

Additive Manufacturing: Unused Potentials

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An attractive company



- One of the global leaders in specialty chemicals
- Investments in the energy and real estate sectors
- Ownership structure: RAG-Stiftung (74.99%) and CVC Capital Partners (25.01%)



Key figures 2010



Sales	€13.3 billion
by Chemicals	€12.9 billion
Real Estate	€0.4 billion
Employees 31.12.2010	34,407

HP as partner offers more than just materials



High Performance Polymers

Analytical studies

IR, NMR, DSC, REM, ...



Local logistic and supply chain experts

Global logistic and supply chain services

Process Technology Developments

Multi-component processes, Bonding, Welding, Laser, Decoration, Sintering,...

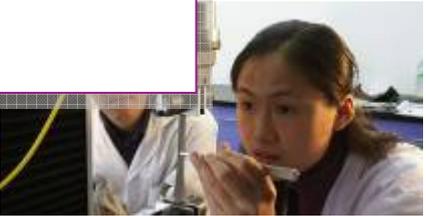


Local facilities and warehouses

Local production and / or stock

Special testing equipment

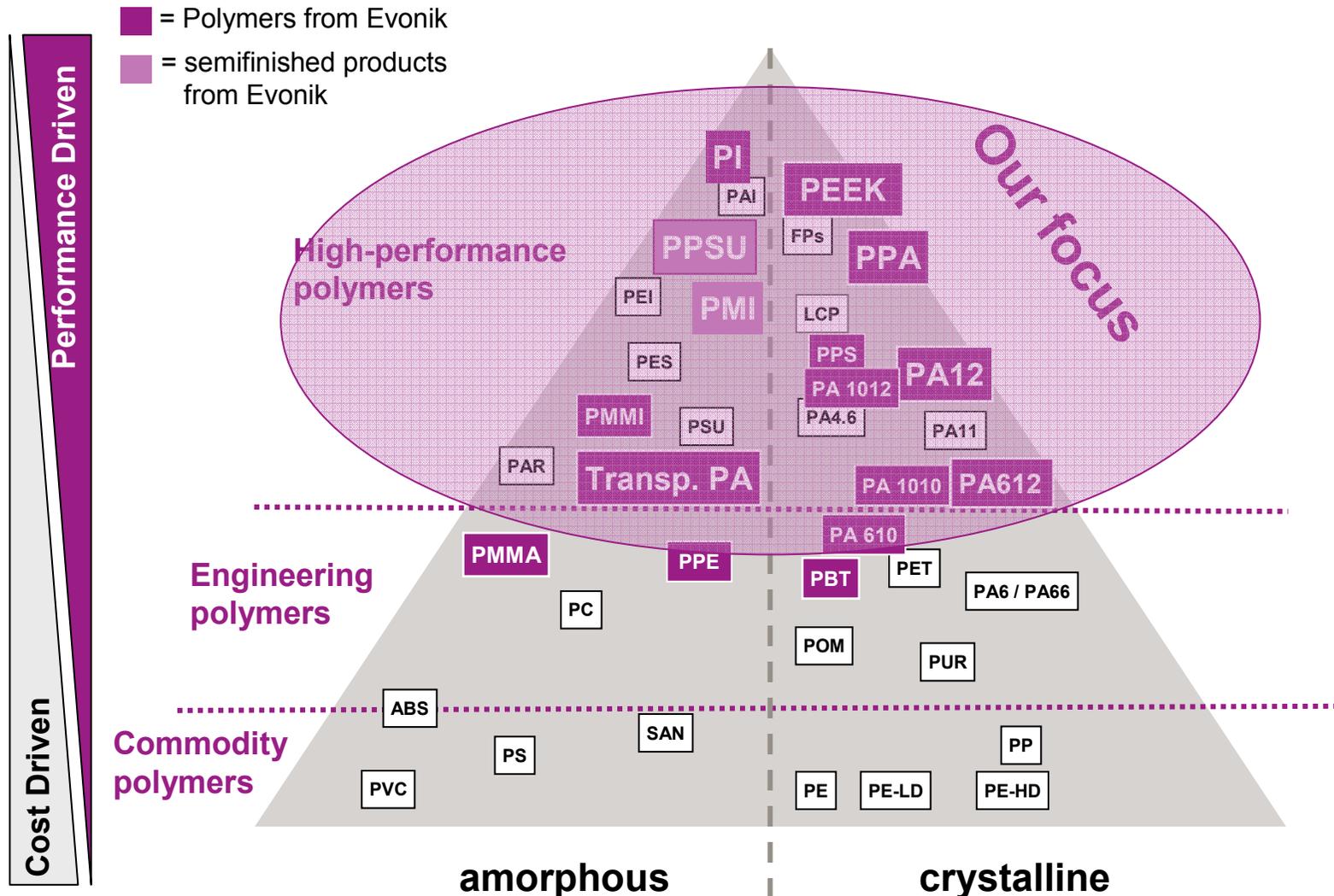
Tensile, Impact, Permeation, Thermal tests, Electric, Burst pressure, ...



Local technical centers and processing experts

On-site support / production maintenance service

Our focus for achieving high performances



HP Product Portfolio Integration



Butadiene

Building Blocks & Monomers

- CDT
- CDAN
- CDON
- DDS
- LL
- COD
- COE
- VCH
- TM-CDT
- DM-COD

Polymers

Compounds & Powders

Semi-finished goods

- PA 12
- PA 612
- PA 1012
- PA 6-3-T
- CoPA
- PPA
- PEEK
- PMMA
- PMI
- PI
- PVDF

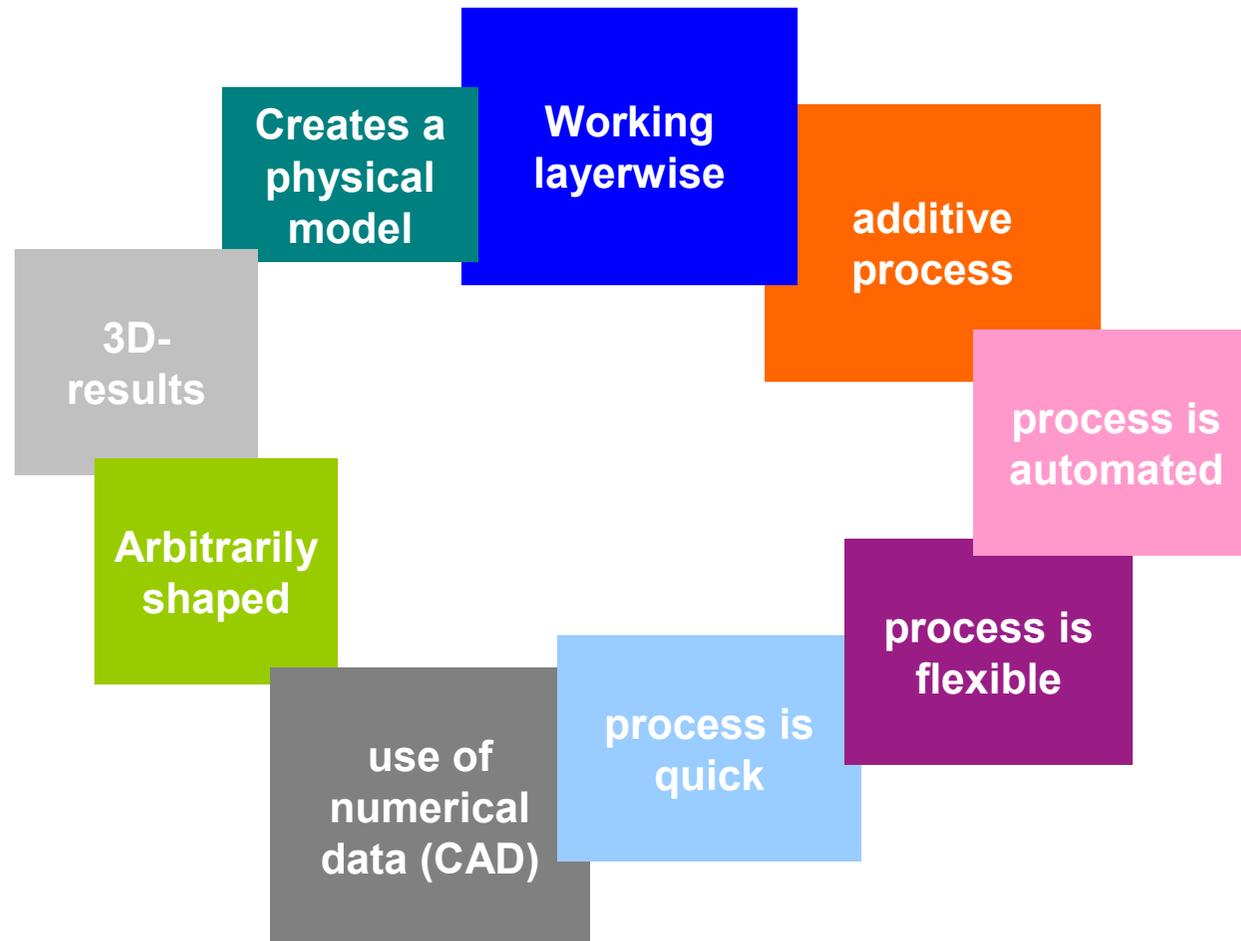
- PI fibers
- PPS fibers
- PMMA sheets
- PMMA films
- PMI foams
- PI foams
- PC films
- PC sheets
- PPSU films
- PPSU sheets
- PMMA - PVDF films



Additive Manufacturing



Characteristics of Additive Fabrication Processes



Additive Manufacturing

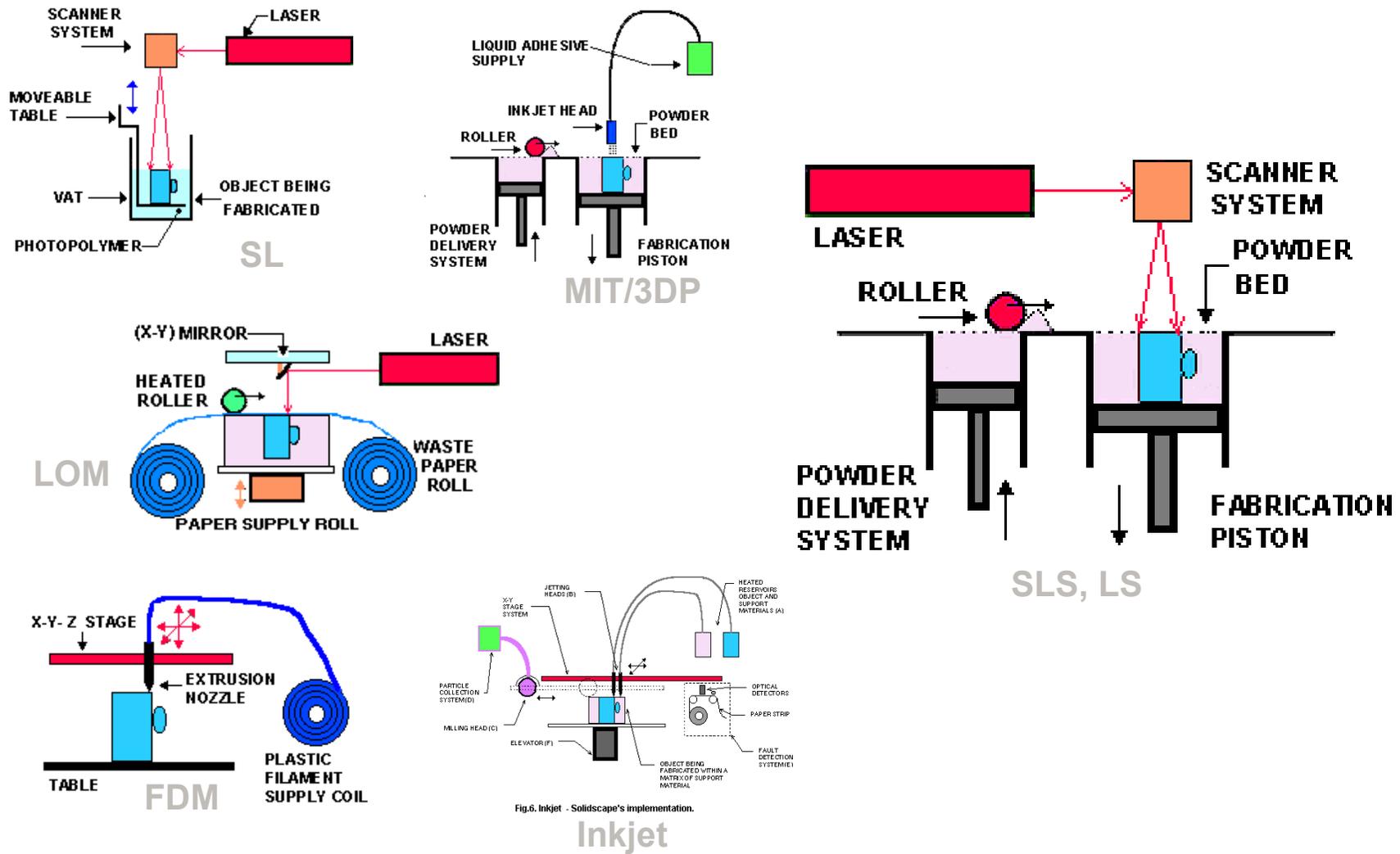
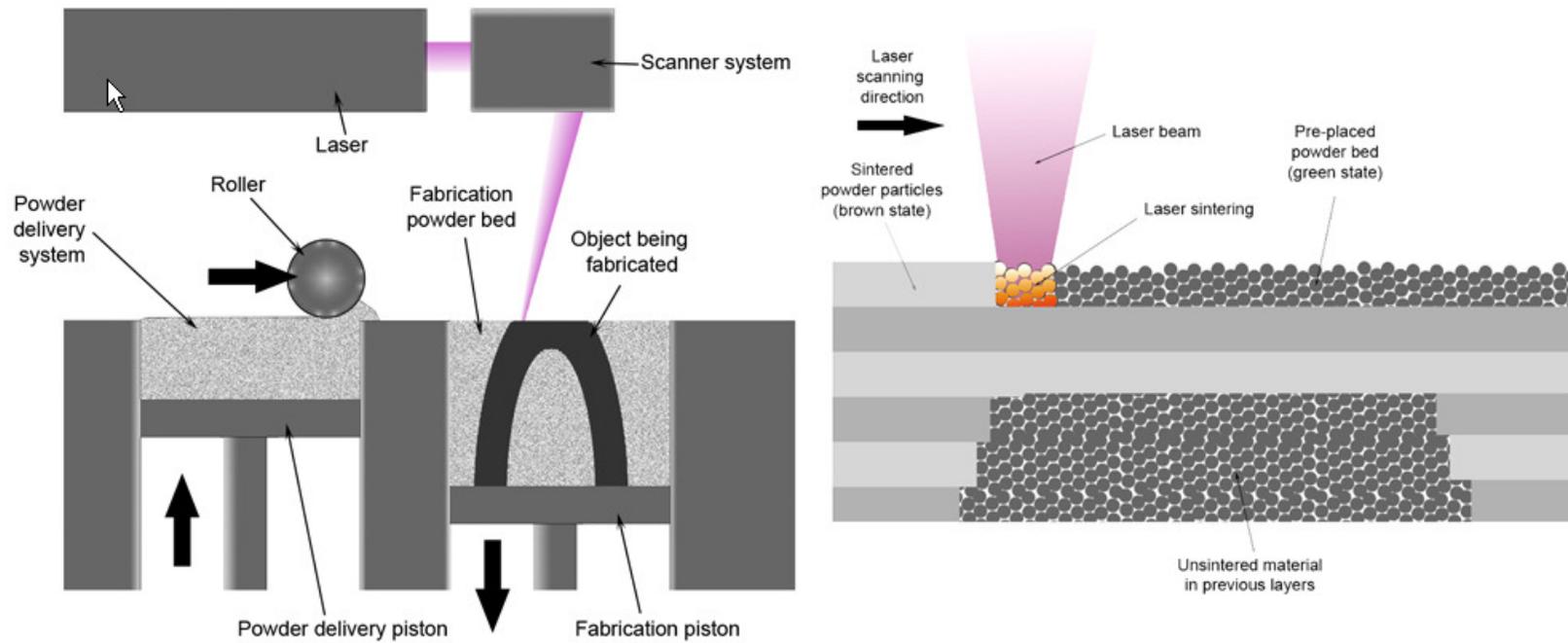


Fig.6. Inkjet - SolidScape's implementation.

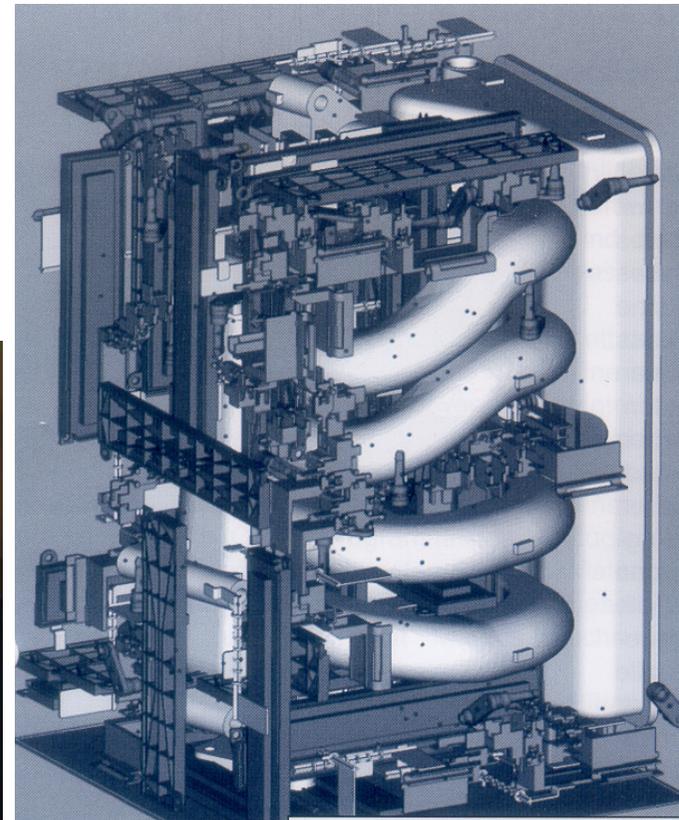
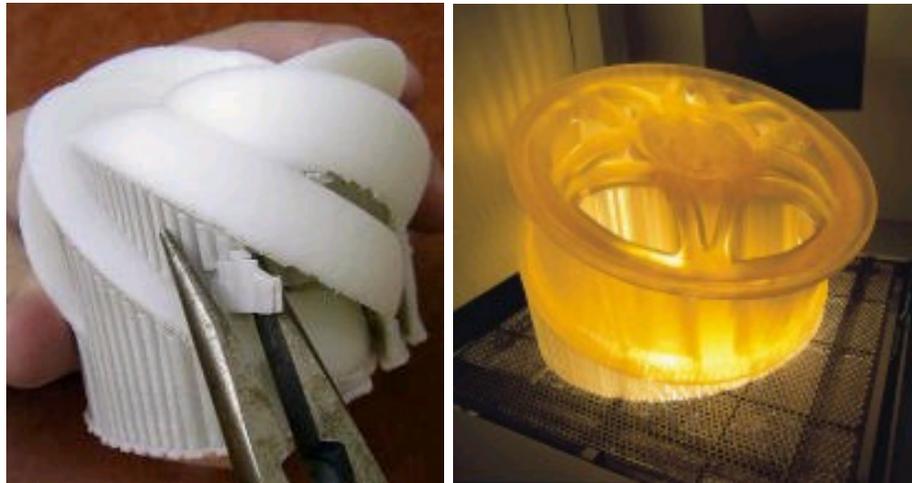
Additive Manufacturing Principle SLS



Additive Manufacturing

Important features of the powder based processes:

- Good mechanical properties
- no support structures necessary
- arbitrary complexity of the parts possible
- big volume usable



→ High potential for real (small) series production

Motivation for the use of toolless fabrication processes

- Price issue for injection moulding of small series (dependent on the part itself)
- Individual parts (needs software and handling etc)
- Impossible to produce by injection moulding (undercuts etc)
- Integration of several parts to one part (difficult to show)(whole production process)

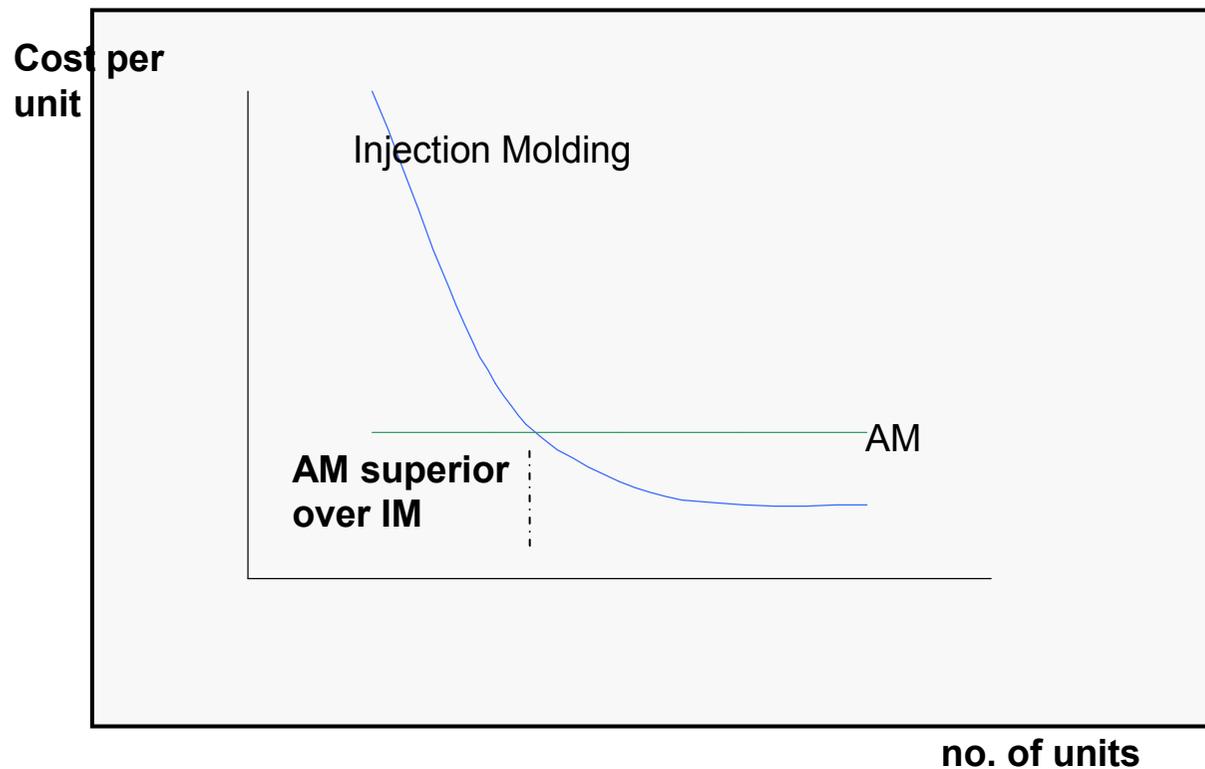
Technology and Economic Aspects



„Rapid“ is no longer important in the sense of Rapid Prototyping

The whole production process has to be economically

↑
Competition against injection moulding



Principle only

Dependent on the specific part

Small parts have higher break even values

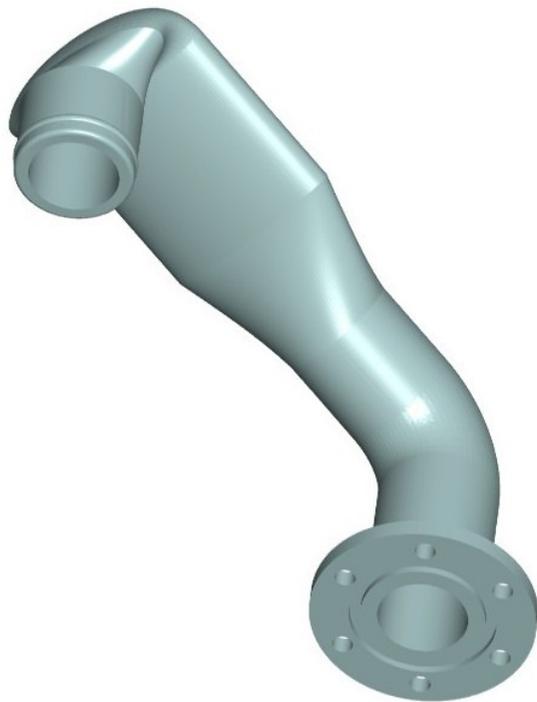
Comparison 1:1, without using advantages like integrating functionality, or more freedom of design

Additive Fabrication

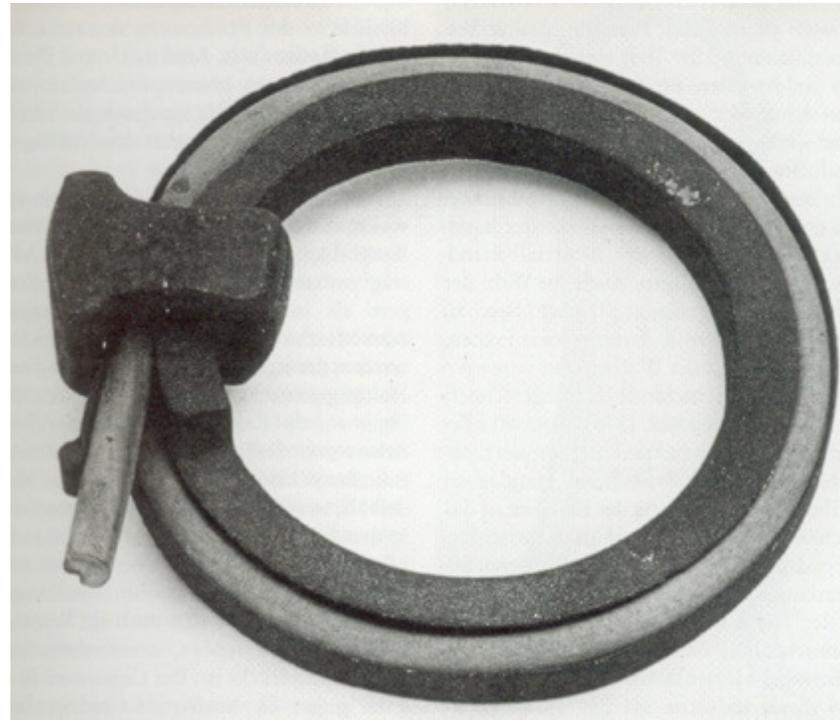
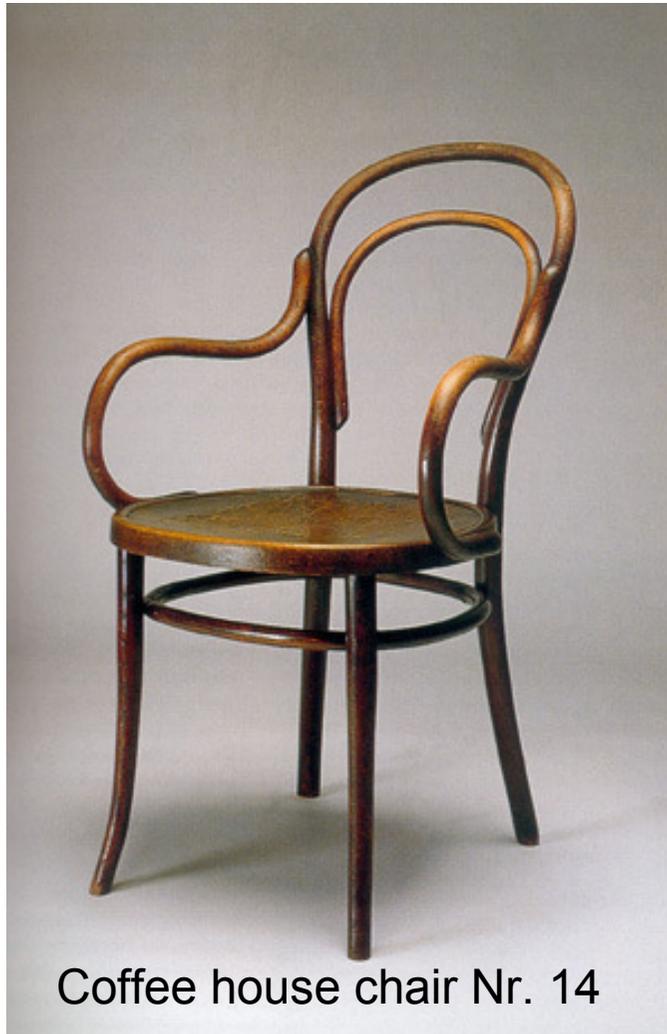
Example for „impossible“ parts



Support Lotus Race Car
SLS-coolant line



Art and Design as early Adopters of new Technologies



Thonet furnitures

Technology of
bending of wood
Start of production 1859

Art and Design as early Adopters of new Technologies



Panton Chair
New plastic formable technologies

stackable
Start of production 1967



Designers today: Production examples



And the examples from today for additive fabrication processes:



Osteon Designer-Stuhl



Designer lamp,
www.futurefactories.com, found at www.designspotter.com,



http://www.stylehive.com/tag/freedom_of_creation



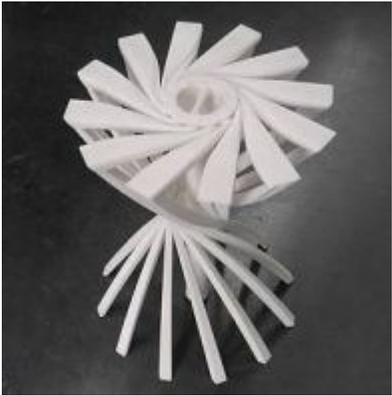
FOC - Hocker



<http://en.red-dot.org>



http://www.inhabitat.com/entry_1168.php



New products for SLS

Flexible material



Comparison of material properties

	standard grade	new flexible material
E modulus	1700 MPa (246.500 psi)	100 - 250 MPa (14.500 – 36.200 psi)
Elongation at break	15 %	>100 %
Tensile strength	45 MPa (6.250 psi)	8 MPa (1.160 psi)
Notched impact strength	3,5 KJ/m ²	No break
Melting point	186 °C (366 F)	150 °C (302 F)
Common refreshing rate	50 %	Not necessary

Shore A 90
Shore D 40



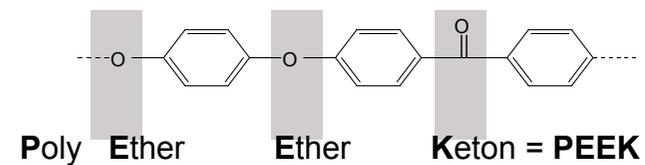
New products for SLS

HT-Material



Material properties

	VESTAKEEP AM 9000
E modulus	3570 MPa > 518 psi)
Elongation at break	2,5 %
Tensile strength	73 MPa (10585 psi)
Melting point	340 °C (644 F)
Continuous operating temperature	280 °C (536 F)



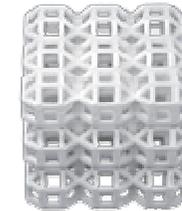
Selective Space Structures



Software for the automated generation of inner structures

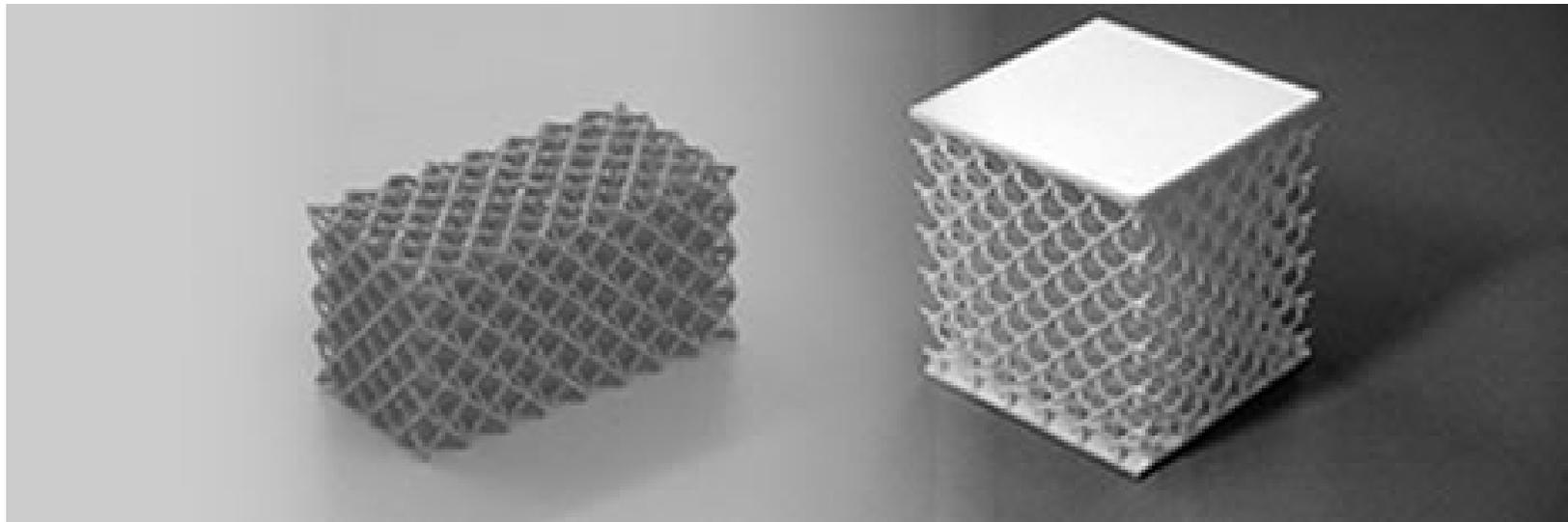
Production only possible by additive manufacturing technologies

Design and production of composite structures, foams etc



Definition of the material properties no longer only by material properties but also by design of special geometries, tailor made to the loading

Special designed porosity possible



Application: Special Gripper (5)



Photo: Festo AG&Co KG

- Made from Polyamide powder, layer thickness 0,1 mm
- Light, flexible, adaptable
- Adjusts itself to the shape of the object to be gripped
- Unique solution for pressure sensitive goods (fruit, bulbs, eggs)
- German Future Price December 2010



- Integration of functionality
- Small series economically doable
- Possibility of bespoke parts
- High flexibility
- Freedom of design
- Spare parts on demand

**What can we do with these new options?
How can we use them to improve our business?**



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