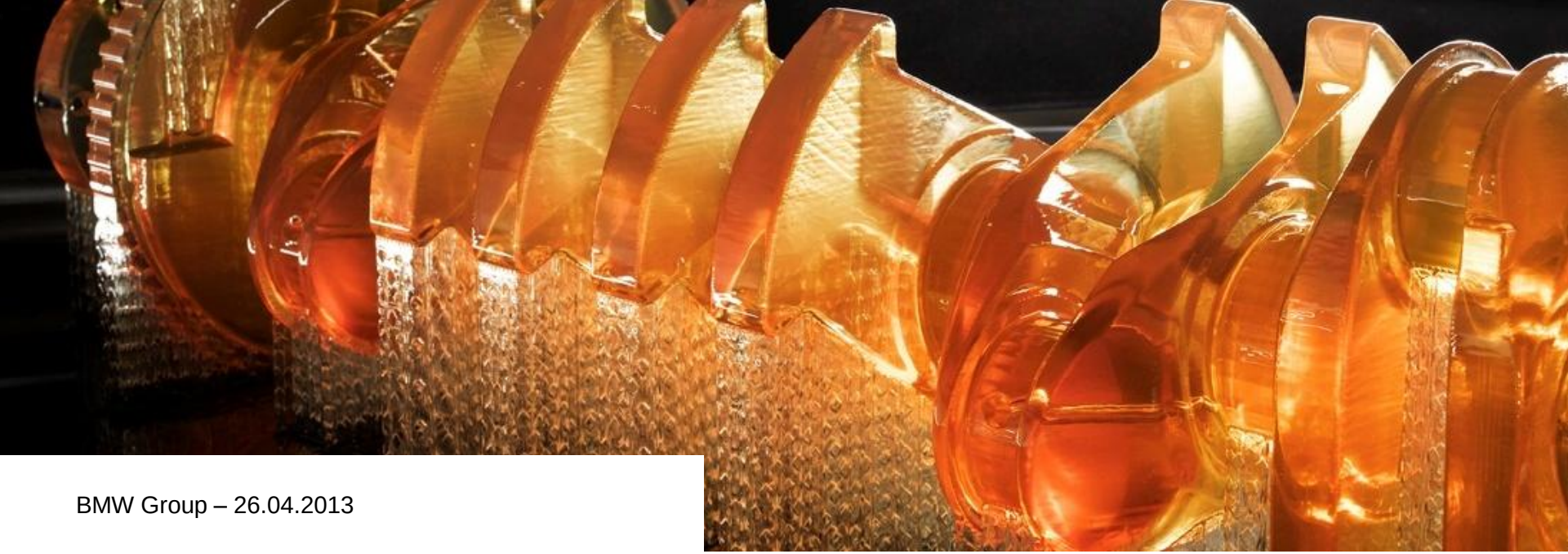


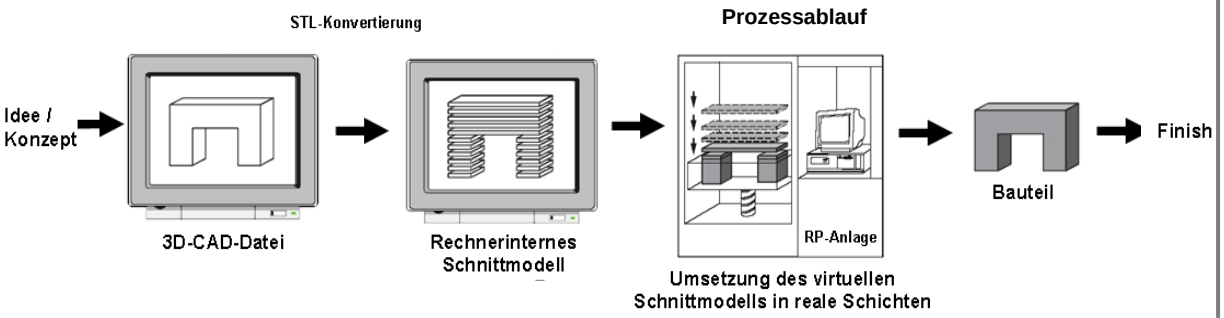
BMW Group – 26.04.2013

ADDITIVE TECHNOLOGIES FOCUSING ON INDUSTRIAL APPLICATIONS FOR METAL AND PLASTIC PARTS.

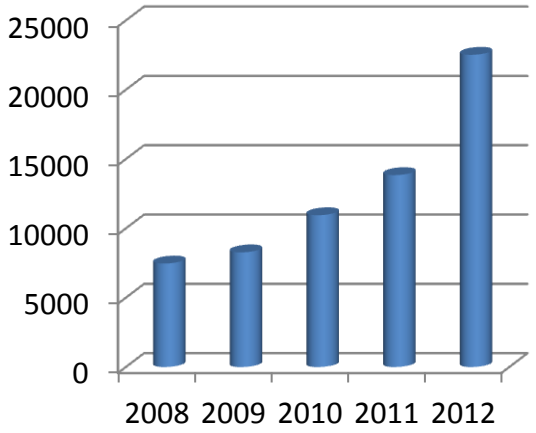
DR. FRANK WÖLLECKE

ADDITIVE TECHNOLOGIES.

Additive Process:



Orders:



Commercially available additive Technologies:

Selektive **L**aser **S**intering

5 Installations

Selektive **L**aser **M**elting

3 Installations

Stereo **L**ithography **A**pparatus

1 Installations

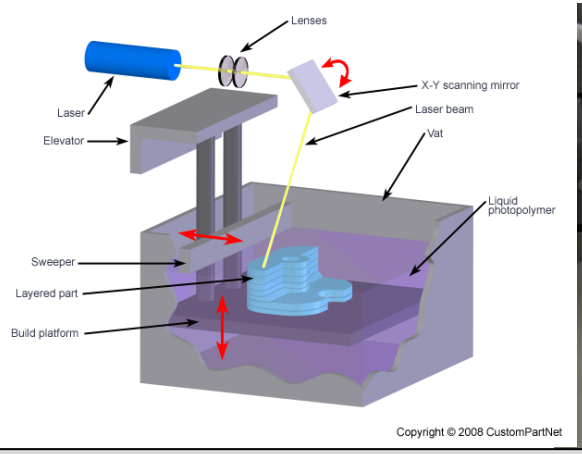
3 D Printing

3 Installations

Fused **D**eposition **M**odeling

3 Installations

AM TECHNOLOGIES. STEREOLITHOGRAPHIE (SLA).



Characteristics:

-First rapid prototyping process, 1988 by 3D Systems Inc.

-Support structure is needed

Strength:

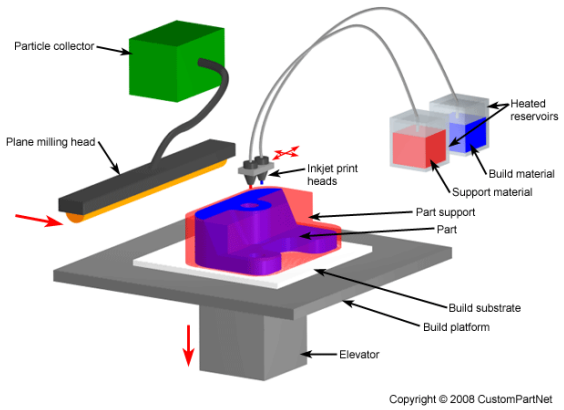
- Design parts
- applicable for trials, e.g. Flow investigations
- high accuracy (+/- 2mm)
- good alternative to 3D-Print
- besser post processing than for SLS
- high material diversity

Materials:

Liquid Photopolymer

-Somos 18420 (Epoxydharz)
- Water Clear Ultra 10122
-Somos 7120 (Epoxydharz)

AM TECHNOLOGIES.
3D-PRINTING (3DP, INKJET).



Characteristics:

-Ink-jet printing head deposits resin
-Support structure is needed

Materials:

UV curable resin

- VeroWhite
- VeroClear
- TangoBlackPlus

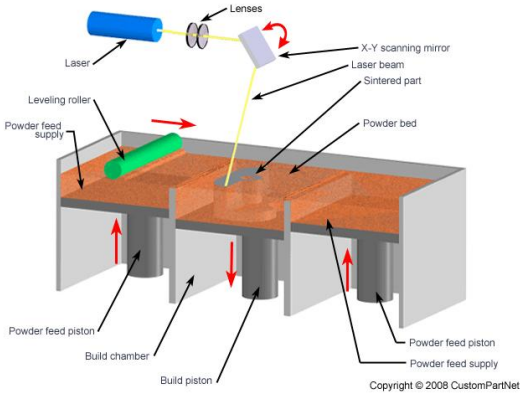
Digital material

Source: Stratasys

Strength:

- high accuracy
- high resolution→ smooth surface, many details
- thin walls (< 0.6 mm)
- easy removal of support material

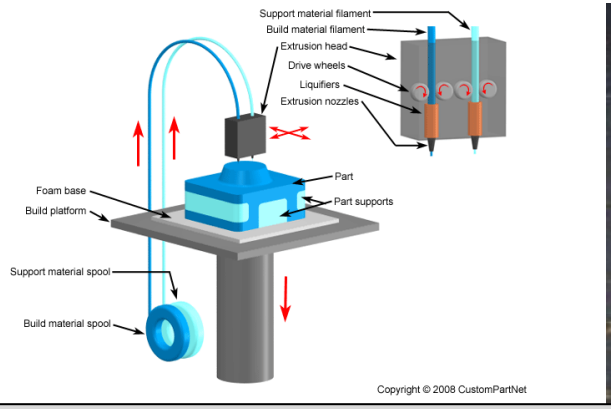
AM TECHNOLOGIES.
SELECTIVE LASER SINTERING (SLS).



Source: EOSINT P 760, EOS

Materials:	**Characteristics:**
- PA 12 unfilled or filled - PA 11 - TPE - PEEK <u>Metalcoating</u> (SLS/SLA) For improvement of strength „Metall optic“	-Laser beam sinters the powder layer by layer -No Support structure is needed **Strength:** -Thermoplastic material, possible fiber reinforcement -Tough -low cost -high E-Modulus, elongation @ Break -Post processing by infiltration possible

AM TECHNOLOGIES.
FUSED DEPOSITION MODELLING (FDM).



Characteristics:

-Material supply to a heated extrusion nozzle
- Extrusion of melted material to form layers
-Support structure is needed

Materials:

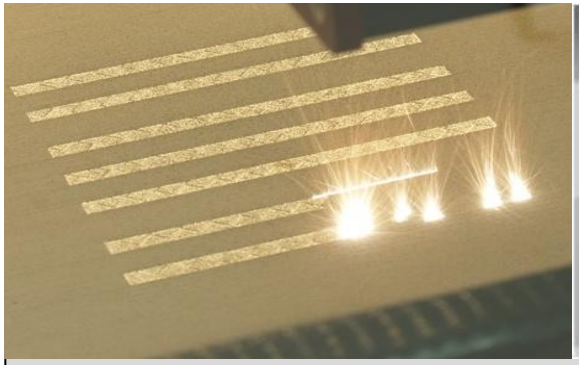
- ABS
- ABS / M30
- PC / ABS
- Ultem

Source: Stratasys

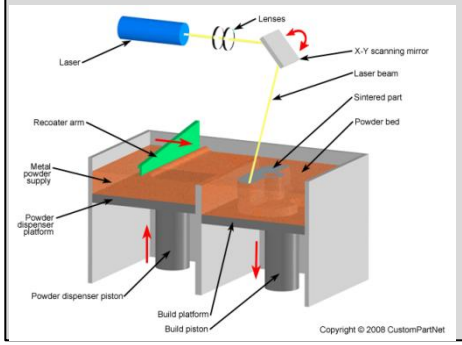
Strength:

- part size
- low warpage
- relatively low cost
- similar material property ` as ABS

AM TECHNOLOGIES.
SELECTIVE LASER MELTING (SLM).



Materials:
- tool steel
- stainless steel
- Aluminium
- „every weldable material“

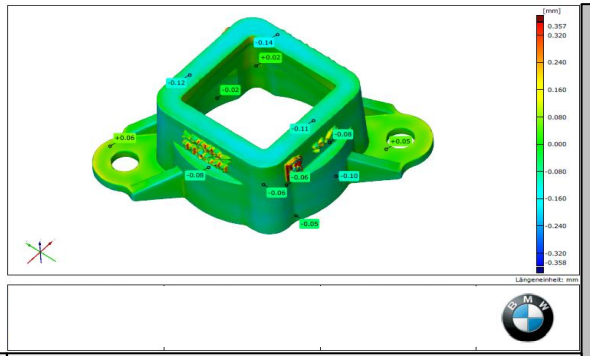


Source: SLM Solutions

Characteristics:
- Laser beam sinters the powder layer by layer
- Support structure is needed

Strength:
- high cooling rates compared to die casting
- high strength
- requirements of series parts can be fulfilled
- warpage can be minimized by support structures or heat treatment

QUALITY CONTROL.



machines :

<u>GOM Atos II Triplescan</u>
accuracy measurements

<u>Powdershape</u>
particle size /form

<u>Z020 (Zwick/Roell)</u>
tensile tests

to ensure:

- robust process

- reproducibility of part properties

Pre-Process:
- Particle analysis
- particle flowability
- MFI (melt viscosity)

In-Process:
- tensile tests
- Shore hardness

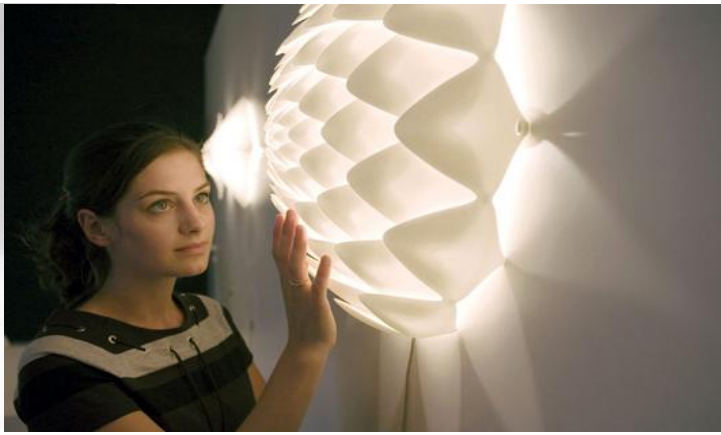
Post-Process:
- accuracy measurements

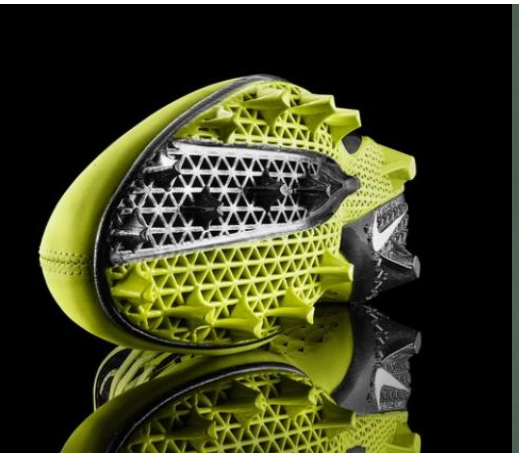
APPLICATIONS

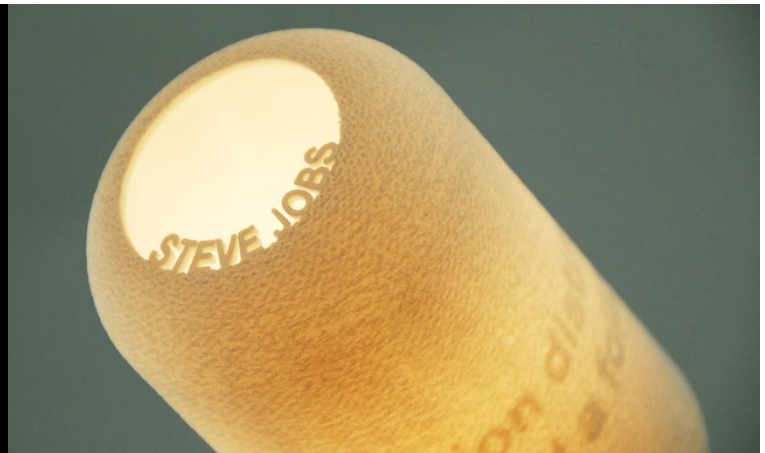
DIFFERENT INDUSTRIAL BRANCHES

FREEDOM OF CREATION

CREATIVITY







NIKE

INDIVIDUALISATION

MATERIALISE

APPLICATIONS

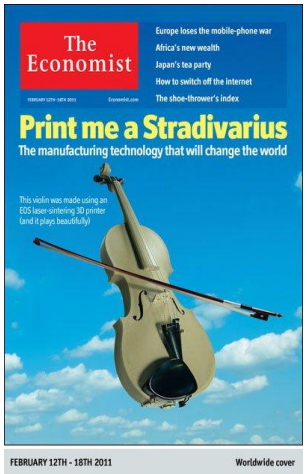
DIFFERENT INDUSTRIAL BRANCHES

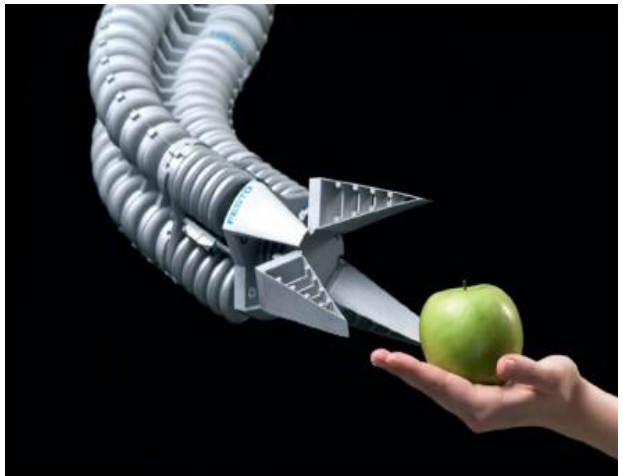
IRIS VAN HERPEN

MODE

JEWELRY

MATERIALISE





ECONOMIST

TREND

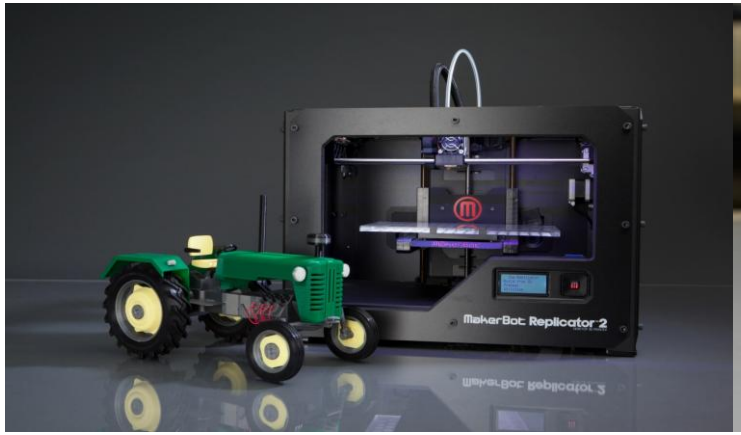
FUNCTIONALITY

FESTO

APPLICATIONS

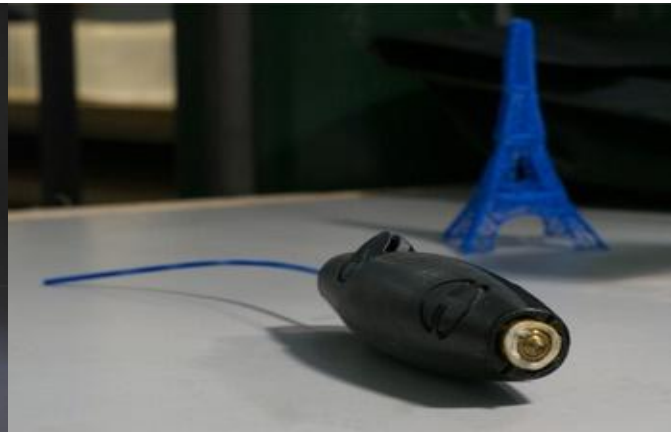
DIFFERENT INDUSTRIAL BRANCHES

MAKERBOT REPLICATOR



DIY @ HOME

3DOODLER



MATERIALISE

DIY @ FACTORY

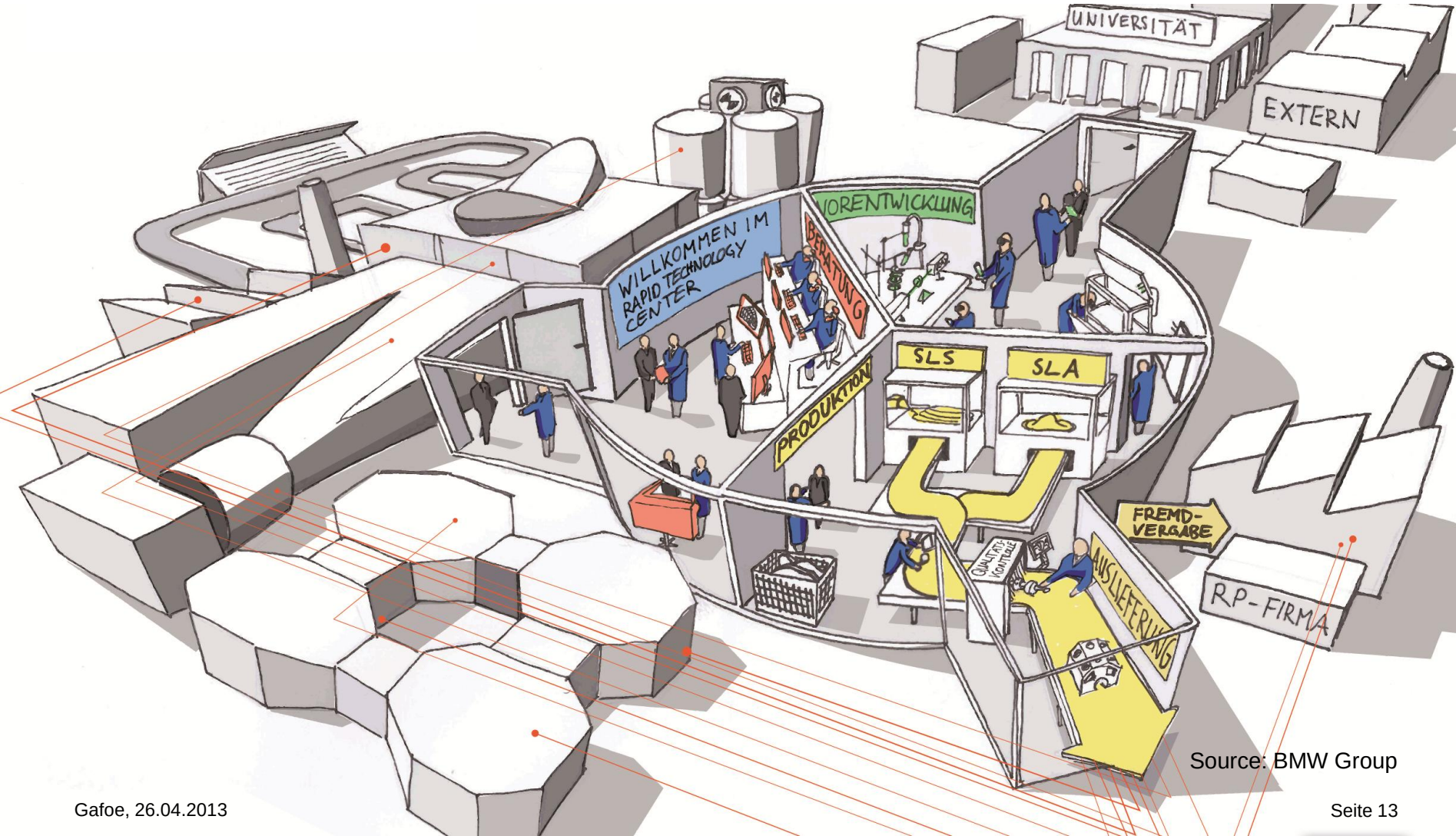
Freeform in function of Aesthetics Design Cars made by AM

Pininfarina Sintesi Citroën Hypnos Citroën GT Renault Ondelios

PGO Hemera Mazda Kiyora Citroën Revolte Jaguar CX-75

Renault Ondelios

RAPID TECHNOLOGIES CENTER AT BMW.



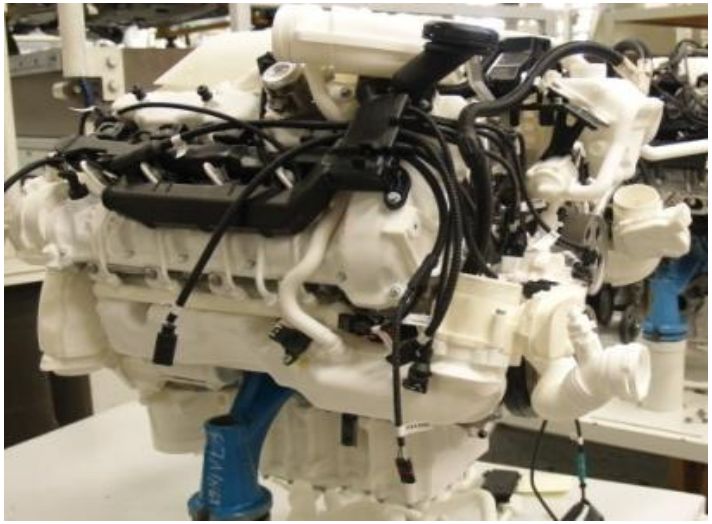
Source: BMW Group

APPLICATIONS

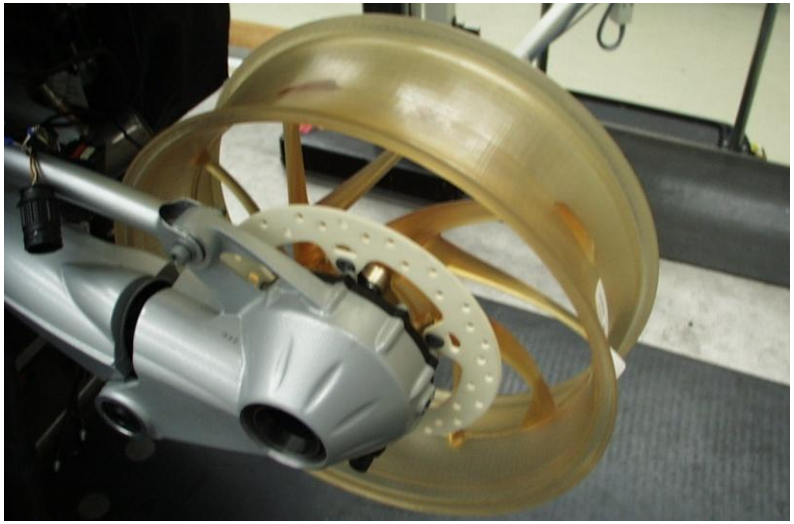
GEOMETRICAL SAFEGUARDING WITHIN THE DEVELOPMENT PROCESS.

Vehicle front using SLS

Crankshaft using SLA



Various motor parts using SLS

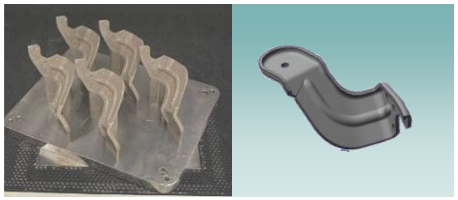


Rear motorcycle wheel using SLA

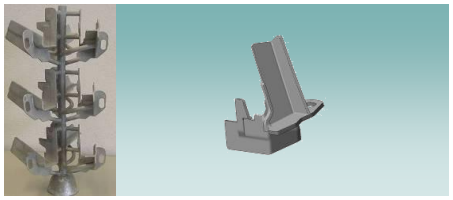
APPLICATIONS.

FUNCTIONAL SAFEGUARDING WITHIN THE DEVELOPMENT PROCESS.

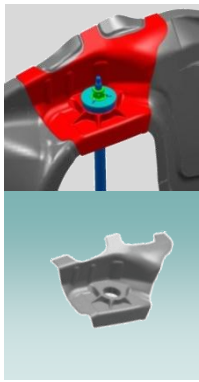
Enginecover (SLS)



Drive train kinematics (SLM)

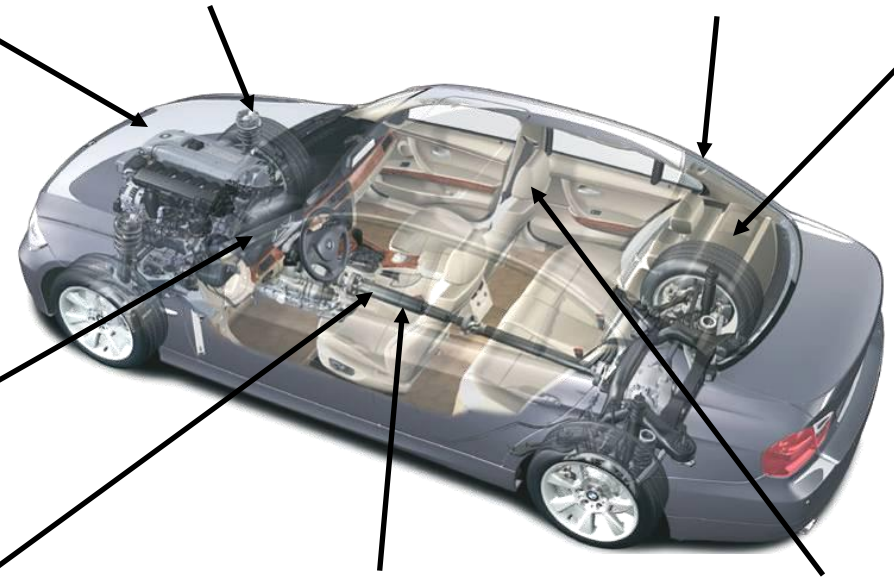


C-pillar intersection
(precision casting)

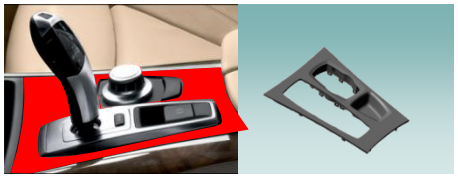


Shock-connecte
(SLM)

Headlight casing
(Vacuumforming)

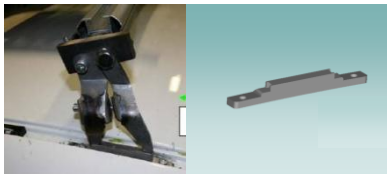


Cover for A- and B-pillars
(Vacuumforming/SLS)



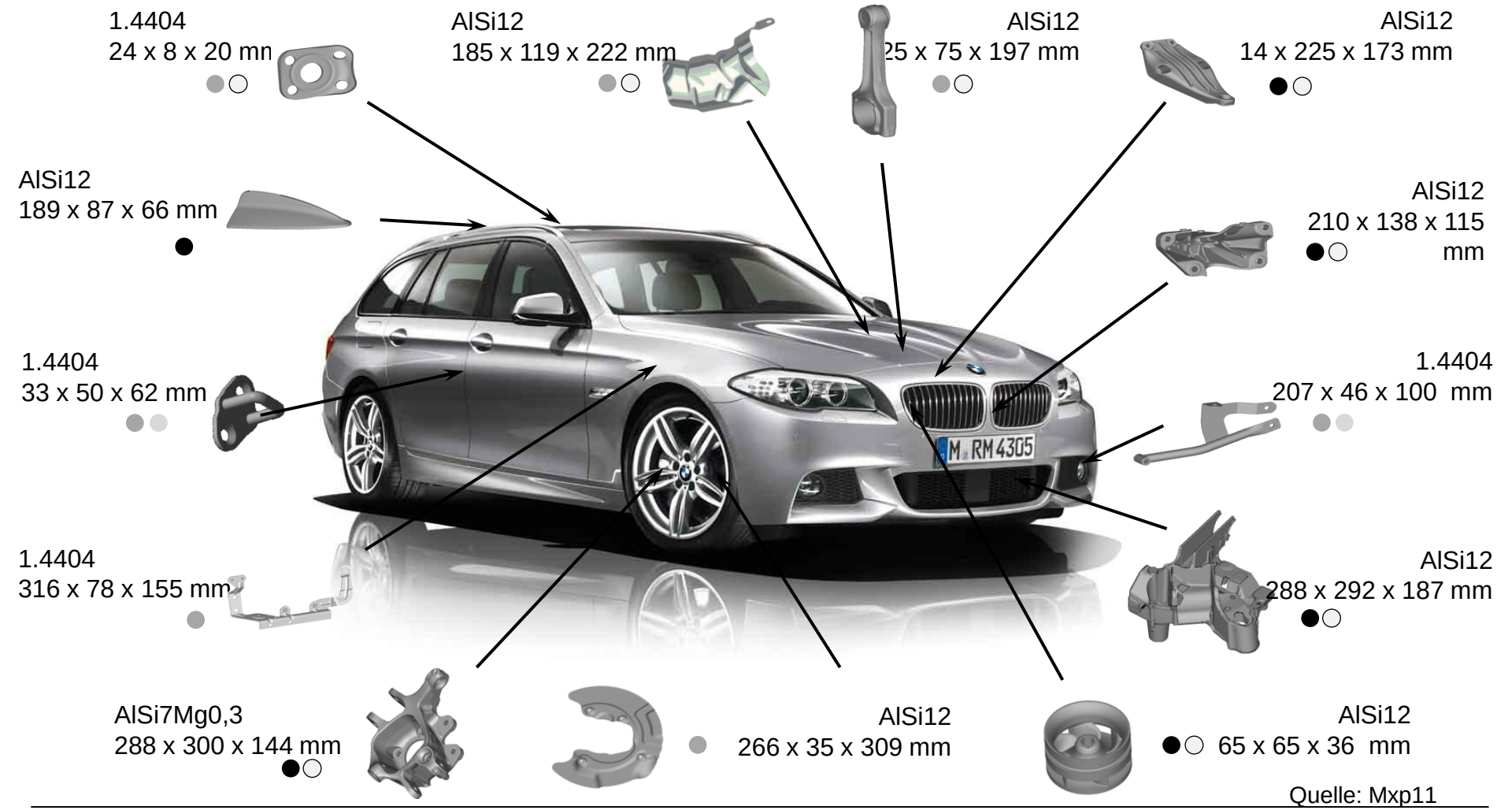
Covers for center console
(SLS)

Cupholder
(SLS)



Roofrack holder
(SLM)

SELECTIVE LASER MELTING (SLM). PARTS 2011 - APPLICATIONS.



Quelle: Mxp11

Substitution of conventional technologies for prototypes by SLM:

● master forming ● metal forming ● joining ○ cutting

APPLICATIONS.

FUNCTIONAL SAFEGUARDING WITHIN THE DEVELOPMENT PROCESS.

Product development process

Product development → **Production**

Development phases

Tooling production

Tooling development

Concept phase ✓ → **Development** ✓

Motorrad

MINI

Rolls Royce

BMW

Series Production
Assembly at the plant

Consumer additions

Spare parts
Assembly at the dealership

SOP → **Series production** → **EOP** → **EOS**

SLM.
ACTUAL APPLICATIONS – ENGINE COMPONENTS.

M3 GT2

Z4 GT3

DTM (ab April ‘12)

Source: Mxp11

Customer: BMW Motorsport

Part conventionally: plastic part of all Series-M3 and M5, two-part clipsed
Manufactured in SLM: ~ 330 parts, manually finished
Material: AlSi12
Volume: 43,6 cm^3 (≈ 118 g)

Vehicle: M3 GT2, Z4 GT3, DTM

ADDITIVE TECHNOLOGIES. FUTURE APPLICATIONS.

Special editions/
country specific

Niche models
(e.g. Rolls Royce)

Security vehicles

Spare parts

Additive manufacturing

accessories

Assembly aids

Special equipment

BMW Classic

CHALLENGES.

- Robust production processes
- Established total quality management process chains
- Sufficient reproducability / reliability
- Customer satisfactory surfaces
- Proof of material lifetime sufficiency
- Extension of batch size economics
- Part properties covering the requirements

HEADLINES.

http://www.3ders.org/index.html

RAPID TECHNOLOGIES CENTER.

Many thanks for your attention.