Toolpath)
- Combined with Subtractive Processes
- Multi-Tasking, Multi-Function, Synchronized 5-Axis CNC Control

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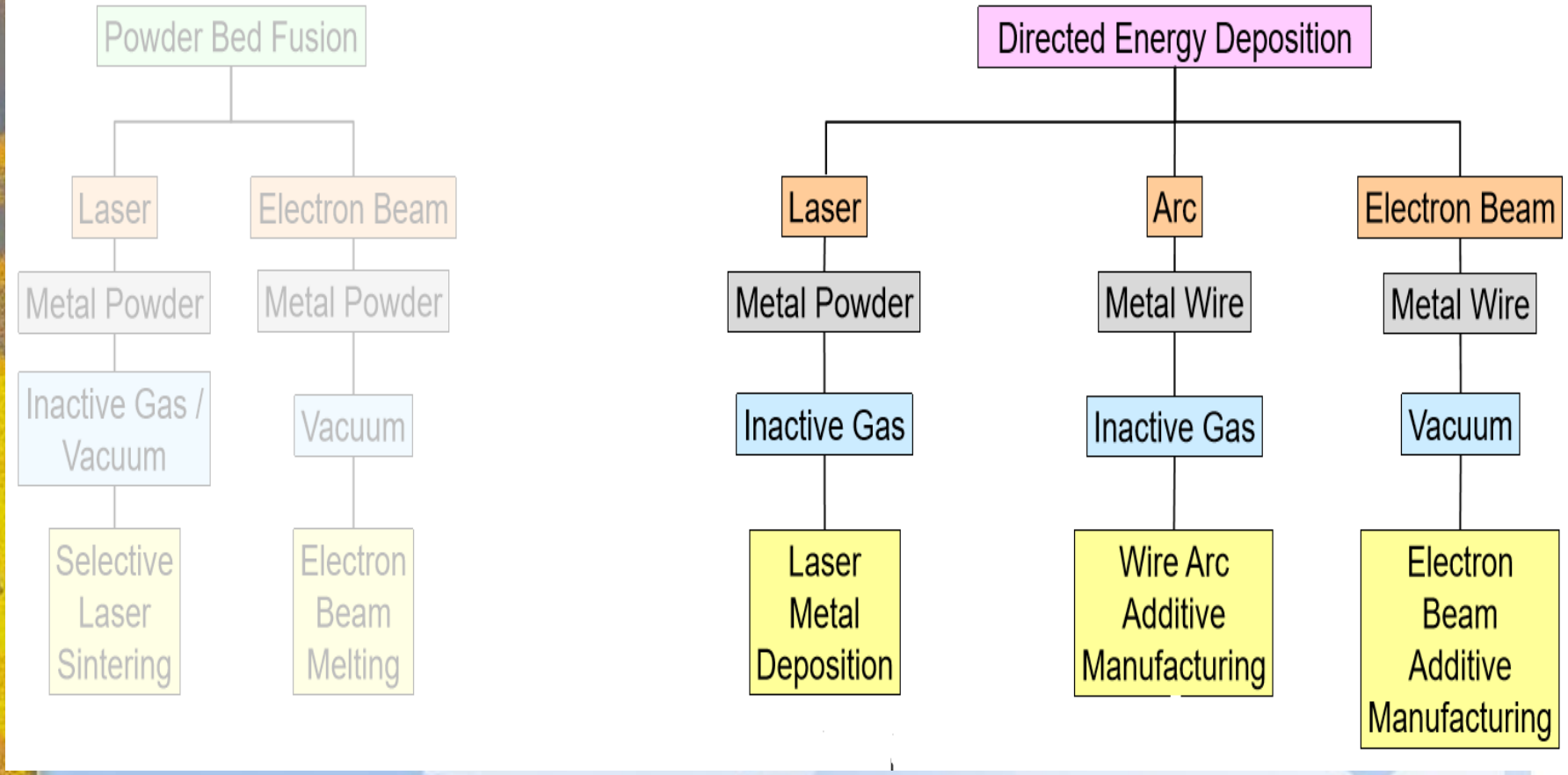
Metal Additive Manufacturing



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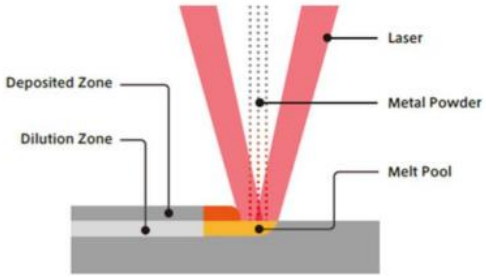
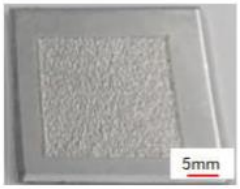
Direct Metal Deposition Types



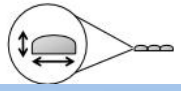
Multi-Laser Metal Deposition

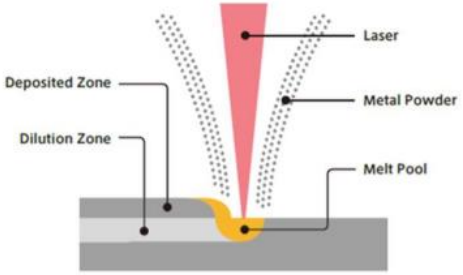
Heat Source : Laser Beams
Material : Metal Powder



Deposition rate : 10cc/h

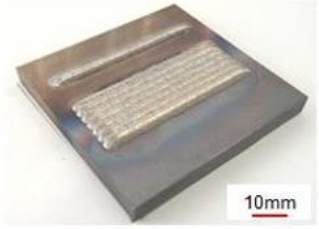
Deposition size : (h) 0.2mm
(w) 0.5mm





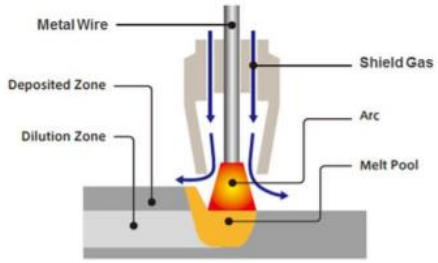
Laser Metal Deposition

Heat Source : Laser Beam
Material : Metal Powder



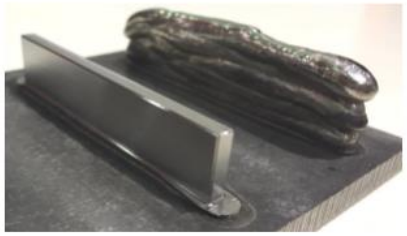
Deposition rate : 60cc/h

Deposition size : (h) 1.5mm
(w) 3.0mm



Wire Arc AM

Heat Source : Arc Discharge
Material : Metal Wire



Deposition rate : 600cc/h

Deposition size : (h) 4.0mm
(w) 7.0mm

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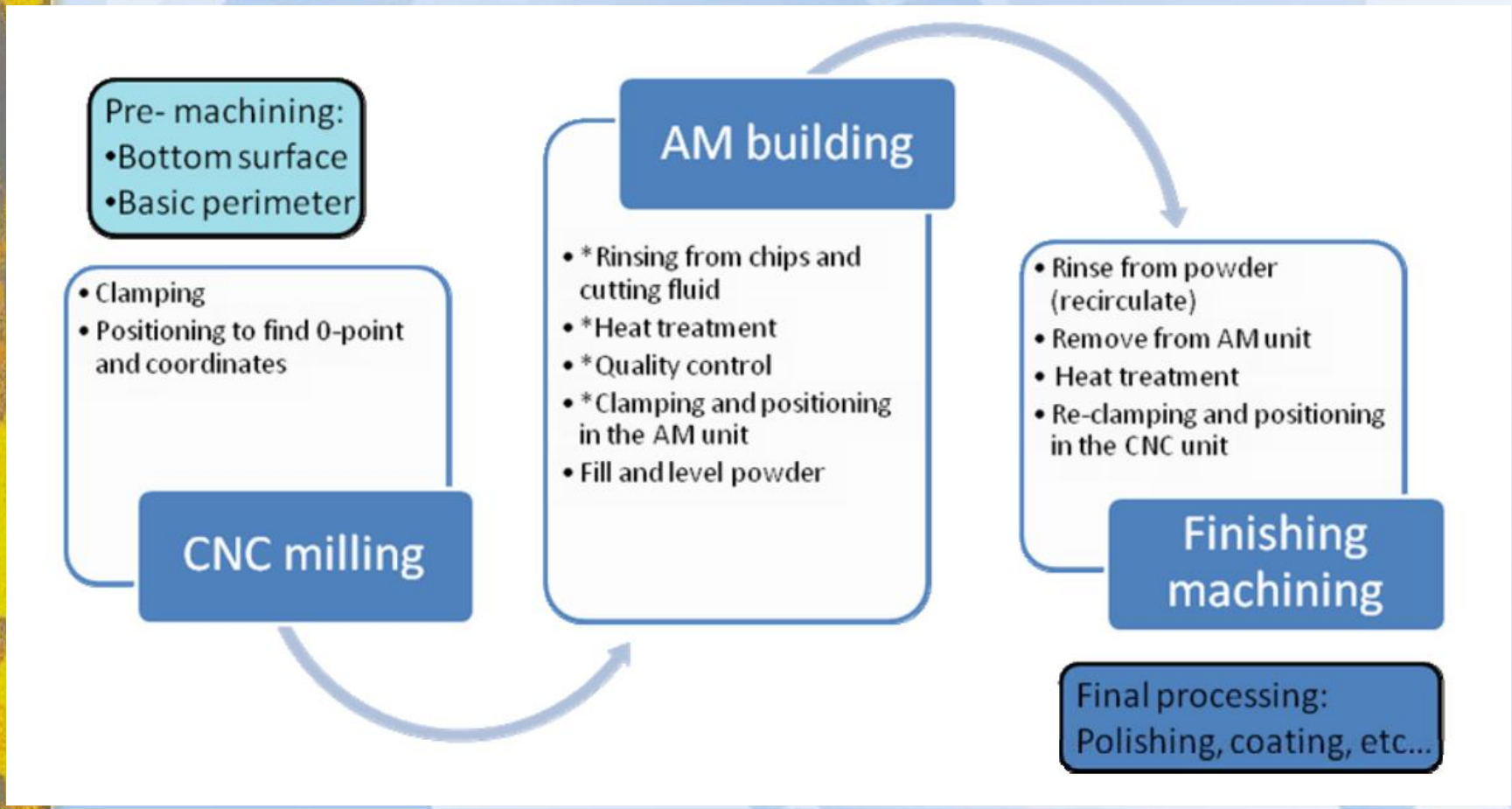
CNC+Additive Technology Work Flow



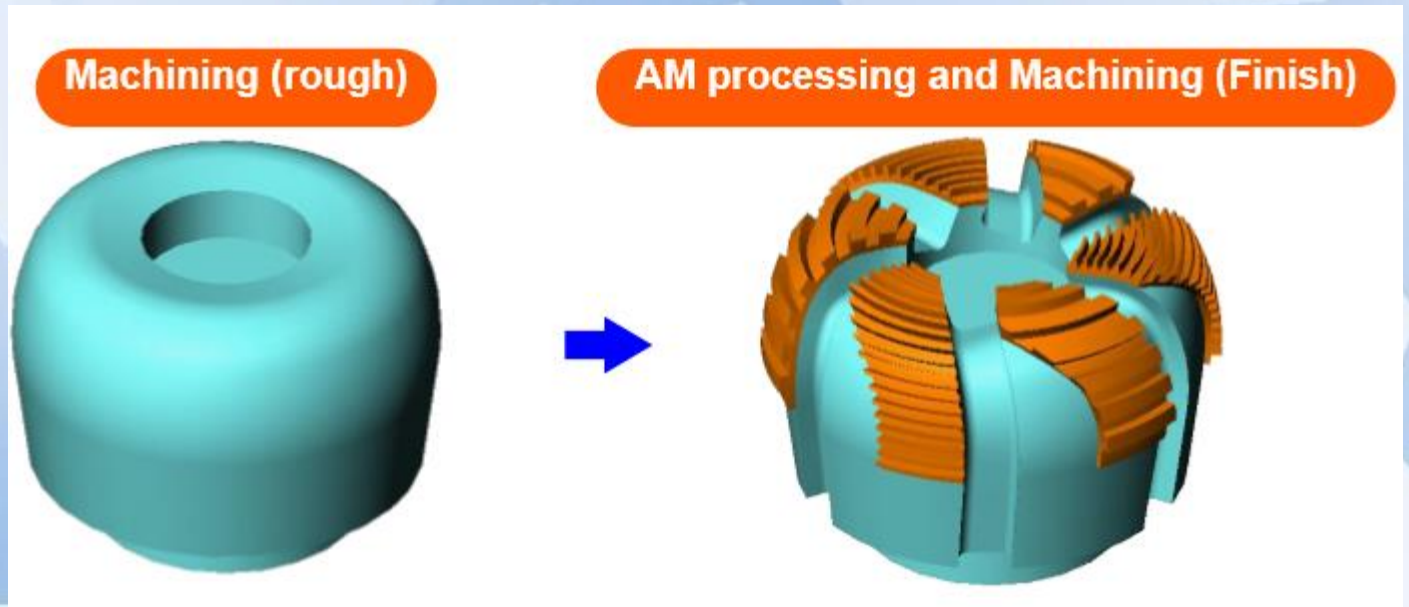
3D Creative Lab

Additive v/s CNC Machining

From isolation to integration – HYBRID

- With the adoption of AM for industrial manufacturing, especially in metals, the need for downstream part processing has intensified.

- In particular, metal parts almost always require some finishing steps, most often machining, polishing, or grinding



3D Creative Lab

HYBRID

Technology Integration Opportunities:

- Surface treatment for heat-proof, wear-proof etc. by coating dissimilar metal on substrate.
- Near-net-shape application.
- Coating and depositing on free-form surface with simultaneous 5-axis process.
- **By process integration, shortening process lead time including material preparation**.

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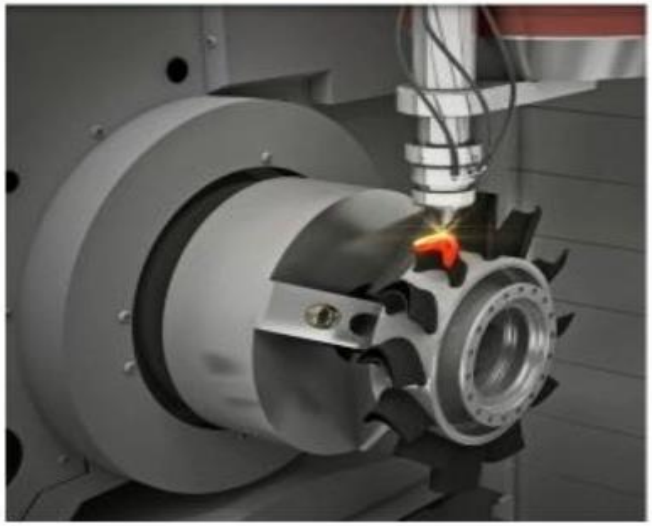
CNC + Additive Integration in one System– HYBRID



Hybrid

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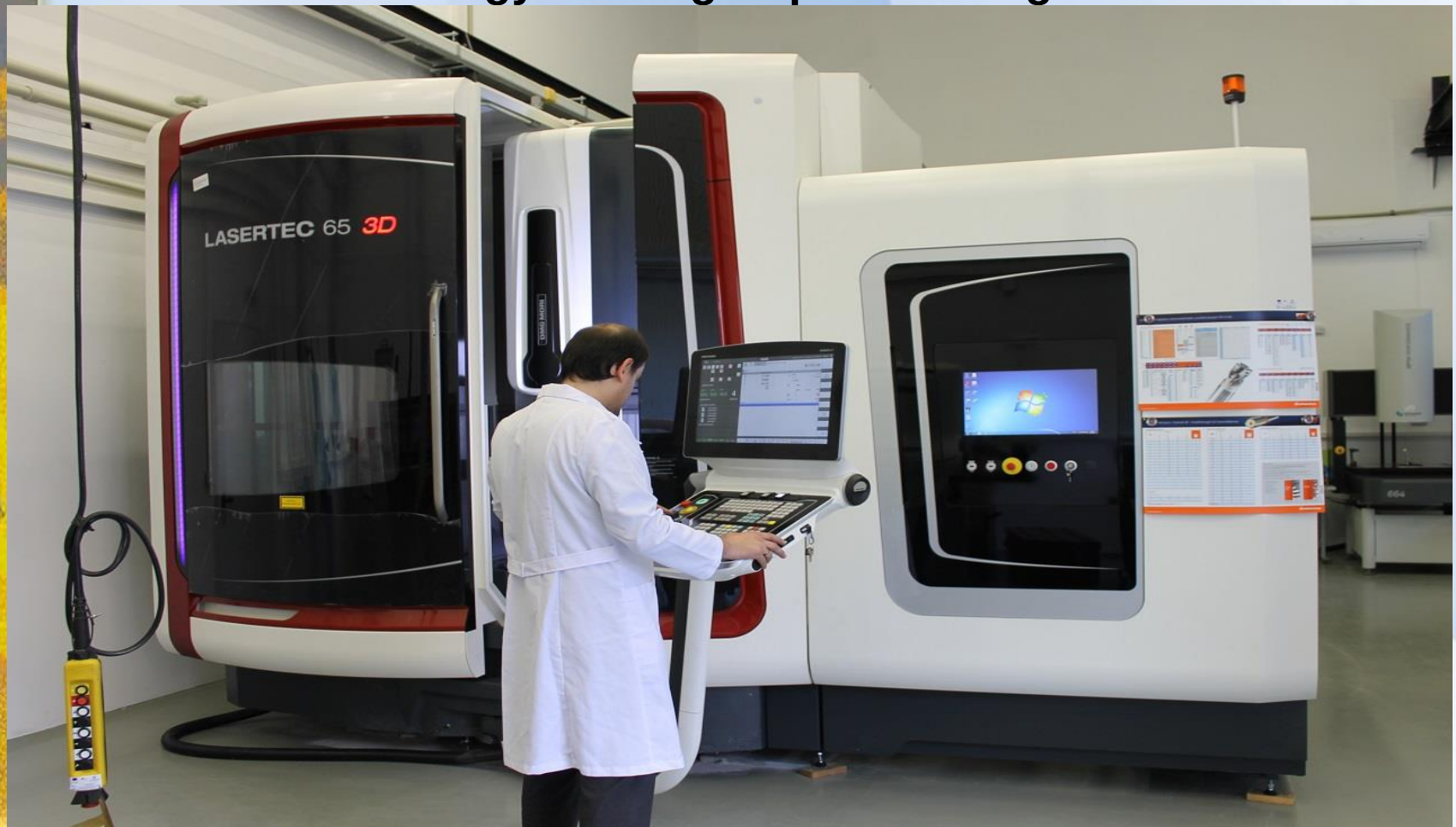
Hybrid manufacturing in Sofia

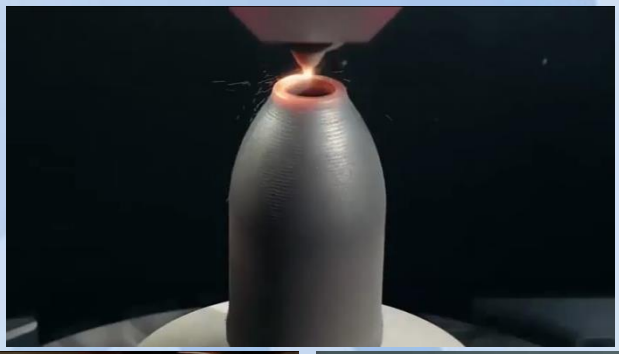
Rapid Prototyping and Rapid Tooling with integrated metal Additive Technology and High Speed Milling- LASERTEC 65D

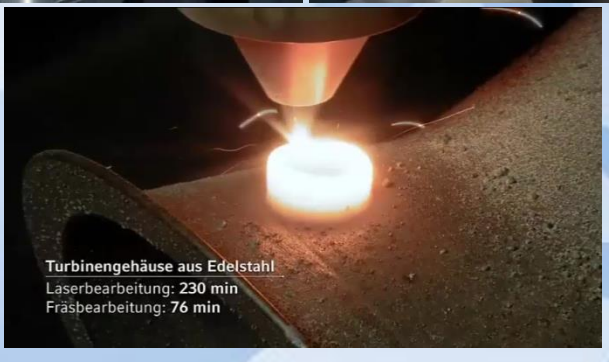


3D Creative Lab

Hybrid manufacturing in Sofia

Additive Technology and High Speed Milling- LASERTEC 65D





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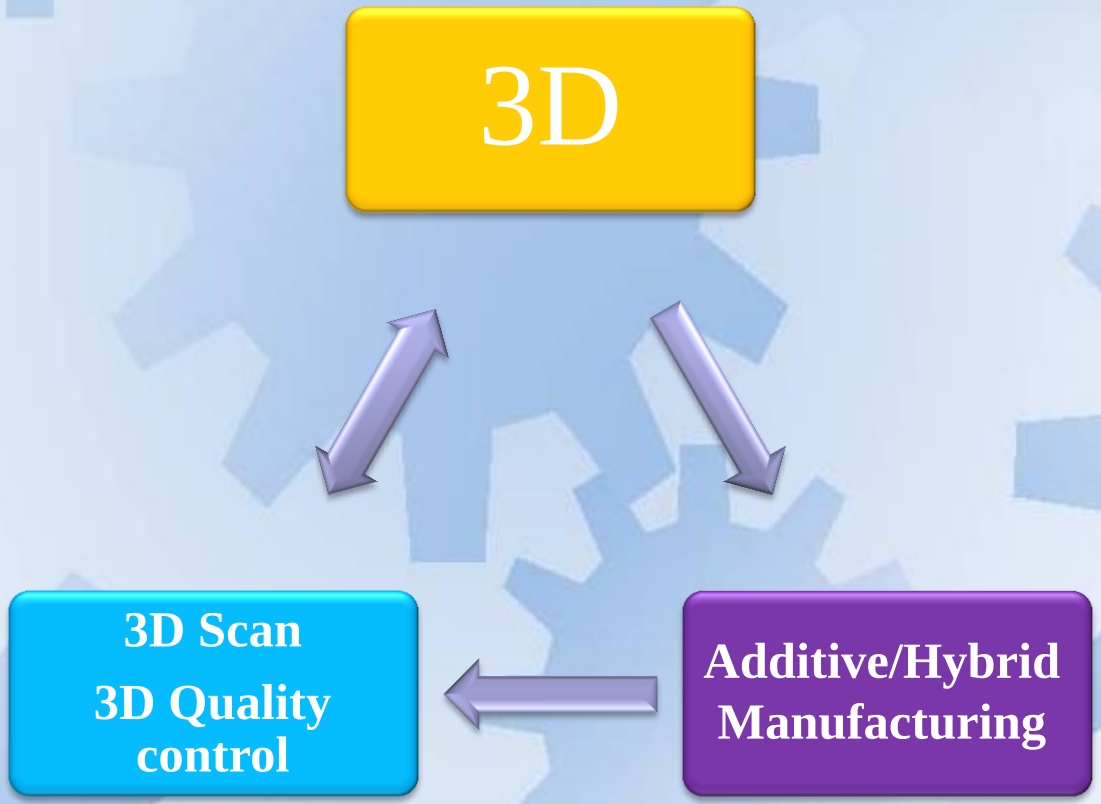
3D Digital Inspection Systems



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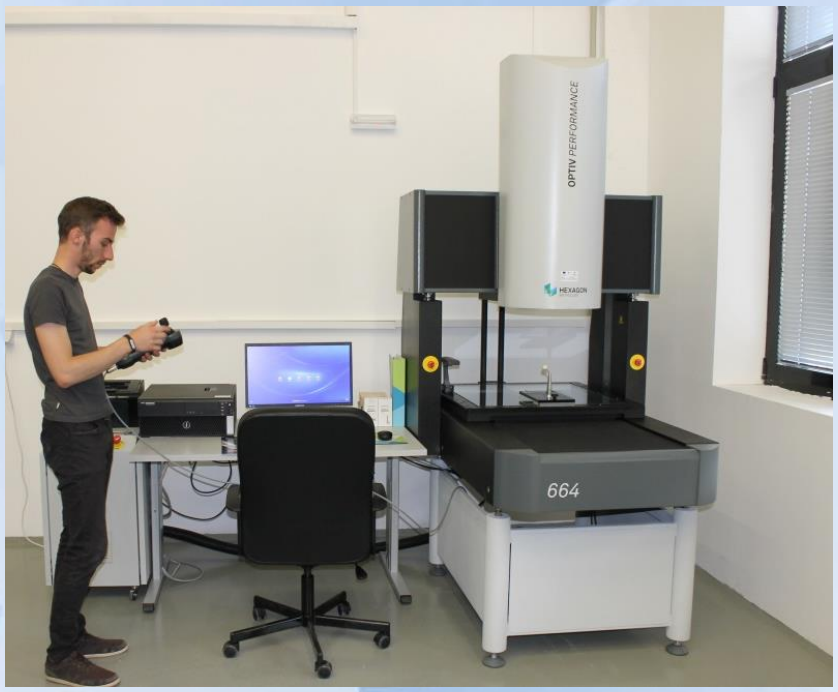
3D Multisensory system

3D precise measuring and scanning system



- High precise measuring capabilities;
- Tactile measuring;
- Vision measuring;
- Contactless laser measuring;
- Work volume: 600 x 600 x 300 mm.

technology + innovation network

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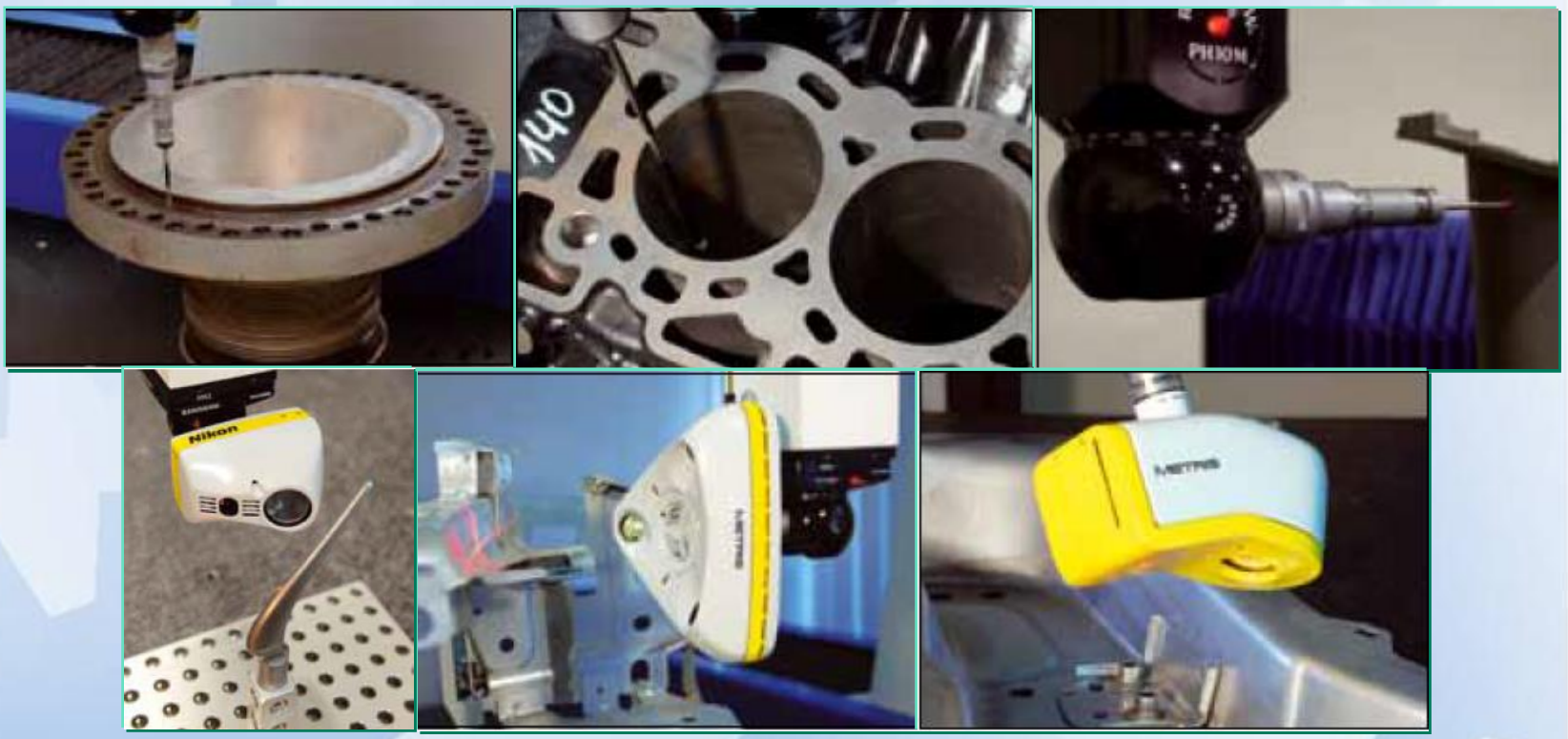
3D Multisensory system



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3D Portable system

3D portable measuring and scanning system

- Universal portable system with accuracy according to ISO 10360-2 or B89.4.22 certification;
- Best for large scale parts;
- Choice between contact ot contactless measuring.

technology + innovation network

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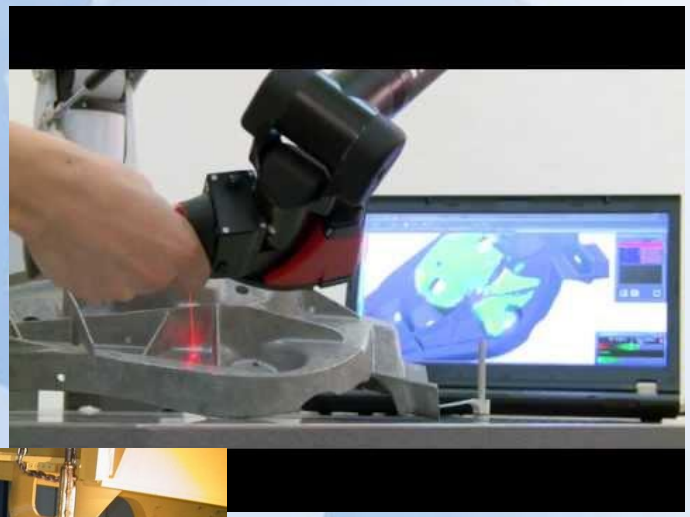
3D Portable Scanning System



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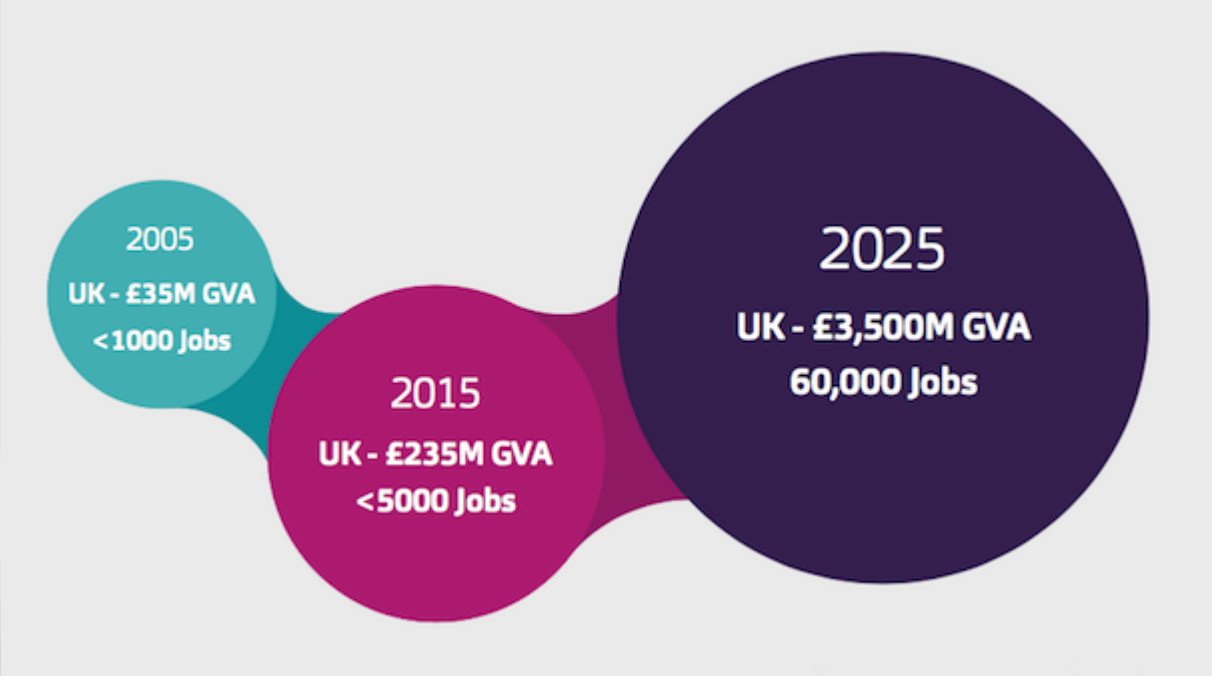
New Jobs in the AM Technology



The UK's AM opportunity proposed by AM UK

FIT, TU-Sofia Response:

NEW Bachelor Program: "DIGITAL INDUSTRIAL TECHNOLOGIES"

The Technical University of Sofia