MIMplus

PRECISION IN METAL
THE FUTURE OF PRODUCTION

MIMplus Technologies Webinar Series 2021
15.04 I 15.06 I 15.09 I 15.11

Webinar Team

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MIMplus Technologies has great knowledge of innovative manufacturing and assembly with a special focus on high-tech materials.

We are a member of OBE Holding GmbH with production sites in Germany and China

>100y

of precision engineering experience

500

employees worldwide

25k

square metre production floor

Key facts MIMplus

- Over 25 Mio. parts and assemblies per year
- Customers from different industries such as medical, aerospace, automotive and luxury
- In house tool shop
- In house machine construction and automation
- Research and development with well equipped laboratory
- Network of leading suppliers
- Certified according to ISO 9001:2015
- Certified according to IATF 16949
- Certificate in preparation ISO 13485:2016
- Certified according to EMAS and ISO 14001

WEBINAR 3

Only the early bird catches the worm-

How co-engineering can lead to competitive advantages

15. September 2021

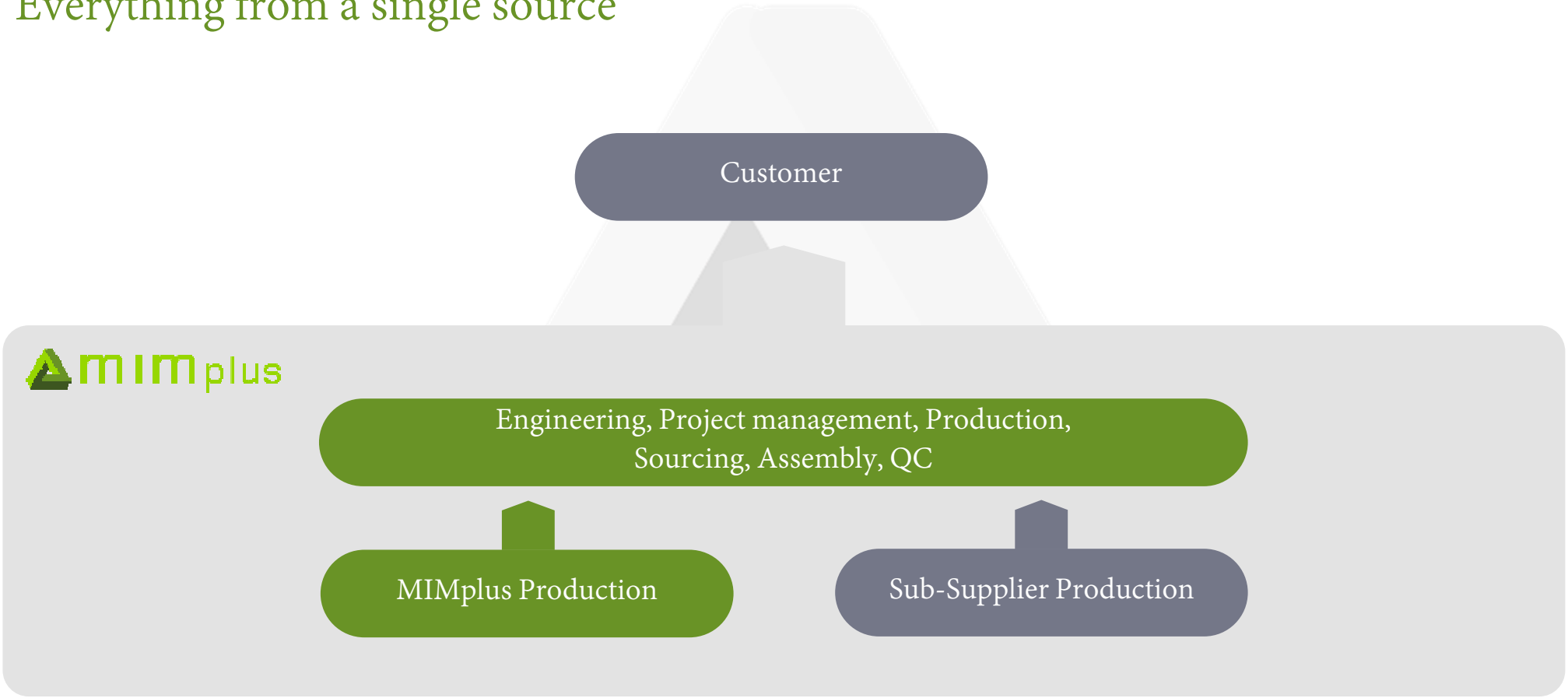
Only the early bird catches the worm
How Co-Engineering can lead to competitive advantages

Our involvement at the earliest possible stage of a development is of particular importance, as **80%** of the part/assembly costs are defined in the early design stage.

This is true for both metal injection molding and sinter-based additive manufacturing.

The webinar builds on the previous webinar 2 and uses illustrative examples to show the benefits of MIM/AM optimized design

Everything from a single source



Design to meet customer specifications

- 80% of the MIM/AM product cost are defined in the early design phase.

  The sooner we get involved, the better we can assist to find the most cost-effective solution for your application. Most parts are designed with the machining process in mind. We will help you to fully utilize the cost saving potential of MIM/AM.

- As MIM/AM is ideally suited for complex parts, numerous functions can be integrated in one part.

  Therefore not only the component itself, but also its specific installation situation in the assembly needs to be taken into account.
  Often it is possible to reduce the number of individual parts by integrating numerous function into one part.

- MIM/AM offers possibilities not known in other processes as:

  green part processing
  co-sintering

Design to meet customer specifications

- As we can make complex parts even with materials unsuited for machining (NdFeB, Cermets, Inconel, etc.) we will help you to rethink your application.

  magnets to clip (NdFeB)
  complex shaped cutting tools with threats (Cermets)
  wear resistant nozzles (Cermets)
  heat resistant complex shaped parts (Inconel)

- Maybe one or more parts of your product/assembly are not suited for MIM/AM. No problem, we have extensive knowledge of all traditional production processes and can offer competitive prices, for parts either produced inhouse or sourced through our extensive supplier network.

Project steps

Typical steps of a MIMplus development project are:

1. Optimization of design
   - From function to form
   - Selection of best suited material
   - Selection of post-processing (heat and surface treatment)
   - Selection of manufacturing process (MIM/AM/machining, cast, etc.)
   - Selection of the assembly/joining process

2. Rapid Prototyping

3. Optimization for serial production
   - Optimization of tooling and fixtures
   - Selection of the best suited subsupplier
   - Selection of best suited automatization

4. Pre-serial production.
   - Verification of capability
   - Parts approval

5. Start serial production

From function to form

Traditional way > design for Machining:

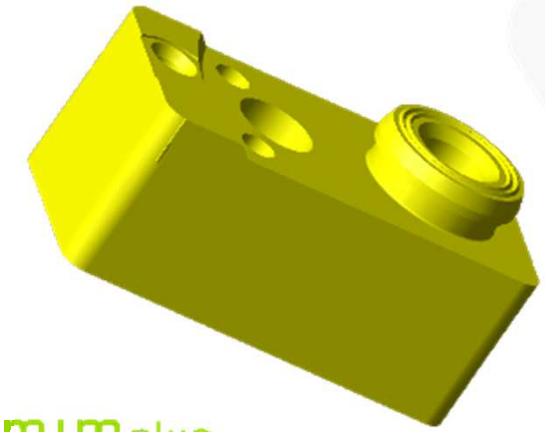
„I created a vision of David in my mind and simply carved away everything that was not David“

Michelangelo 16th Century

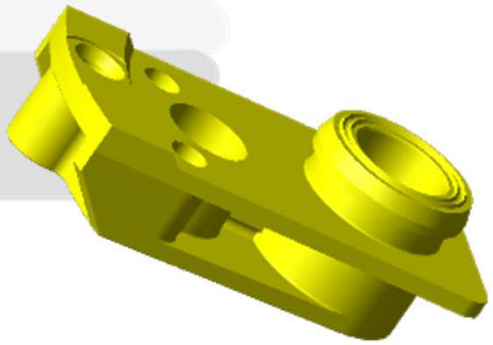
The new way > from function to form:

„Visualize the function of your part and only add material where you need it for the function“

Design for Machining



Design for MIM/AM

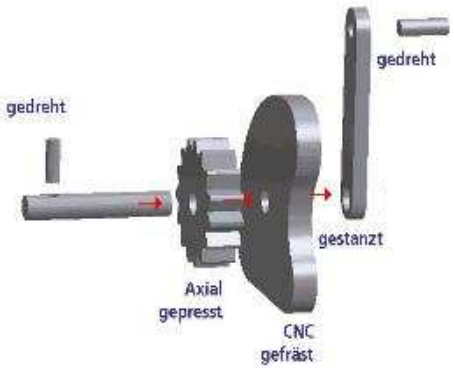


From function to form > integration of function

As MIM/AM is ideally suited for complex parts, numerous functions can be integrated in one part.

Often it is possible to reduce the number of individual parts by integrating numerous function into one part.

conventional design



MIM/AM design

From function to form > green part processing

Some materials are really hard to machine

green part processing is much easier

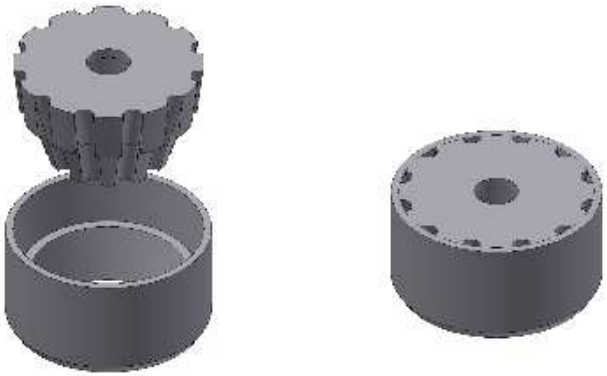
Cermets, Nickel based alloys, …
if it is not possible to integrate some features in the tool –
think of green part processing

Example:

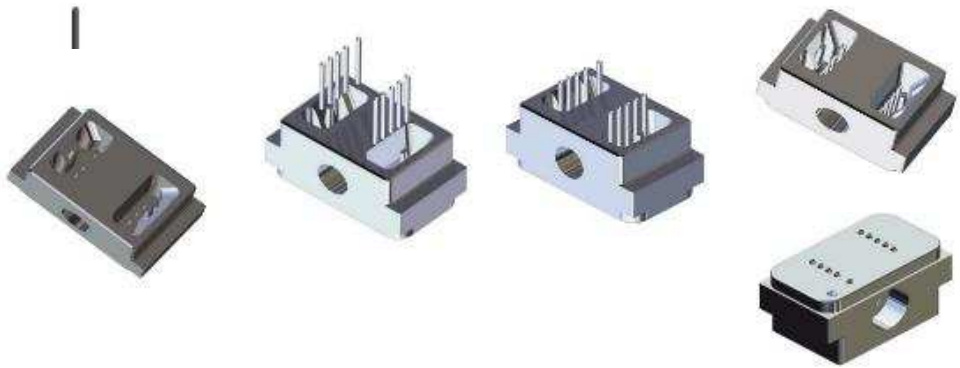
Finger follower made of hardened tool steel > bore with diameter 0.6mm drilled in green stage

From function to form > opportunities of co-sintering

Sometimes two simple MIM/AM parts combined will give you a cost-effective solution to create a complex part impossible to produce otherwise



Get the benefit of different production processes by combining MIM/AM parts with non-MIM/AM parts



Selection of best suited material

- Stainless steels (e.g. 316 L, 17-4 PH, 440C) for high corrosion resistance, some alloys are paramagnetic, some alloys can be hardened
- Low alloyed steels (e.g. 100Cr6, FN02) for high strength and toughness
- Tool steels (e.g. M2) for high strength, high abrasion resistance at elevated temperatures
- Soft magnetic alloys (FeSi3, FN50) for applications that require high relative permeability, high saturation magnetization and low intrinsic coercivity
- Titanium and its alloys for lightweight applications (e.g. aerospace) or in the medical sector
- Stellite (Co-base alloys) for high resistance against abrasion at high temperatures
- Inconel (Ni-base alloys) for high mechanical strength and high corrosion resistance at high temperatures
- Cermets for highest hardness and abrasion resistance
- NdFeB permanent magnets for magnetic assemblies that require complex shaped permanent magnets with a high energy product (e.g. electric engines, electronic devices, consumer goods)

Material Highlights and their fields of application

- Inconel 601 for spark plugs for industrial engines with 3 ground electrodes > Matrix material with Iridium to save Iridium
  (Iridium is currently 2,8 times more expensive than gold !)
- Cermets (WC/Co 88/12) for cutting devices that require high hardness and abrasion resistance
- Stellite6 for high resistance against abrasion at high temperatures
- NdFeB permanent magnets for consumer goods with a complex geometry to facilitate assembly

Post Processing of parts to optimize part properties

A unique selling point of MIMplus represent the comprehensive possibilities for post processing namely surface finishing and surface coating of parts.

Tumbling

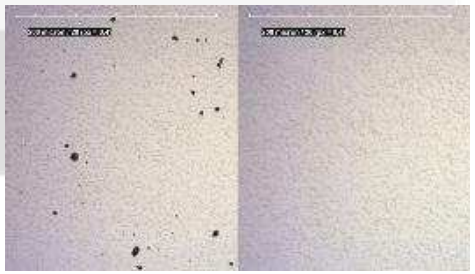
Tumble polishing

Surface Grinding

Electroplating

PVD Coating

DLC Coating



Hot isostatic pressing- HIP

Heat Treatment

Selection of manufacturing process

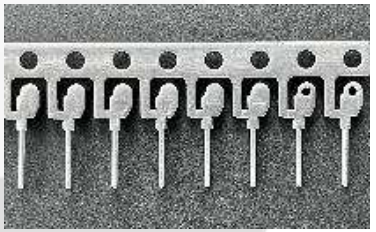
MIM and Additive Manufacturing are stunning technologies with great possibilities. But if complexity or special materials are not required, conventional production processes might give you a cost advantage. Often in assemblies a mix of MIM/AM and conventional parts will give you the best costs.

Therefore MIMplus offers components from different manufacturing processes which are either available in house or purchased from a network of qualified suppliers.

Turning and Milling

Profile Machining

Investment Casting

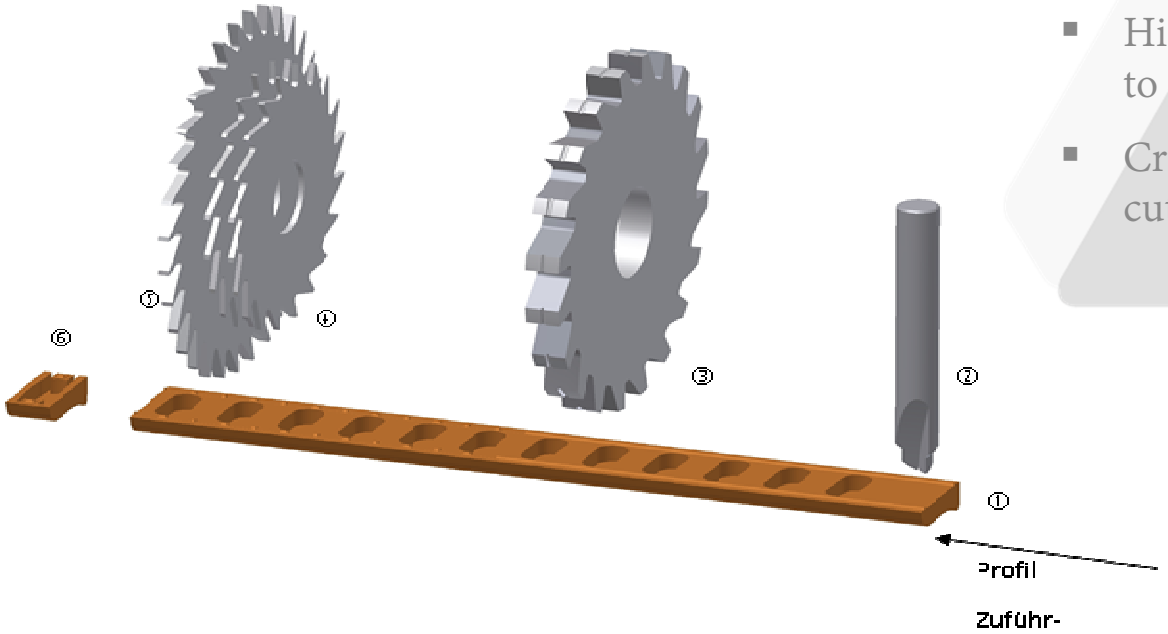


Stamping

Plastic Injection Moulding/ overmoulding

As example: Profile Machining– The process

- Self-developed machines
- High productivity with up to 70 parts per minute
- Cross drilling and thread cutting possible



Manufacturing of Profile — 1

Step Finger Milling — 2

Step Roll Cutter (for welding warts) — 3

Step Slot Sawing and Cutting — 4 5

Tumbling — 6

Finished Part — 7

Rapid prototyping

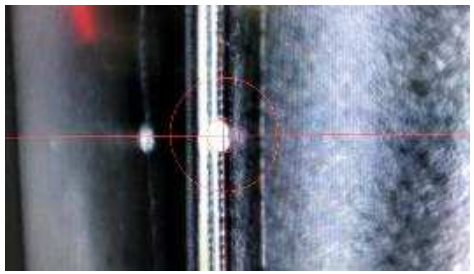
Depending on the complexity and number of the prototypes required, following processes are available at MIMplus:

1. AM > very complex parts
   - Mold jet — prototypes / serial production, high volumes, small to big sized
   - Cold metal fusion — prototypes / serial production, small to medium volumes, medium to big sized
   - Stereolithographic — prototypes, small parts with very good surface finish
   - SLM — prototypes, medium and big sized parts
2. Printed plastic tool inserts > simple forms (> green part processing)
   - Suited for small number of simple / medium complex prototypes
3. Aluminium injection tooling
   - Suited for medium volumes of complex prototypes
4. One cavity prototype tooling (possibility to convert into serial tooling)
   - Suited for high volumes of very complex prototypes

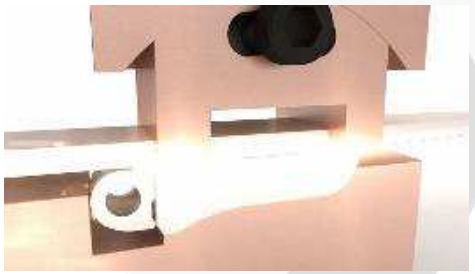
Choosing the best assembly process and level of Automation

Dependent on the project MIMplus offers manual, semi- or fully-automated assembly using resistance and laser welding, soldering, conglutination as well as dismountable joining technologies.

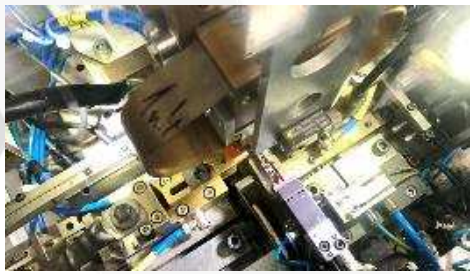
!MIM/AM parts are clean and don't need a cleaning step before welding, soldering or bonding.



Laser Welding

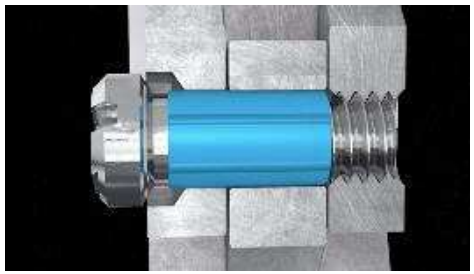


Resistance Welding



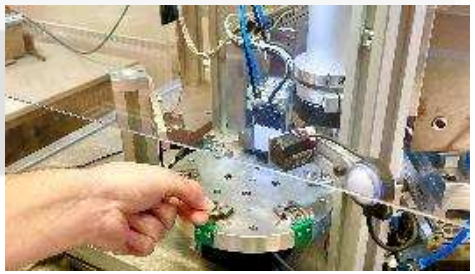
Soldering

Bonding

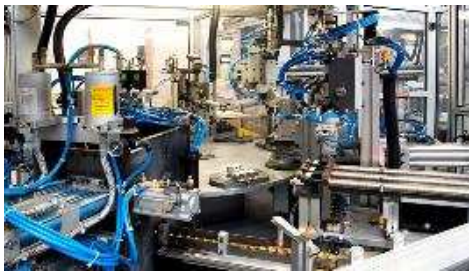


Bolted Connection

Co-Sintering



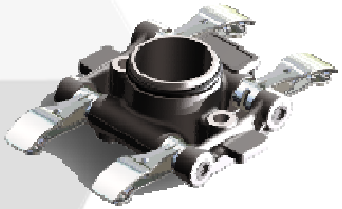
Semi-automated



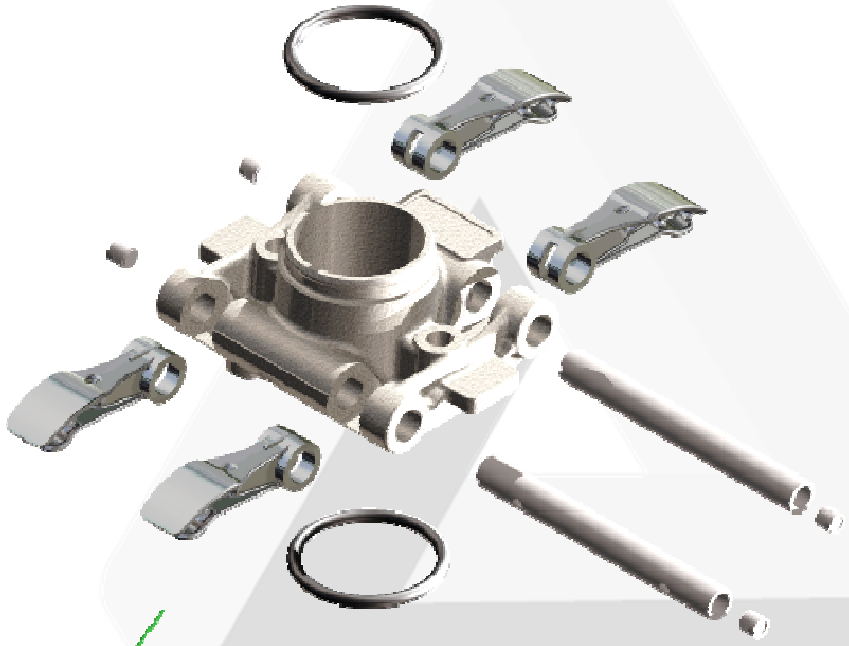
Full-automated

Example Co-Engineering- Valve Train

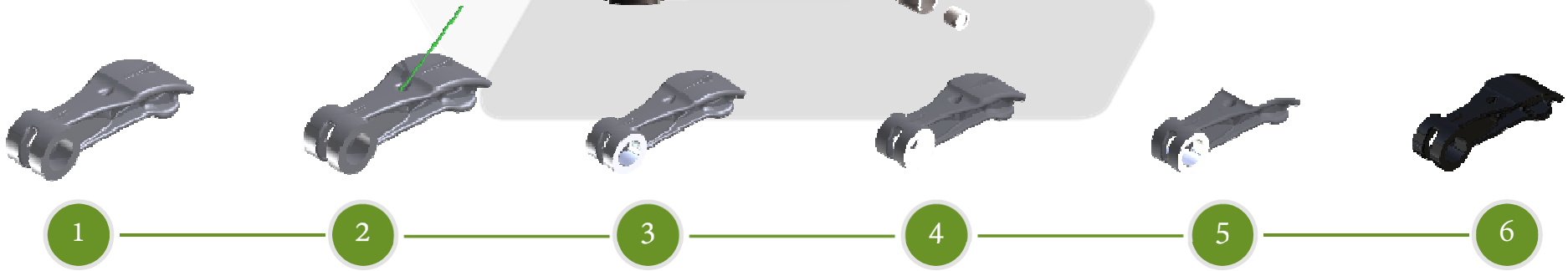
1. From function to form. Material only where you need it for function > lightweight design + green part processing for bore
2. Material selection (Customer specific material development for highly stressed finger followers)
3. Optimization of wear resistance through heat treatment, a special grinding geometry and subsequent surface coating
4. Production of prototypes and execution of tests
5. Selection of suppliers for purchase parts and external process steps
6. Development of the series process with partial- and full-automation and full responsibility for all sub-suppliers



Example Project Co-Engineering- Valve Train



- More than 30 working steps
- 9 suppliers including extended workbench
- 10 manufacturing technologies



Cost saving MIM vs machining

Improvement of function and costs

Major customer request:
Oil feeding through a 0,6 mm hole (drilled in green stage)
Weight reduction due to reinforcing rips > complex shape

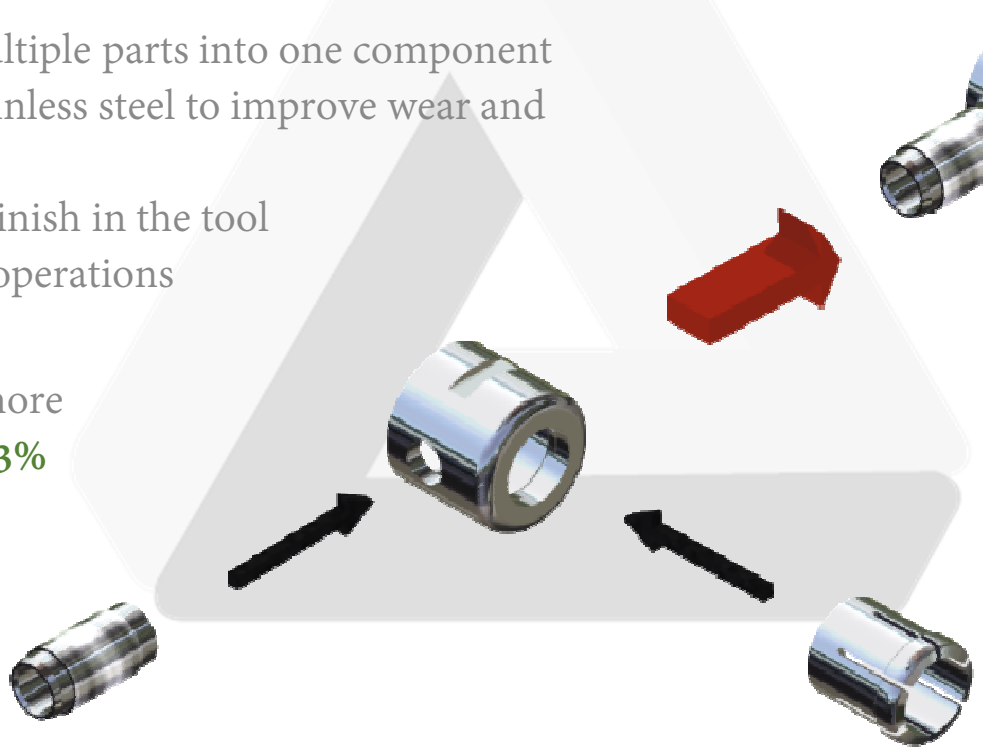
Cost reduction MIM compared to machined part **-41,2%**

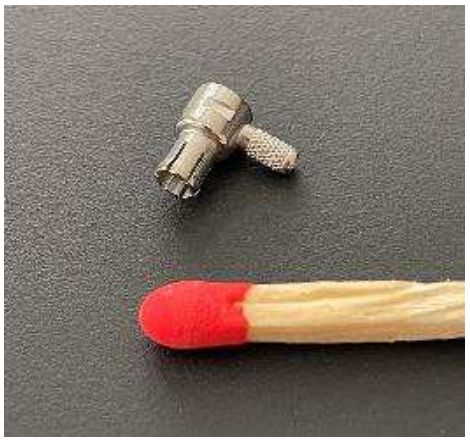
Cost saving through integration of functions

Existing plastic part showed mechanical problems

- We consolidated the multiple parts into one component
- Changed material to stainless steel to improve wear and heat resistance
- Included knurl surface finish in the tool
- Eliminated two joining operations

Cost saving in spite of the more expensive raw material **-68,3%**



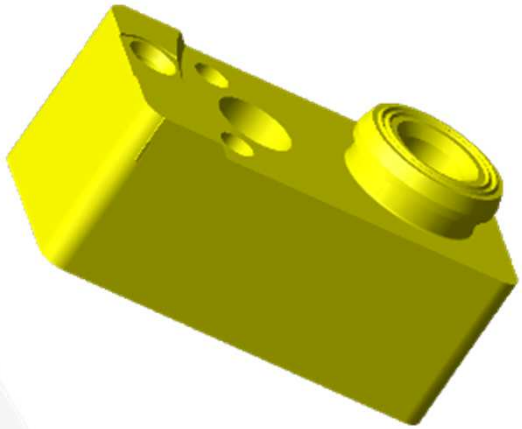


Cost saving through functional design

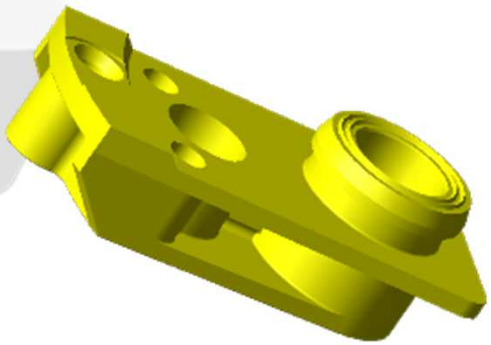
We changed the design from a machined aluminium part to a stainless steel MIM part and achieved:

Cost reduction of -30,4%
Weight reduction of -20,3%

Machined aluminium part



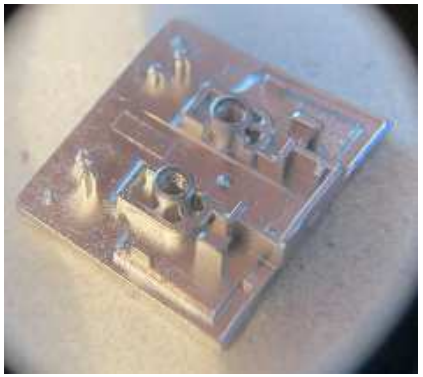
Stainless steel MIM part



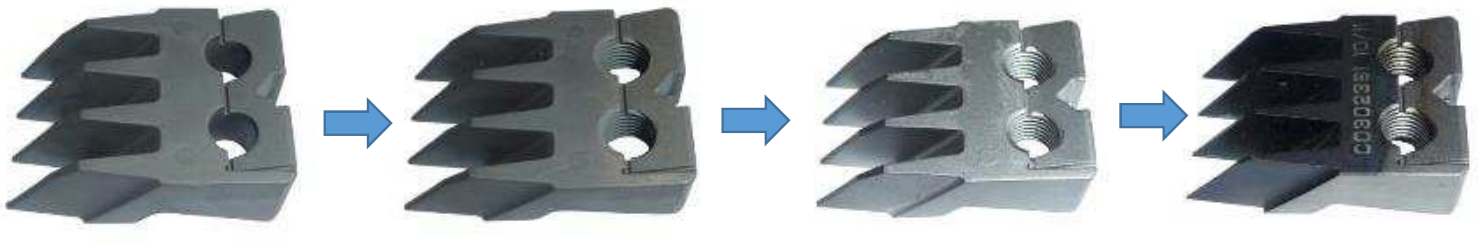
Cost saving through green part processing

Three ways to create a threat example M2 x 3,8,
200000pcs per year, material 316L:

Conventional	threat cutting in the as sintered condition	
Green part processing	threat cutting in the green condition (no tool wear)	cost saving -55%
Injection moulding	Threat created with special tool	cost saving -88%



Example for threat cutting M12 in the green > M2 tool steel cost saving -79%



Example: Post Processing and Assembly

Laser welded and shot-blasted hinge mechanism with glued-in magnet developed in co-operation

Example- Post Processing and Assembly

Benefits for customer:

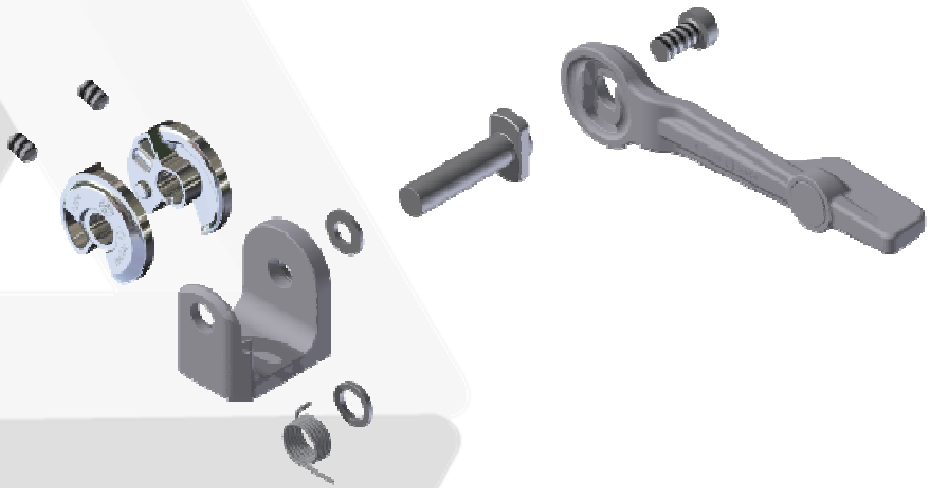
1. Highly integrated functions as:
   - integrated magnet for on/off functionality
   - complex freeform design to achieve snap functionality
   - alignment pins for mini circuit board assembly

2. Special surface treatment to:
   - achieve the same surface finish for MIM and stamped parts
   - anti- fingerprint feature

3. Design for production:
   - M2 treats direct from the mould
   - Special features to facilitate the laser welding process

Example: Assembly with components from sub-contractors

- 12 working steps
- 2 MIM parts
- 10 purchased parts
- assembled at MIMplus
- quality control and responsibility for all suppliers at MIMplus



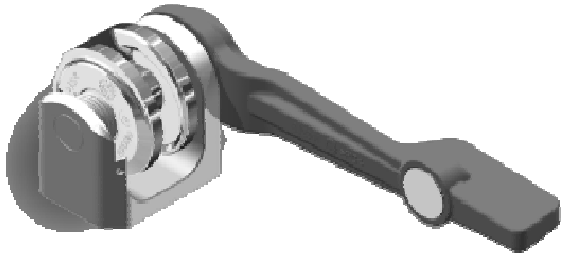
Example- Assembly with Components from Sub-suppliers

Benefits for customer:
Everything from one source

1. Processes
   - MIM parts are heat and surface treated by customer specified sub suppliers. Full responsibility at MIMplus

2. Sourcing
   - All non-MIM parts are sourced by MIMplus. MIMplus takes full responsibility for his supply chain (stock management, Quality, disposability, sustainability, etc.)

3. Assembly
   - Assembly done in house. Ensures reactivity and short lead times



MIMplus

Leica

Example: NdFeB

Example 1

- Magnet for an assembly in electronic devices
- Magnet has a thickness of < 0.8 mm
- State of the art production of the part: press & sintering and post-processing via wire cutting

Example 2

- Holding magnet
- Clip feature integrated in the magnet
- State of the art production of the part: not possible
- Cost saving: elimination of magnet holder and bonding process

Example- AM vs MIM

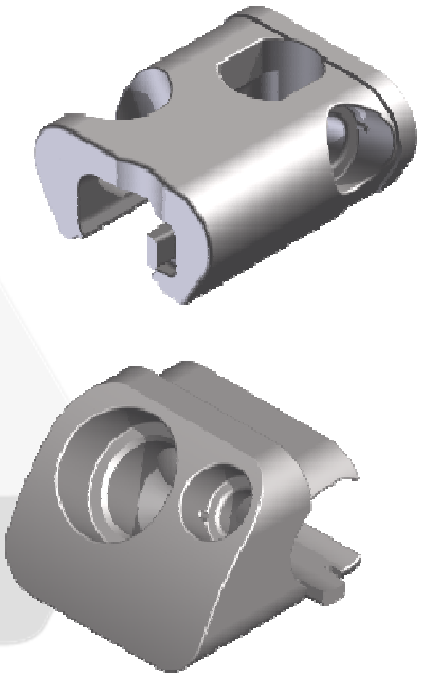
Those two parts are small 4mm*2,5mm*5mm and have a highly complex internal shapes. The requested volumes were 200k per year.

Due to the complex internal form, the MIM injection tool would have been expensive and limited to max 2 cavities.

Thus we took the AM approach and could reduce the costs by:

Part 1 -20,4%

Part 2 -16,3%



Questions &Answers

Preview Webinars

15.11.21

Webinar 4

WEBINAR 4

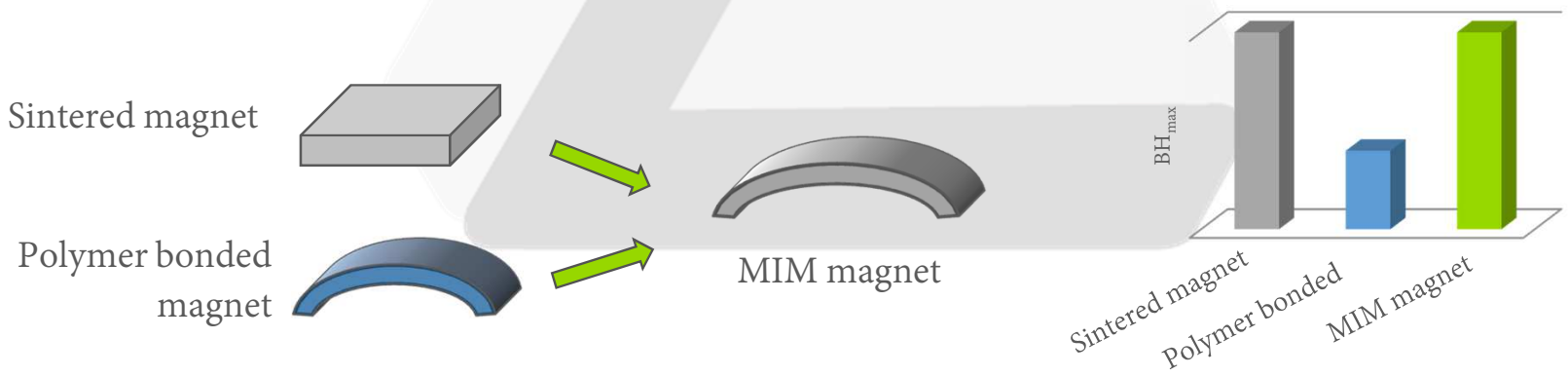
Recycling of NdFeB and production of complex new MIM-magnets

The problem

- China mines, produces and thus controls over 2/3 of the world's demand for rare earths. (2018)
- Major environmental damage from the mining methods used
- Rare earths are difficult to substitute for the production of high-end NdFeB-magnets
- Strong price fluctuations depending on current objectives of the Chinese leadership
- Europe and the USA need to become less dependent on Chinese supplies of rare earths

The solution

- Recycling of NdFeB from end-of-life magnets
- Innovative technologies for using ressources more efficient, e.g. by manufacturing of magnets via MIM
- MIM magnets combine the advantages of sintered magnets (high energy product BH_{max}) with polymer bonded magnets (complex geometries and magnetization)



Thank you !

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