



Hybrid Workflow with LMF-Metal-3D-printing

Timo Degen| Produktmanagement | June 1st, 2022

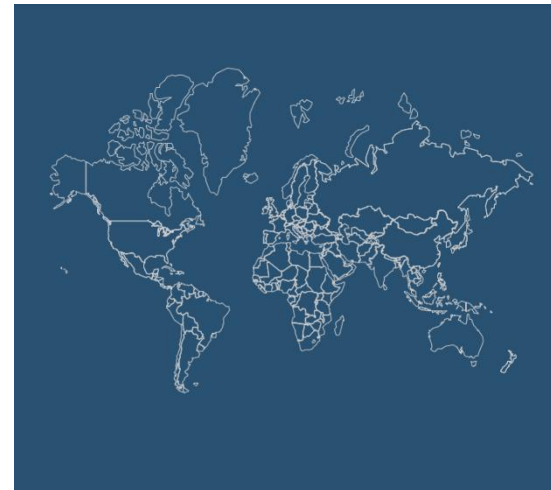
TRUMPF is...



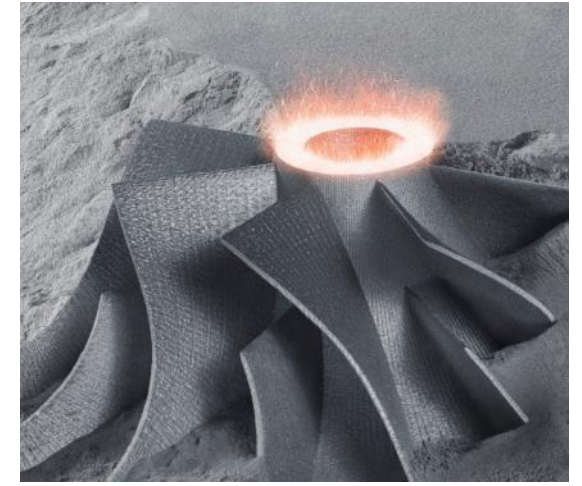
Family business



Technology leader



Close to the customer



Innovation guarantor

Industry overview

LMF meets the manifold requirements of a wide range of industries

	 Aerospace	 Energy & turbines	 Automotive	 General Industries	 Tool & die making	 Medical	 Dental	 Development & Institutes	 Fashion & Lifestyle	 Jewelry	 Job Shops
Materials	Titanium, aluminum, nickel-based alloys	Nickel-based alloys	Aluminum, steels	Aluminum, steels	Tool steel	Titanium, cobalt-chrome	Cobalt-chrome	Various	Bronze, steel, titanium	Precious metals, bronze	Various
Applications	Structural parts, brackets	Turbines, nozzles	Prototypes, tools, small series	Various	Dies, tools, tooling inserts	Implants, medical instruments	Dental crowns, bridges	Material developm., R&D for parts	Accessories, design objects	Rings, brooches, necklace pendants	Suppliers for multiple industries
Sample parts											

LMF Machines

TruPrint series – a comparison of technical data

TruPrint 1000



Compact and robust 3D printing

- **Build cylinder:** Ø 100 x H 100 mm
- **Max. laser power at the workpiece (TRUMPF fiber laser):** 1 x / 2 x 200 W
- **Beam diameter:** 30 / 55 µm

TruPrint 2000



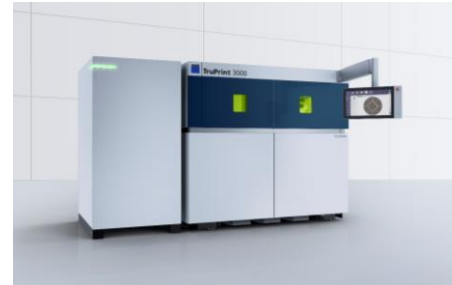
Economical 3D printing with premium quality

- **Build cylinder:** Ø 200 x 200 mm
- **Max. laser power at the workpiece (TRUMPF fiber laser):** 1 x / 2 x 300W
- **Beam diameter:** 55 µm
- **Preheating:** up to 200 °C
- **Inert powder handling:** yes

External powder management

Powder management on an industrial scale

TruPrint 3000



Flexible solution for industrial 3D printing

- **Build cylinder:** Ø 300 x H 400 mm
- **Max. laser power at the workpiece (TRUMPF fiber laser):** 1x / 2 x 500 W
- **Beam diameter:** 80 µm
- **Preheating:** up to 200 °C
- **Inert powder handling:** yes

External part and powder management

Part and powder management on an industrial scale

TruPrint 5000

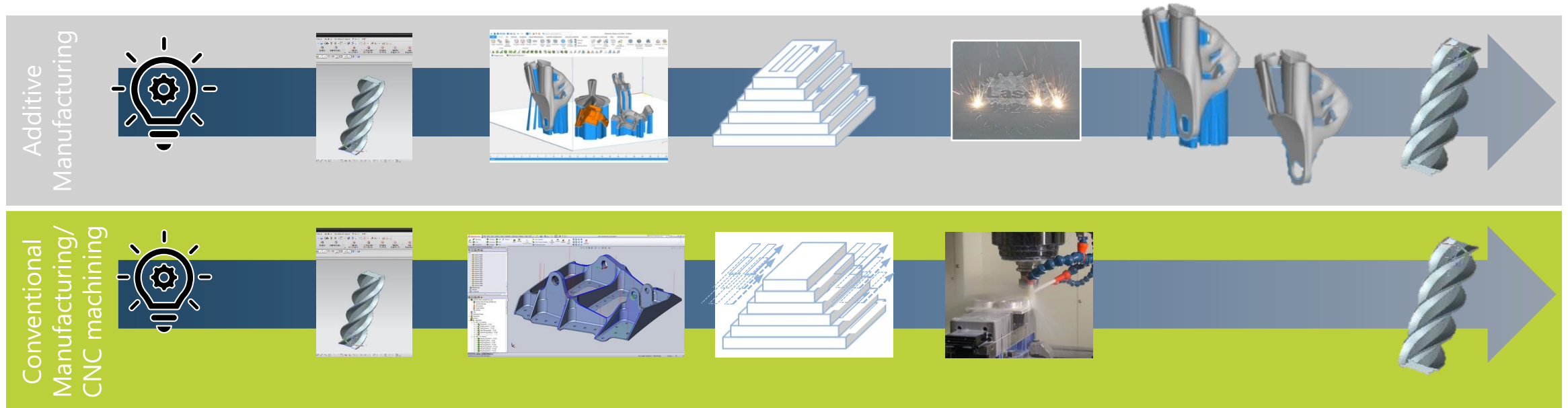


Highly productive 3D printing for industrial serial production

- **Build cylinder:** Ø 300 x H 400 mm | Ø 290 x H 400 mm (reduction if preheating is >200 °C)
- **Max. laser power at the workpiece (TRUMPF fiber laser):** 3 x 500 W
- **Beam diameter:** 80 µm
- **Preheating:** up to 500 °C (optional)
- **Inert powder handling:** yes

Process Chain

Additive and Conventional Manufacturing



Source: https://th.bing.com/th/id/R.c797cfd772c27db3b6b237fe7d93213e?rik=ZFJeC%2blwyEpiQ&riu=http%3a%2f%2fwww.solidcam.com%2ffileadmin%2fuser_upload%2f_processed_%2f8%2f4%2fcsn_HSS_01_31edf3ade5.jpg&ehk=qQijw6EpGGAYdTh42yT%2f8%2ftyd5Vcl7diA3xmkO2c74U%3d&risl=&pid=ImgRaw&r=0

Source: <https://upload.wikimedia.org/wikipedia/commons/thumb/1/16/Makino-S33-MachiningCenter-example.jpg/1024px-Makino-S33-MachiningCenter-example.jpg>

Hybrid Workflow in Additive Examples

Etymology:

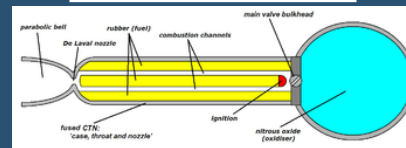
Latin „hybrida“ = offspring of a mixed union

Biology



<https://de.wikipedia.org/wiki/Zebroide>

Rocket Motor



https://en.wikipedia.org/wiki/File:SpaceShipOne_schematic.png

Harddisk



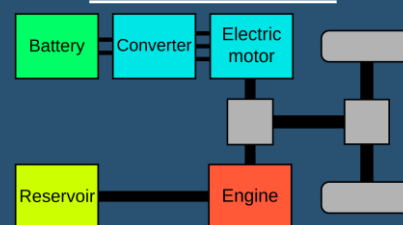
https://imgix.gizmodo.com.au/content/uploads/sites/2/2014/06/seagate_desktop_sshd_4.jpg?ar=16:9&auto=format&fit=crop&q=65&w=720

Software



<http://www.clipartbest.com/clipart-LTKk6yk8c>
<http://www.vecotourism.org/news/wp-content/uploads/2013/10/Apple-logo-icon-Aluminum.png>

Automotive



<https://upload.wikimedia.org/wikipedia/commons/thumb/5/5b/Hybridpar.svg/1920px-Hybridpar.svg.png>

Politics



https://upload.wikimedia.org/wikipedia/commons/thumb/b/b7/Flag_of_Europe.svg/1280px-Flag_of_Europe.svg.png

Getting the best out of two worlds

Additive Manufacturing

- ❖ Freedom of Design
- ❖ Added complexity at no additional cost
- ❖ Low waste-rate
- ❖ Material possibilities
- Low build rates (volume-wise)
 - Expensive
 - Surface quality

Hybrid Manufacturing

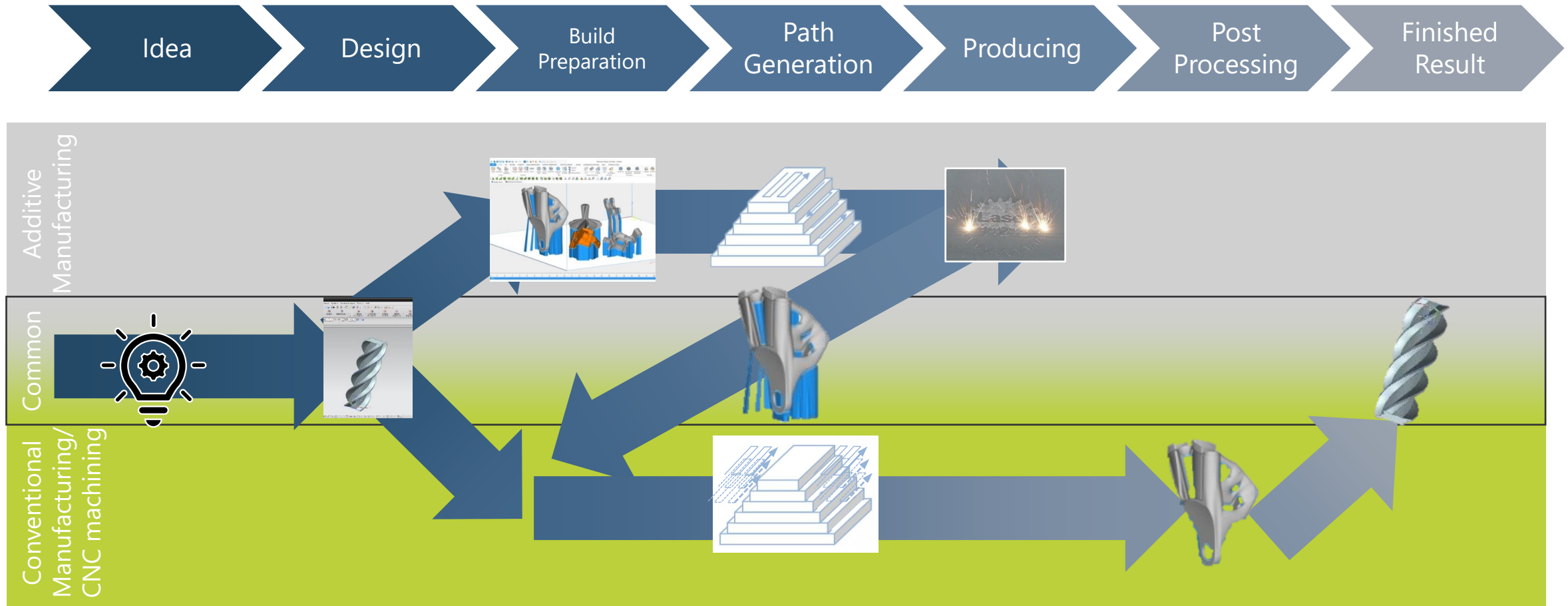
- ❖ Freedom of Design
- ❖ Added complexity at no additional cost
- ❖ Low waste-rate
- ❖ Material possibilities
- ❖ Feedstock availability
 - ❖ Surface finish
 - ❖ Tolerances
- ❖ High build rates
 - ❖ Low price

CNC Machining

- ❖ Feedstock availability
 - ❖ Surface finish
 - ❖ Tolerances
- ❖ High build rates
 - ❖ Low price
- Limited design possibilities
 - Added costs for higher complexity
- Potentially high waste rate

Hybrid Workflow

Classic approach



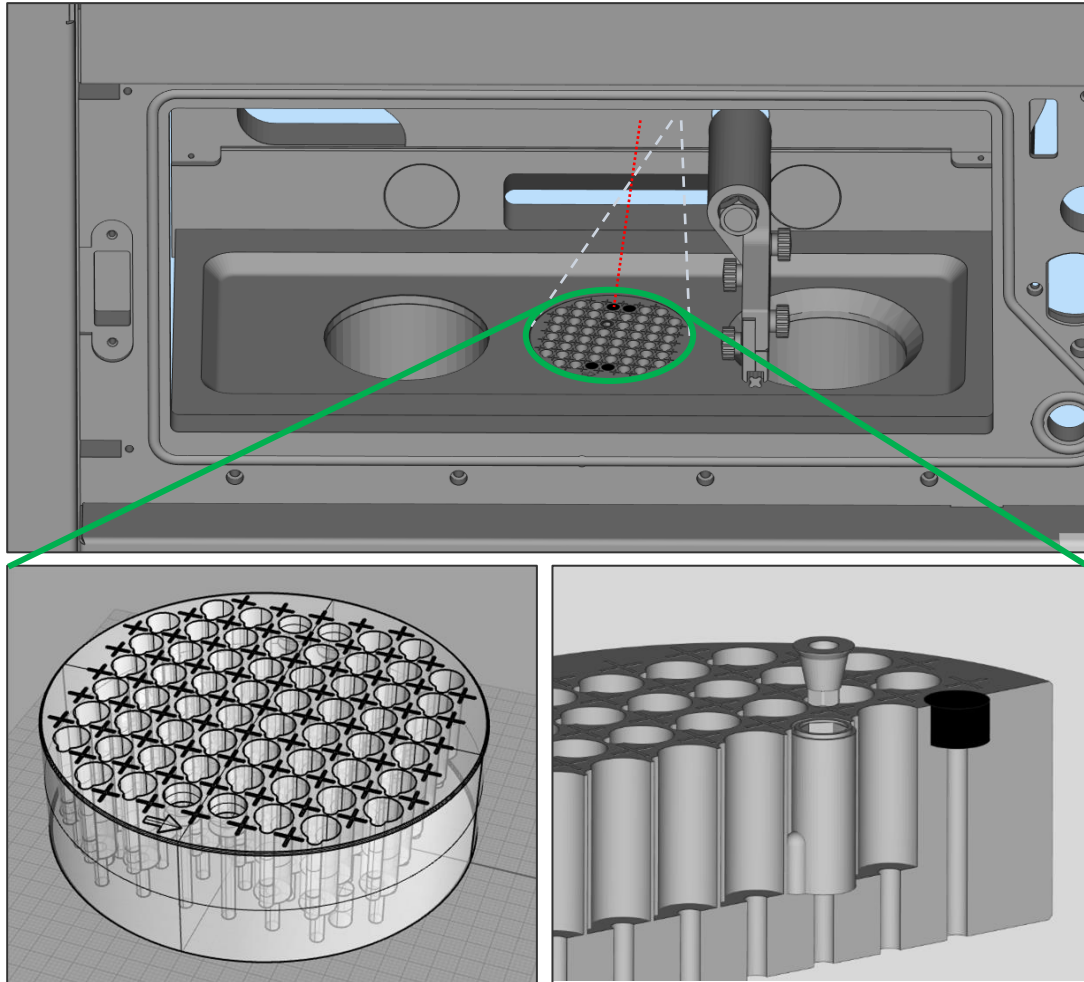
Hybrid Workflow

Classic approach



Video-Link:

https://www.trumpf.com/filestorage/TRUMPF_Master/Industries/Dental/TRUMPF-Additive-Manufacturing-Dental-Hybrider-Workflow-DE.mp4



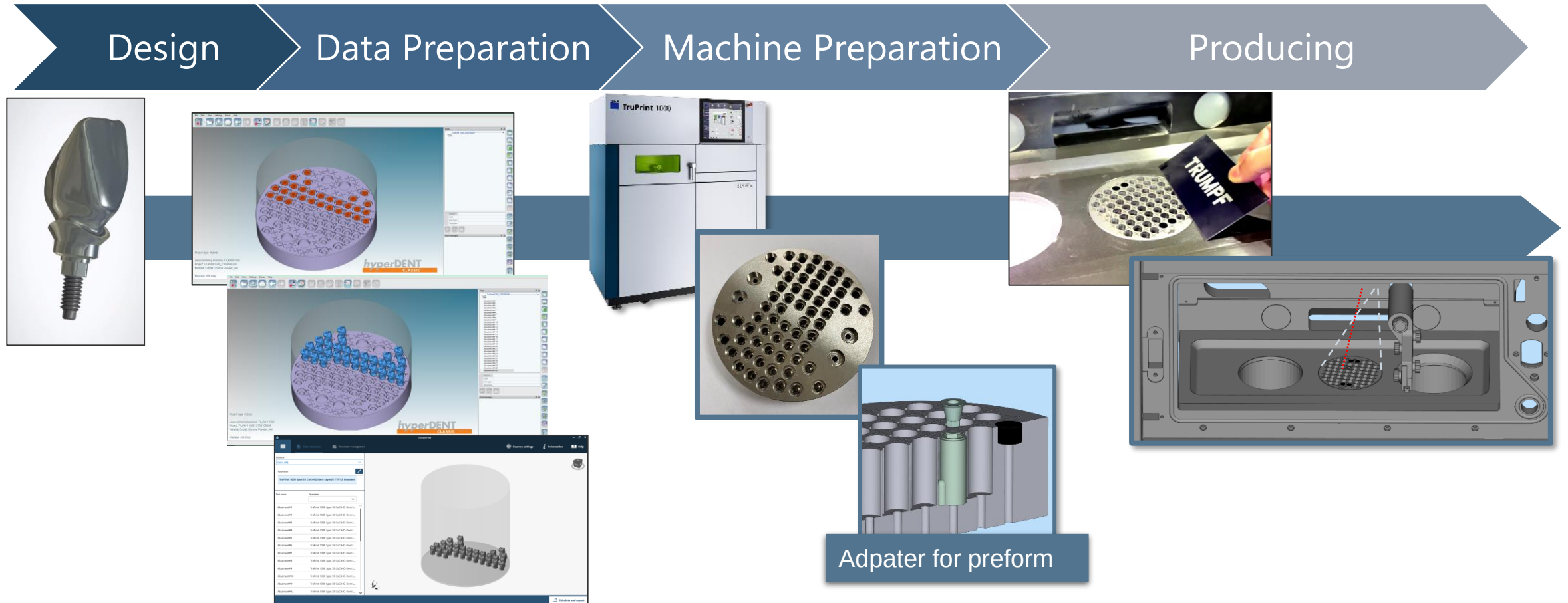
Dental Example

Hybrid-Workflow with PreForm

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Hybrid Workflow with PreForm

Technical solution



TruPrint 1000 | Dental Preform Set

Printed abutment



Printing with an accuracy of down to
50 μ m



Full plate 64 parts printed in **3 h**
with Multilaser | **5 h** with Single laser



Cost saving per single abutment of
more than **50%**



Substitution of up to **8** milling machines.



Hybrid Workflow with PreForm

Videos on PreForm-Option TruPrint1000:

<https://youtu.be/Dt2Rhx5lBME>

<https://youtu.be/WFpCy0LVu5M>

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