MIM plus

Possibilities to consolidate mechanical components with Metal Injection Moulding and Additive Manufacturing

How to improve Cost and functionality with green part and post processing

15.06.2021

„If you only remember two technologies […] they should be additive manufacturing and metal injection moulding.“

Factory of the Future, McKinsey Report, 2014

If you want to be fast …

… choose the right vehicle

And don't forget …

… it must fit to the road

Conclusion
the form must fit to the function and the process

From powder to complex metal parts…

AM

MIM

raw material
metal powder, binder

shaping
AM / MIM

debinding
solvent, catalytic, thermal

sintering
sintering furnace

metal part

1 — 2 — 3 — 4 — 5

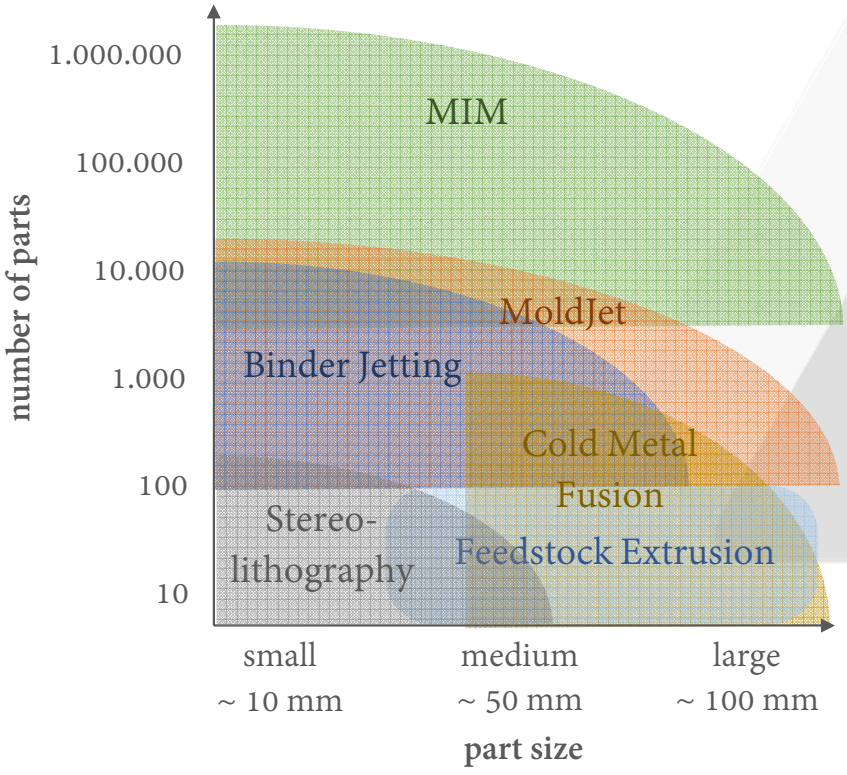
MIM or sinter based AM

- Whatever process you use - the possibilities of consolidation are just the same
  - feel free - use the possibilities of complex shapes
  - mix it – combine different materials and processes for clever solutions
  - Consider the effects of sinter distortion

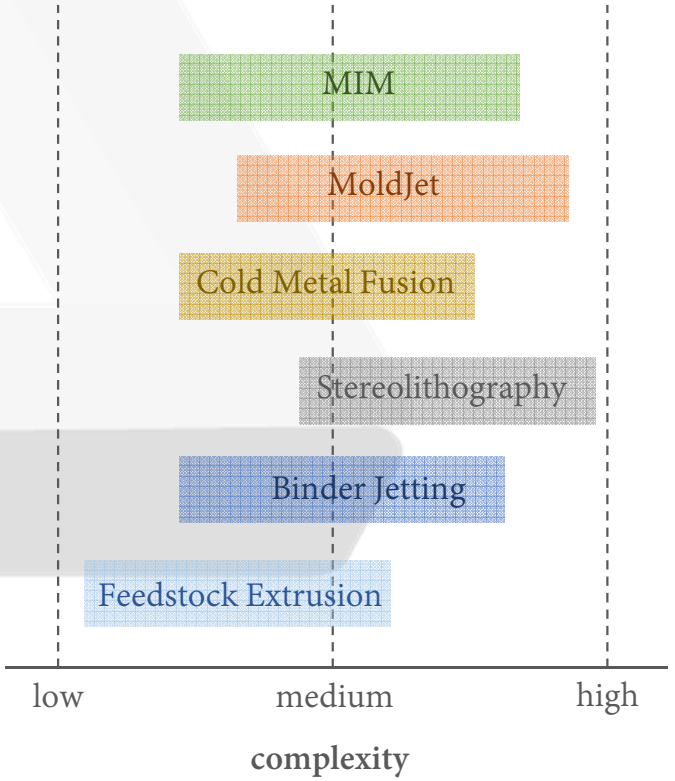
AM	MIM
	
✓	✓

MIM or sinter based AM

Part size and production volume



Part complexity



Comparison of MIM and Sinter based AM

	MIM	AM
High Volumes	++	0
Low Volumes	0	++
Surface quality	++	0
Non-demouldable cavities	0	++

AM	MIM
	
✓	✓

Think MIM

The way to design machined parts:

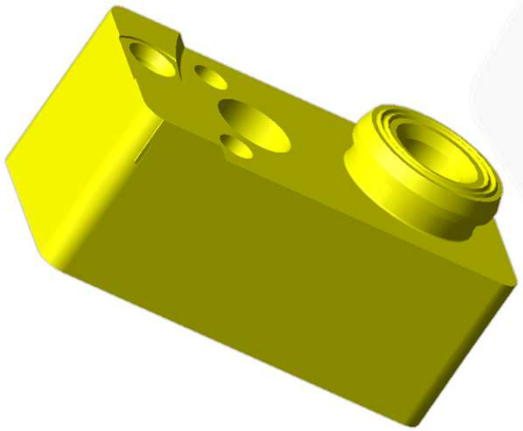
„I created a vision of David in my mind and simply carved away everything that was not David“

Michelangelo 16th Century

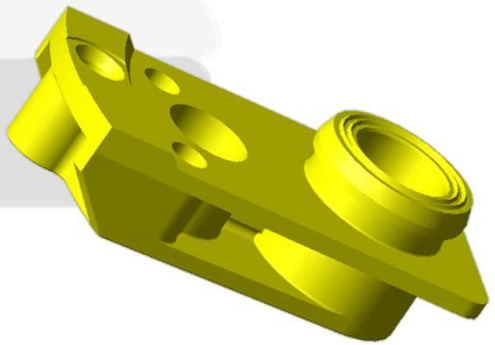
The way to design MIM parts:

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

Machined design



MIM design



AM	MIM
	
✓	✓

Feel free

use the design possibilities of the injection process

- Save material - save resources

  Put your parts on a diet.

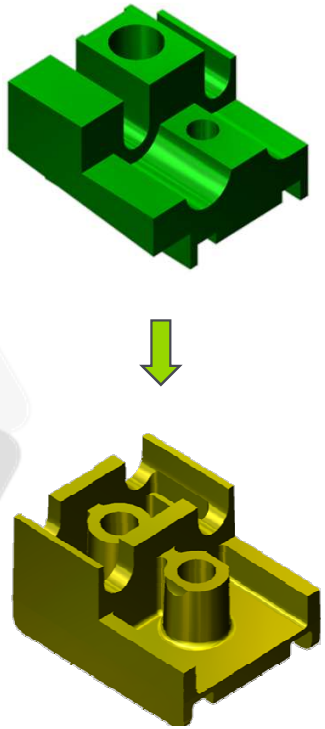
  Try to utilize the design freedom of the MIM process to create lightweight parts.

  This will save material, resources and costs !

  Example: holder for tape measure

  original design: milled

  MIM solution: 50% weight reduction



AM	MIM
	
✓	✓

Feel free

use the possibilities of the MIM process to consolidate parts

- Save assembly cost by making one part out of three

  Integrate different functions into one single part

  Forget the limitations of conventional processes that force you to split a solution in different, easy to produce parts.

  Don't worry about assembly problems

  Just integrate all your functions into one single part

  Open your horizon for new solutions

  Example: Electronics connector
  conventionally made out of 3 parts
  MIM solution integrates all into one part

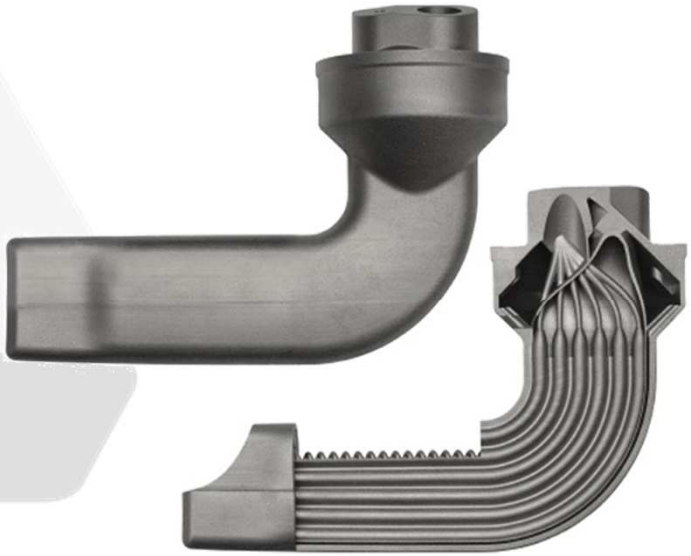
Conventional solution

MIM solution

Non-demouldable cavities

AM	MIM
	
✓	✗

- Use the freedom of design that only AM offers you
- AM can produce internal structures, no other process can achieve due to demoulding restrictions
- Example: curved cooling channels



Non-demouldable cavities

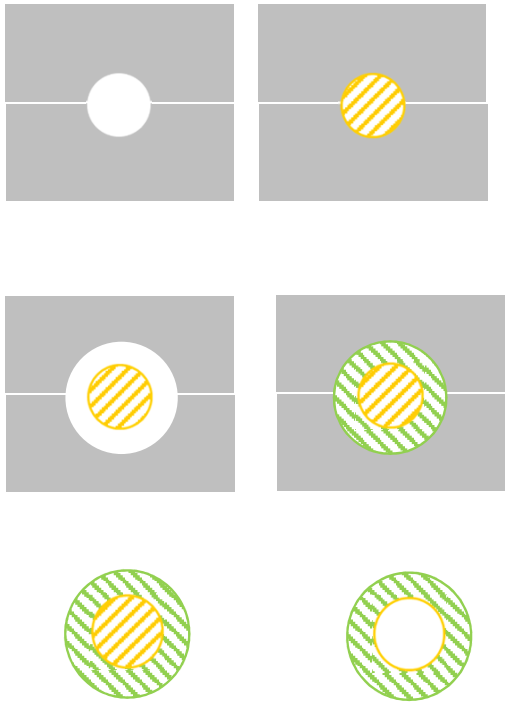
AM	MIM
	
✘	✓

- Your expectations on surface quality are too high for AM
- Your volumes are not economical for AM
- And you need non demouldable cavities?

Use the possibilities of 2K injection.

Your second component will be removed during debinding

This gives you even more freedom of design for MIM parts



Minimise distortion during Sinter process

AM	MIM
	
✓	✓

- Create a flat area to position the part in the furnace

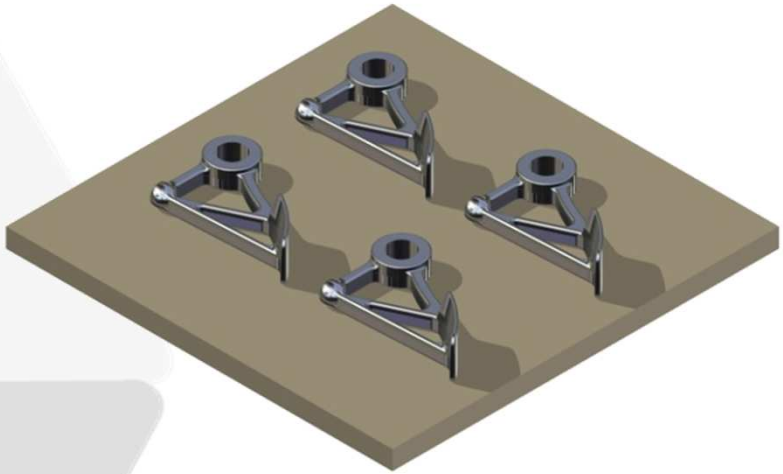
  During sinter process the part is very weak due to temperatures of ≈ 1300°

  In addition the parts shrinks ca. 20% in length

  It is best practise, to have a flat area to position the parts in the furnace

  Example: finger follower

  the wide of the paddle is not positioned symmetrical as you would normally do. So a flat support surface was created.



AM	MIM
	
✓	✓

Minimise distortion during Sinter process

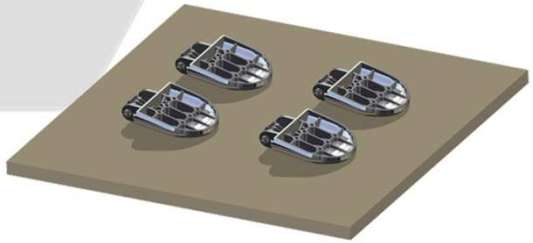
- Give the part enough strength by a clever design

  If a flat support surface is not possible, increase the strength of your part e.g. by ribs or other solutions

  Example: Hinge part for headphone

  Lightweight part due to constant wall thickness:

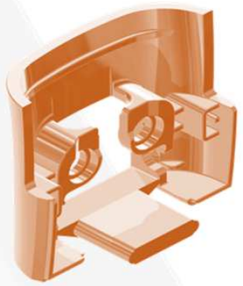
  Ribs increase strength against distortion



Minimise distortion during Sinter process

AM	MIM
	
✓	✓

- Add support structures
- You can remove these structures easily by just breaking them.
- No chips, no lubricant after removing the support structures



AM	MIM
	
✓	✓

2K AM and MIM

combine materials

- 2K MIM: injecting 2 materials in the tool
- 2K AM: print 2 different materials
  - combine materials with different properties in the same part
  - You need a partially magnetic part? – combine 316L and 17-4PH
  - You need high friction or temperature resistance?

    e.g. combine Inconel for the functional areas and normal steel for the support material. This way you save money without compromising the performance of your part.
  - The only limit is the is the sintering temperature and atmosphere

    Our development team will help you to find the best combination

Mix it

mix different processes

AM	MIM
	
✓	✓

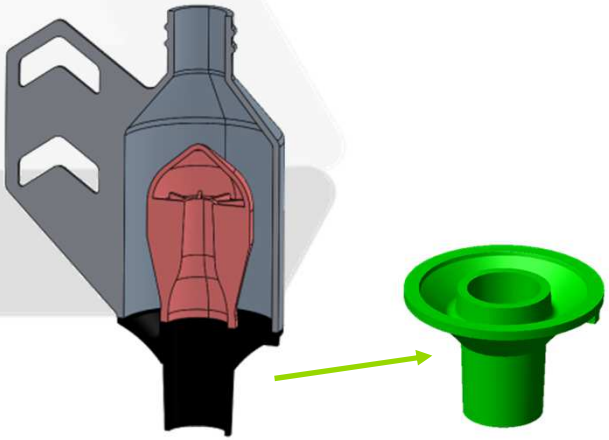
- Combine MIM and AM

You have many part variants, but the base is always the same?

MIM your base and print the variants on the MIM part.

This saves printing time and reduces your costs.

Example: Check valve for railroad car



AM	MIM
	
✗	✓

Co Sintering

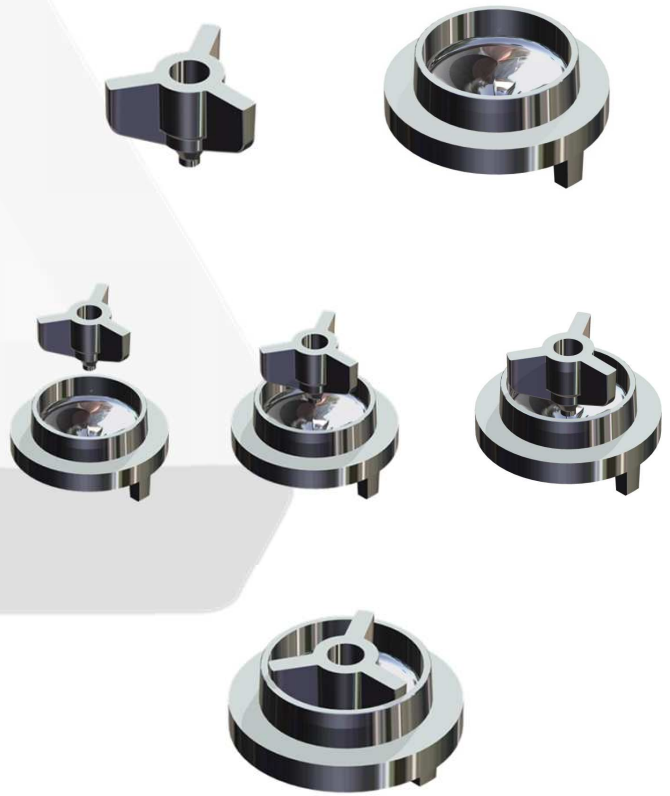
same process

- Combine 2 MIM parts

Geometries that are not possible in MIM but the quantity is too high for AM?

Create two or more MIM parts, assemble them in green stage. After sintering you will get one part

Example: Nozzle for Ad blue injection



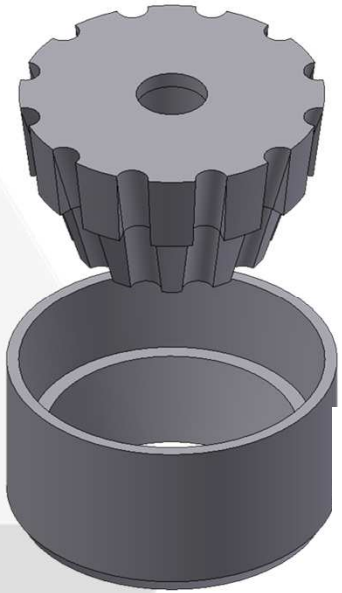
Co Sintering

same process

AM	MIM
	
✘	✓

- Create non demouldable geometries or very filigree structures by using the co-sintering technology

- Example: nozzle with micro holes



Co Sintering

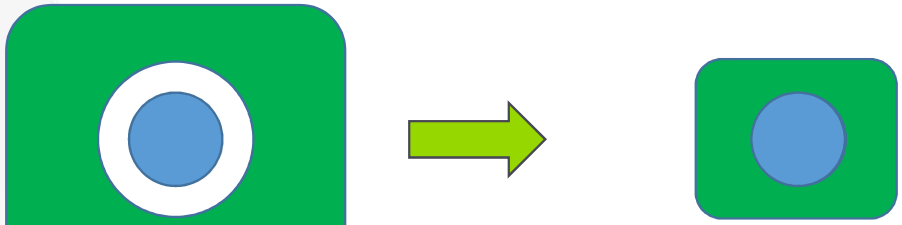
mix different processes

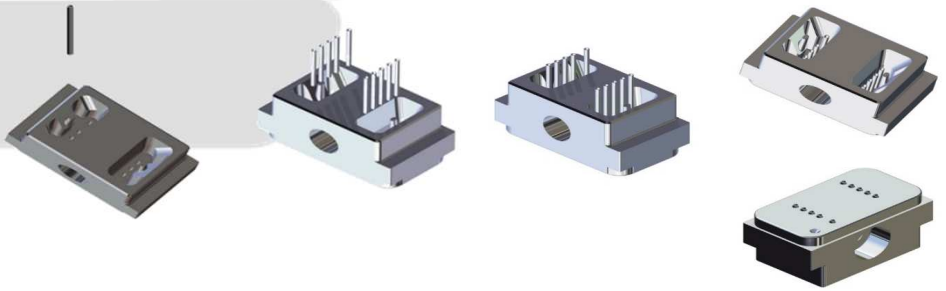
AM	MIM
	
✓	✓

- Combine MIM and conventional manufactured parts

Use the shrinking during sintering to assemble MIM with conventionally produced parts.

Example: plug for glass fibre cables
No laser welding necessary





AM	MIM
	
✓	✓

Co Sintering

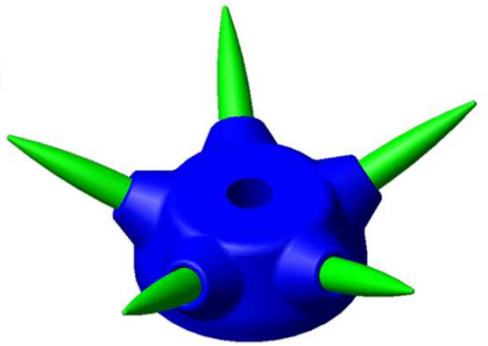
different processes and materials

- Over mould in the tool a inlay out of a different material
- Assemble 2 materials by sintering them together

This strategy enables you to combine a even wider range of materials

One material is manufactured by conventional processes

Example: combination of Iridium and Inconel



AM	MIM
	
✓	✓

Think smart

opportunities of green part processing

- Some materials are really hard to machine

  green part processing is much easier

  Hardened steel, Nickel based alloys, …

  if it is not possible to integrate features in the tool –

  think of green part processing

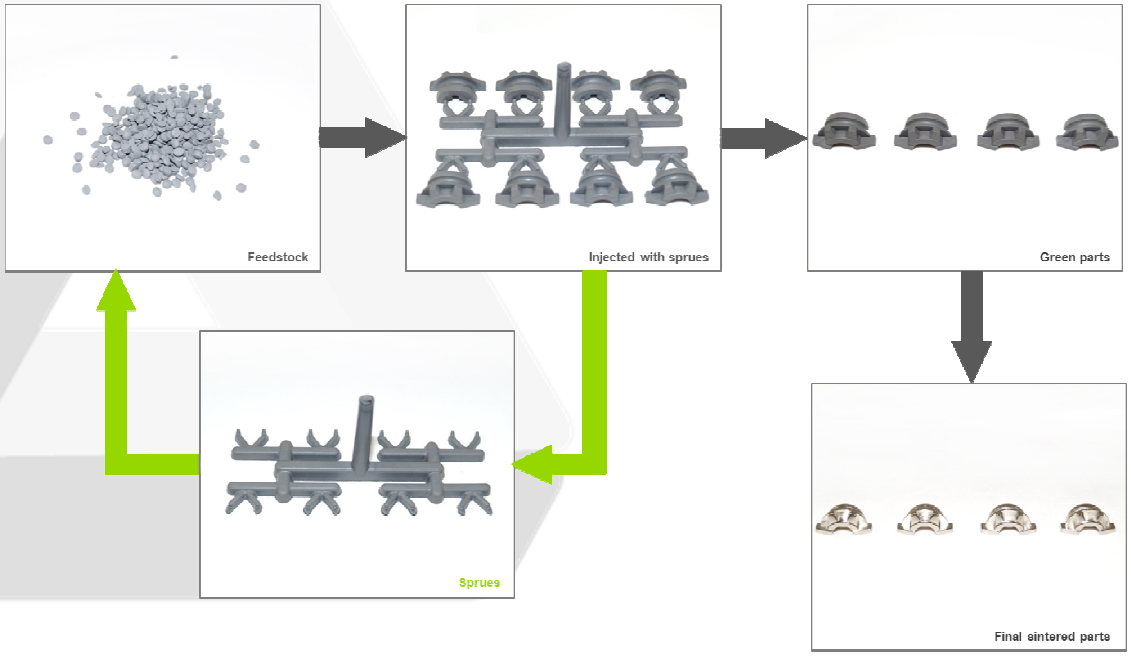
Example: Finger follower made of hardened tool steel

bore with diameter 0.5mm drilled in green stage

Think green

MIM and AM a green technology

- Application of only necessary resources
- Recycling thinking implemented in process
- 100% waste free technology
- Lightweight construction



Thank you !

www.mimplus.com