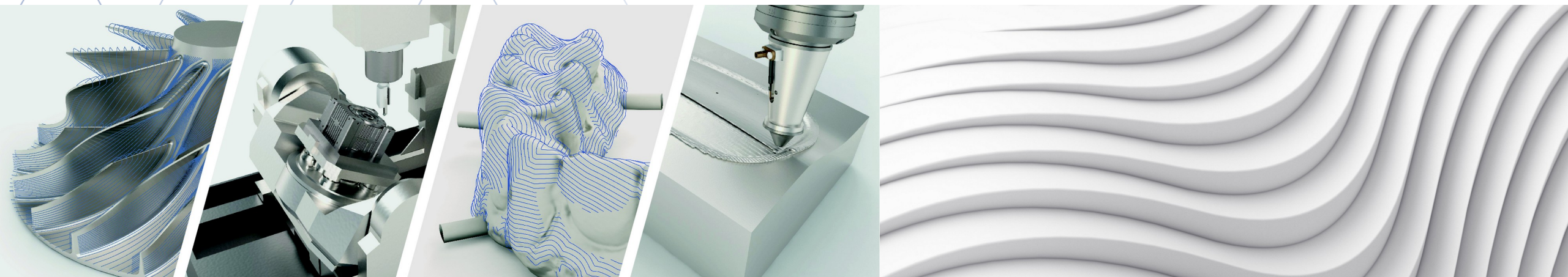


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ModuleWorks

Get There Faster.



Additive Manufacturing in Focus

Mathias Rohler, Product Manager



Mathias Rohler

Product Manager – Business
Development Board Additive and
Process Technologies

mathiasr@moduleworks.com

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Agenda

- Hype cycle off additive solutions
- Market Analysis and Product Focus
- ModuleWorks Additive Solutions Outlook
- Spot on Showroom Area

The
Future is
now.

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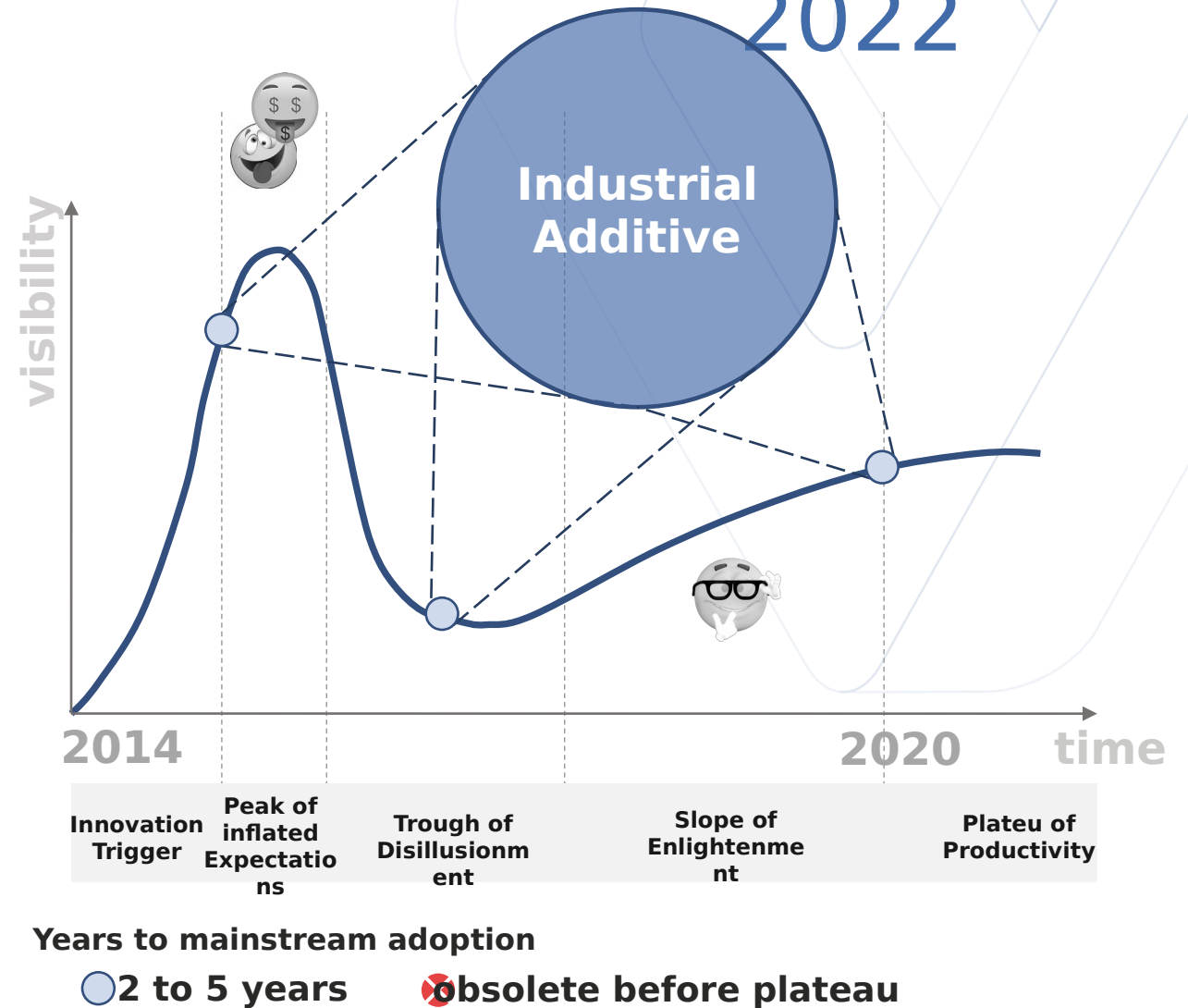
Get There Faster.



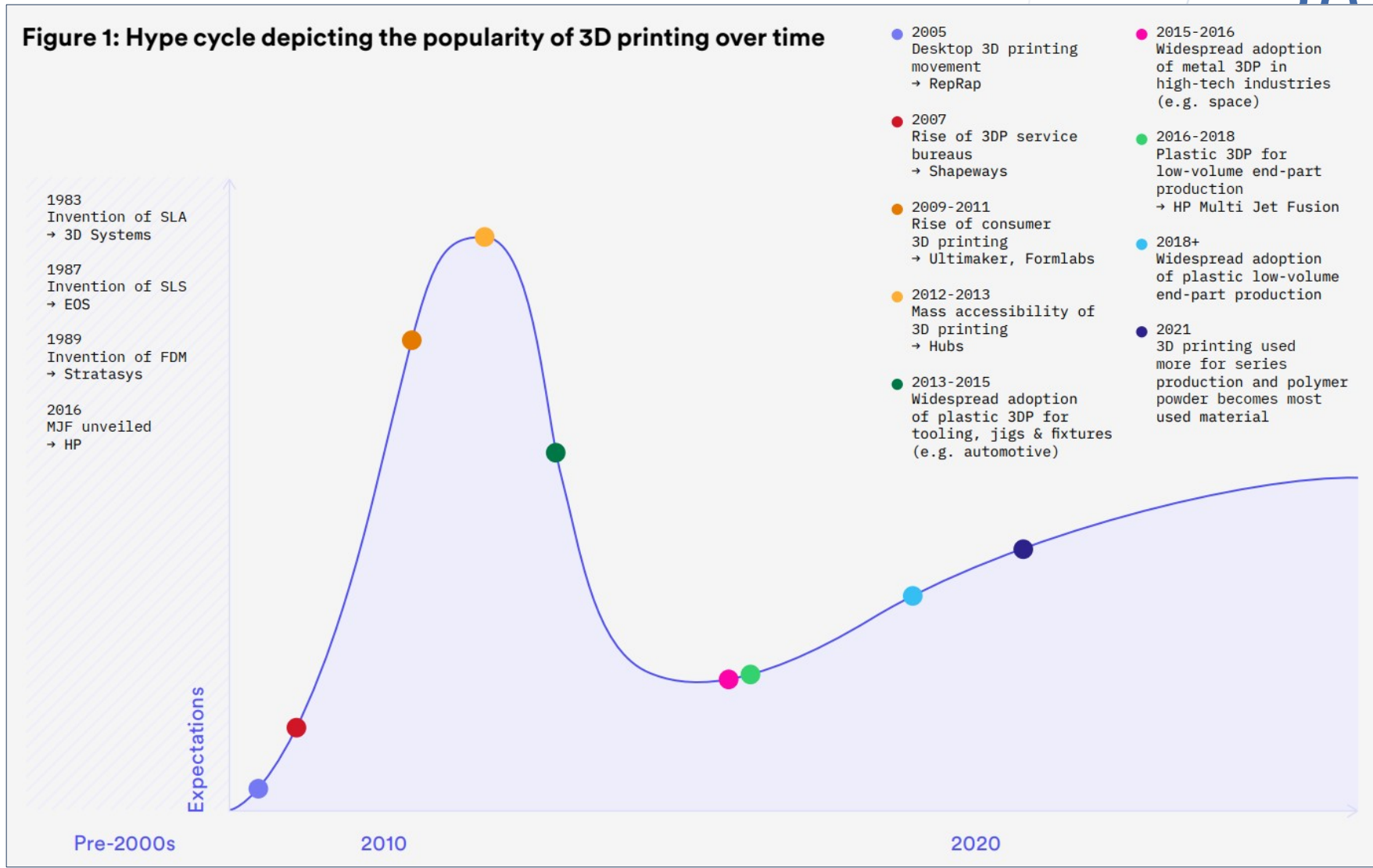
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Additive Trends – Hype cycle

- 2015 Additive was in a stage of „Inflated expectations“
- 2018 Additive went through the „Trough of Disillusionment“
- Then reaches the „Slope of Enlightenment“
- **2020 - 2022** some of the additive processes reached the „Plateau of Productivity“
- Additive is **evolving into a viable solution** for end-use parts and larger-scale production applications



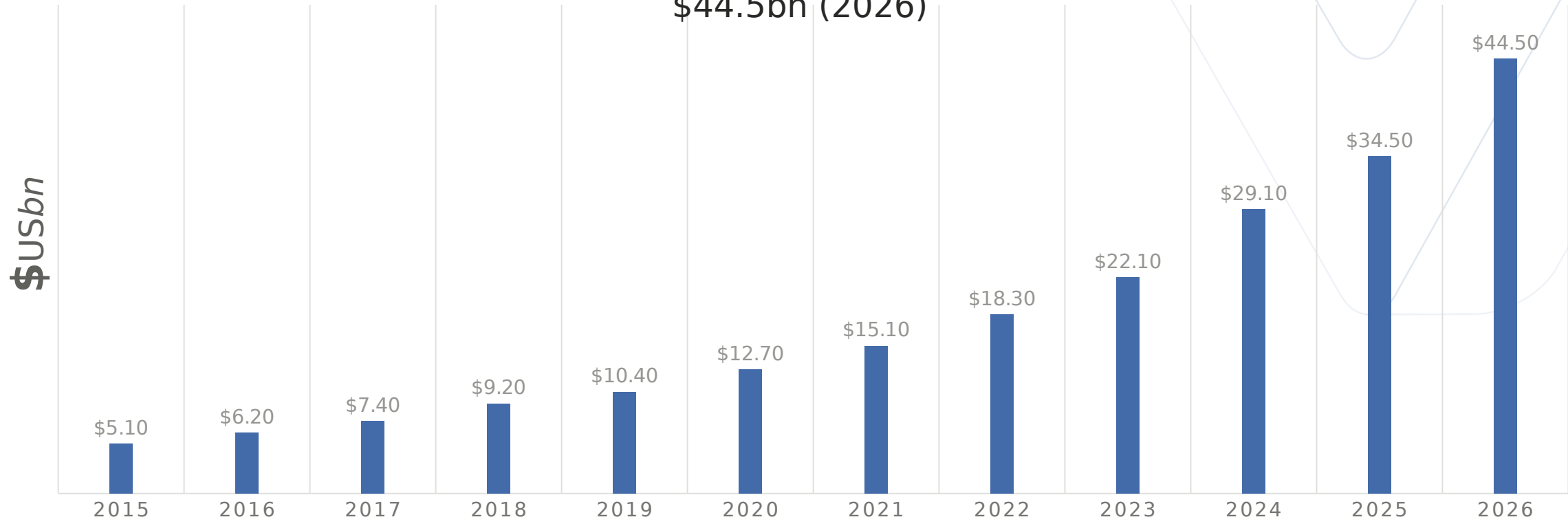
Hype Cycle – Additive Technologies



Source: HUBS – 3D Printing Trend Report

Additive Market Growth

The additive market is forecasted to almost
triple in size
over the next 4 years
\$44.5bn (2026)



■ 3D printing market forecast

Source: HUBS – 3D Printing Trend Report

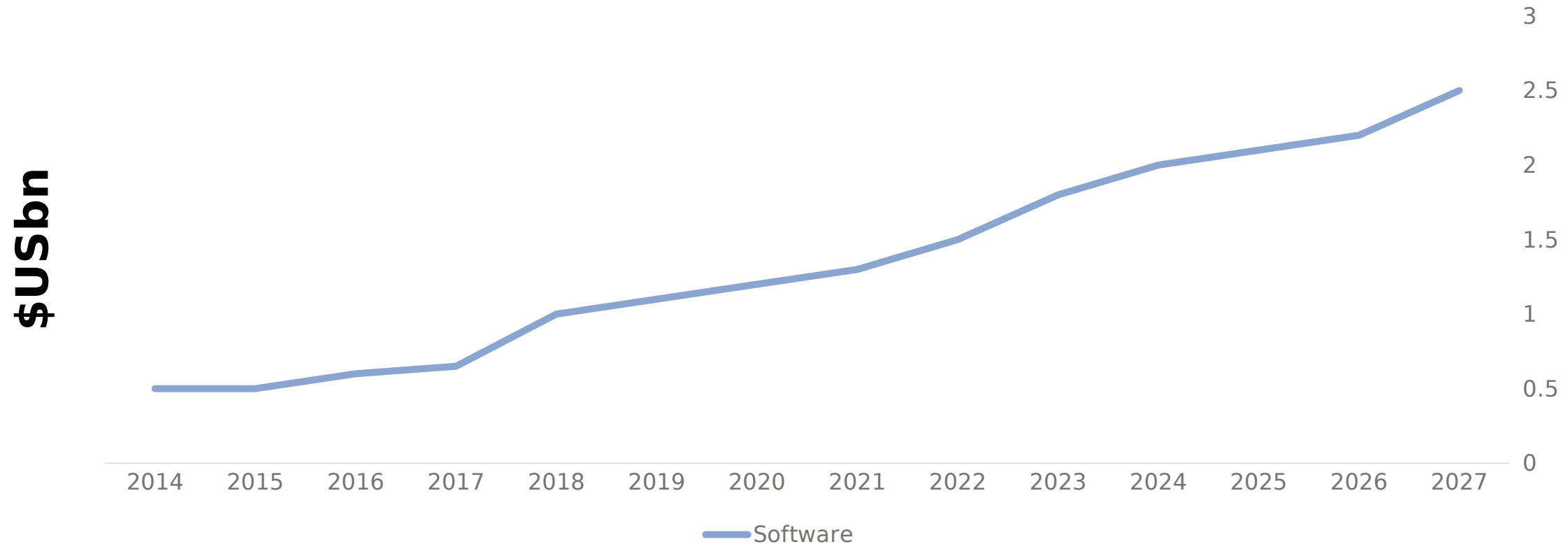
Market Size - Software

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Growth by **4 times** in the last 10 years

Software makes up a ~**6%** share of revenue from

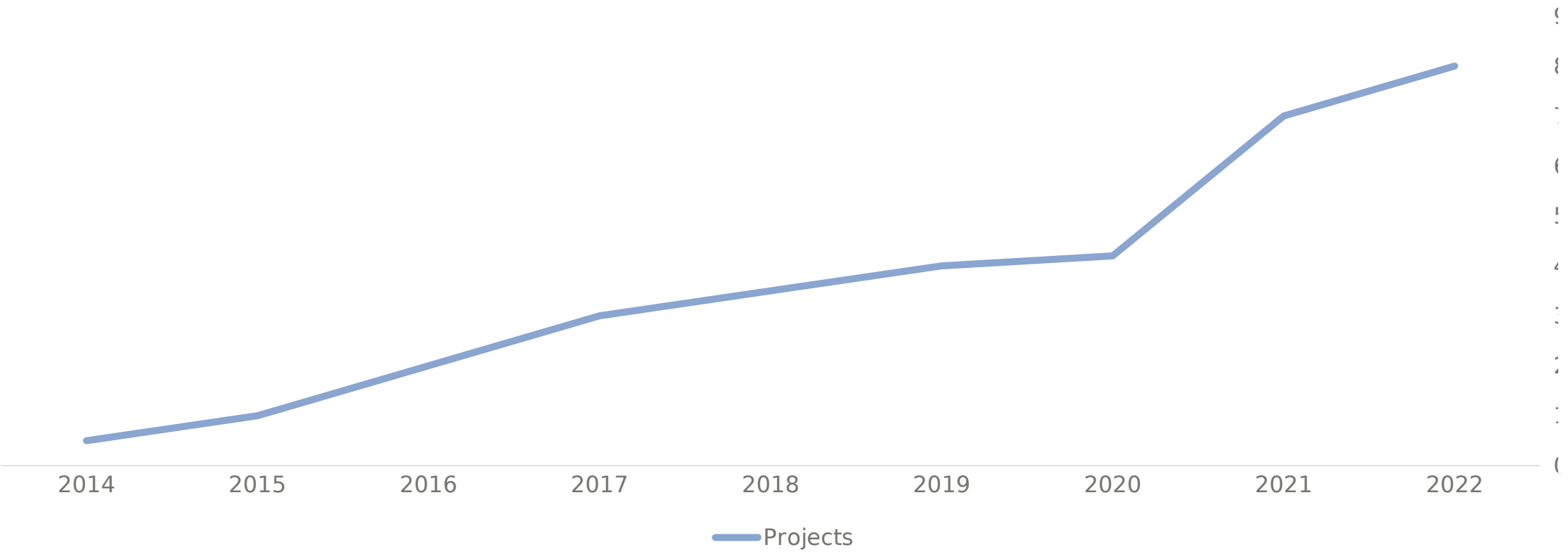


Correlation between Projects and Market evolvment

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Number of Additive Projects at ModuleWorks over time (Trend)





49%

printed **10+** parts in their production runs,
compared to 36% in 2021

Additive has **evolved beyond a rapid prototyping technology only** and
engineers are using additive for larger production run



68%

of engineering businesses surveyed used additive
solutions
more in 2021 than in 2020



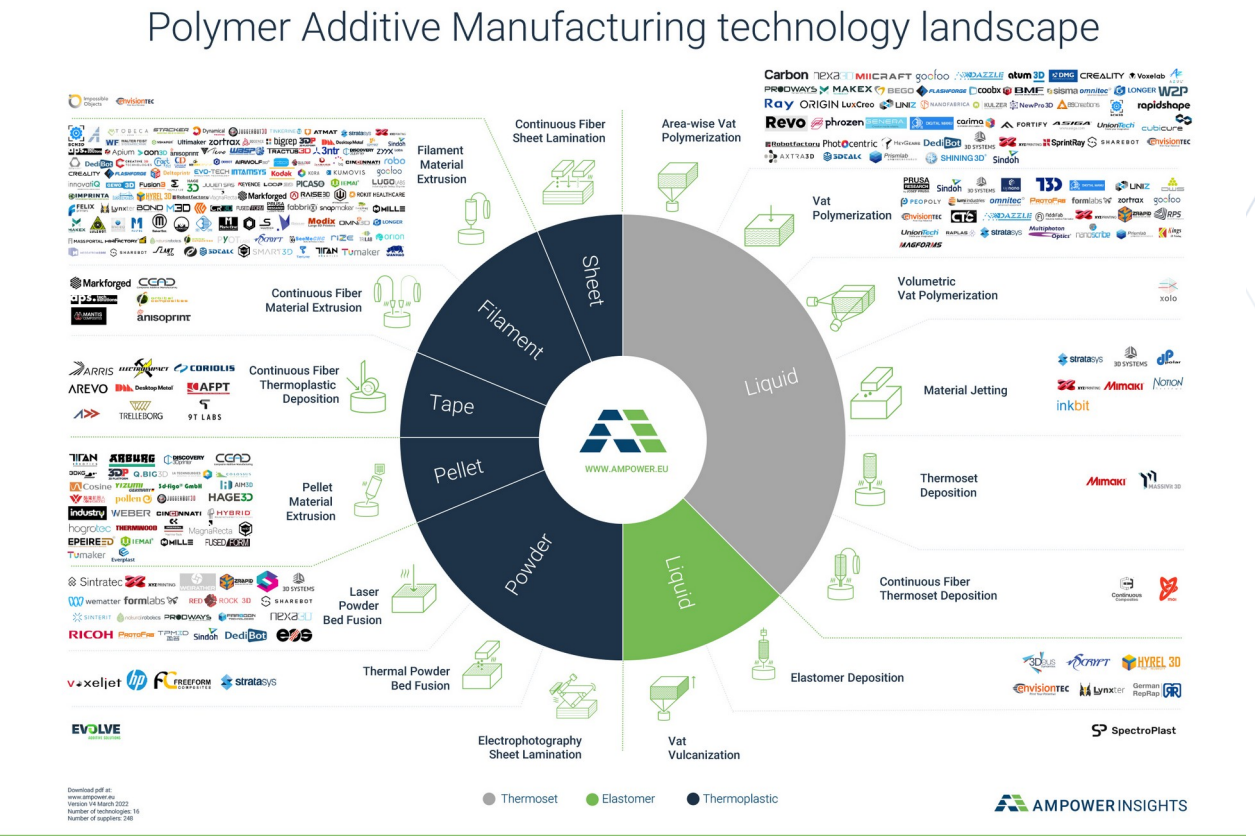
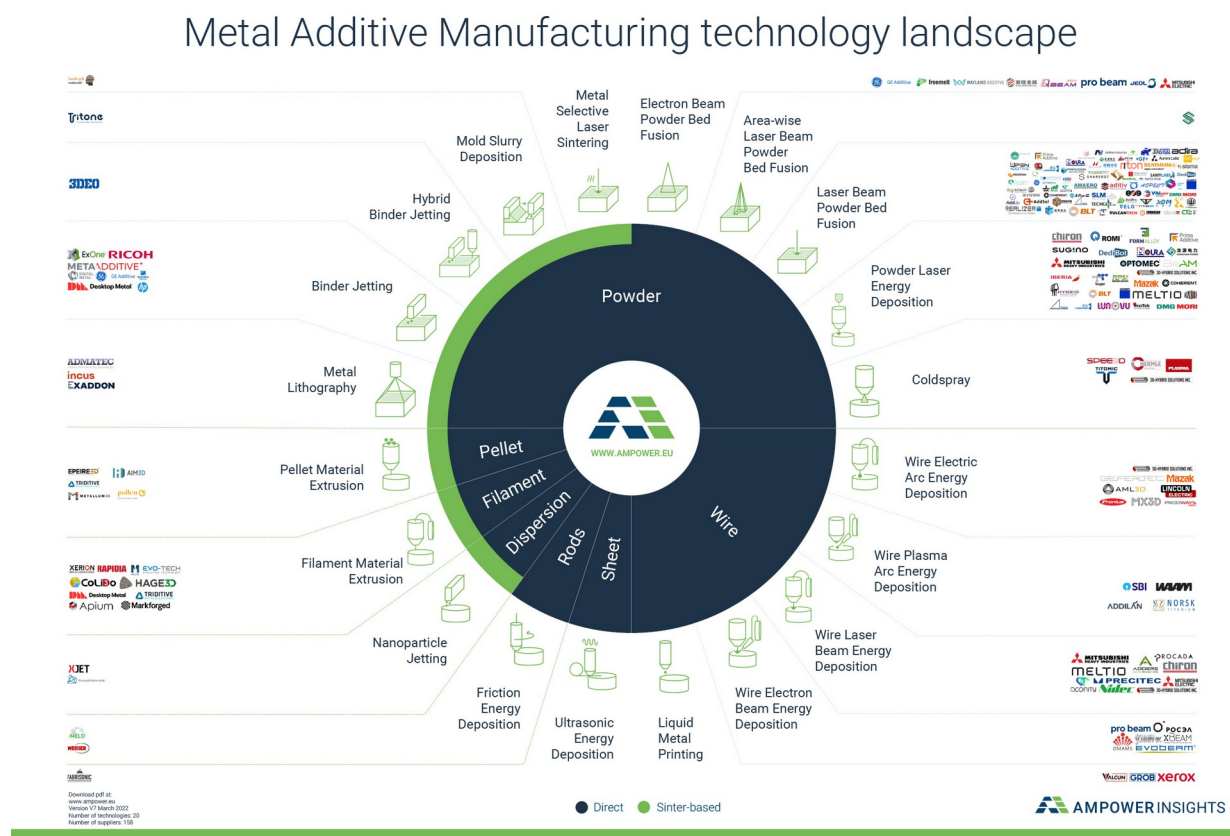
What Do You Believe Will Be the Top Developments

44% of engineering businesses predict **the top development in 2022 will be new materials and composites**

44% New materials

A horizontal bar chart with two bars. The top bar is divided into a dark blue segment on the left and a light blue segment on the right. The bottom bar is also divided into a dark blue segment on the left and a light blue segment on the right. The dark blue segments contain the text '44% New materials' and '21% Hybrid manufacturing' respectively.

21% Hybrid
manufacturing

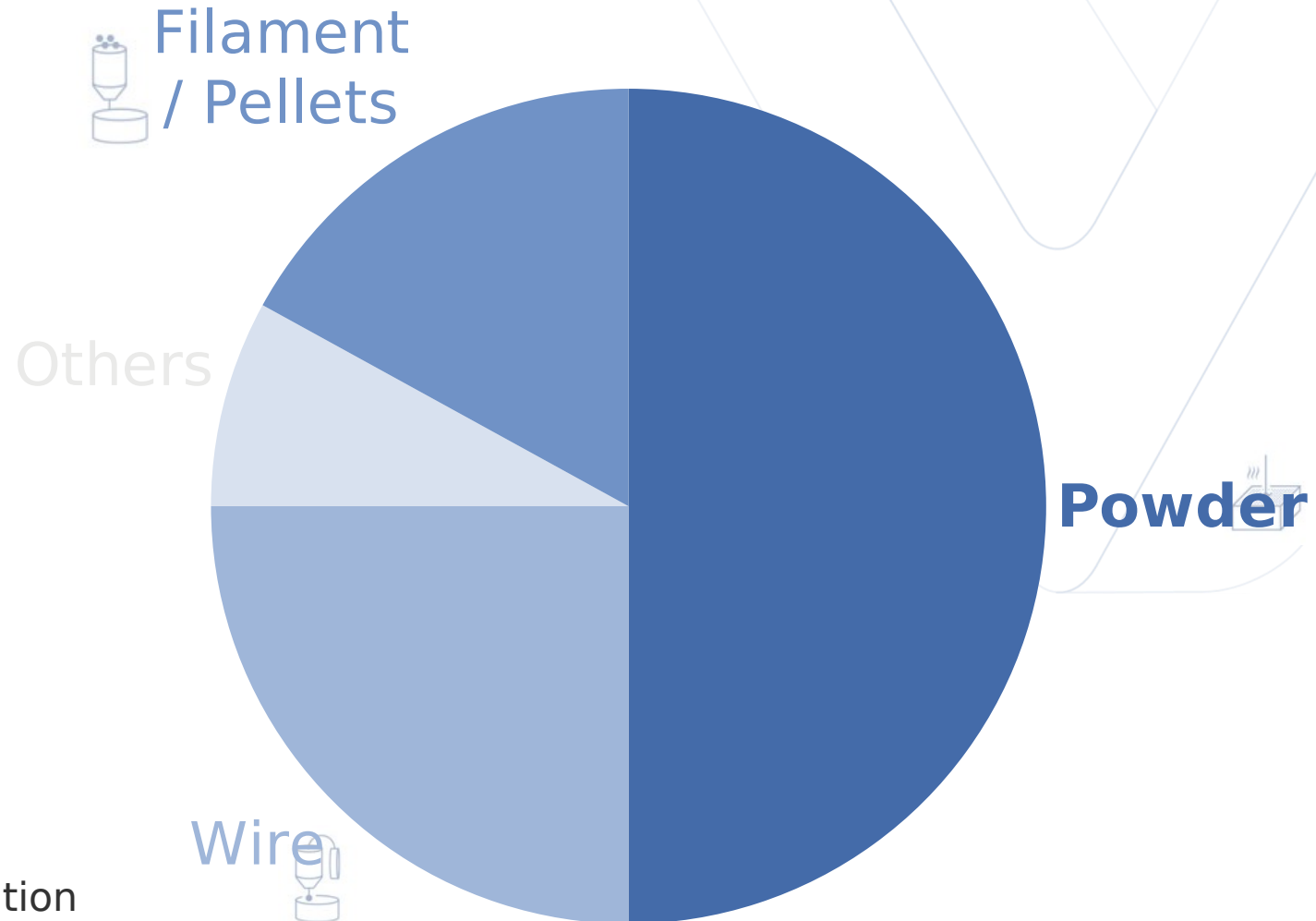


Source: Ampower.eu

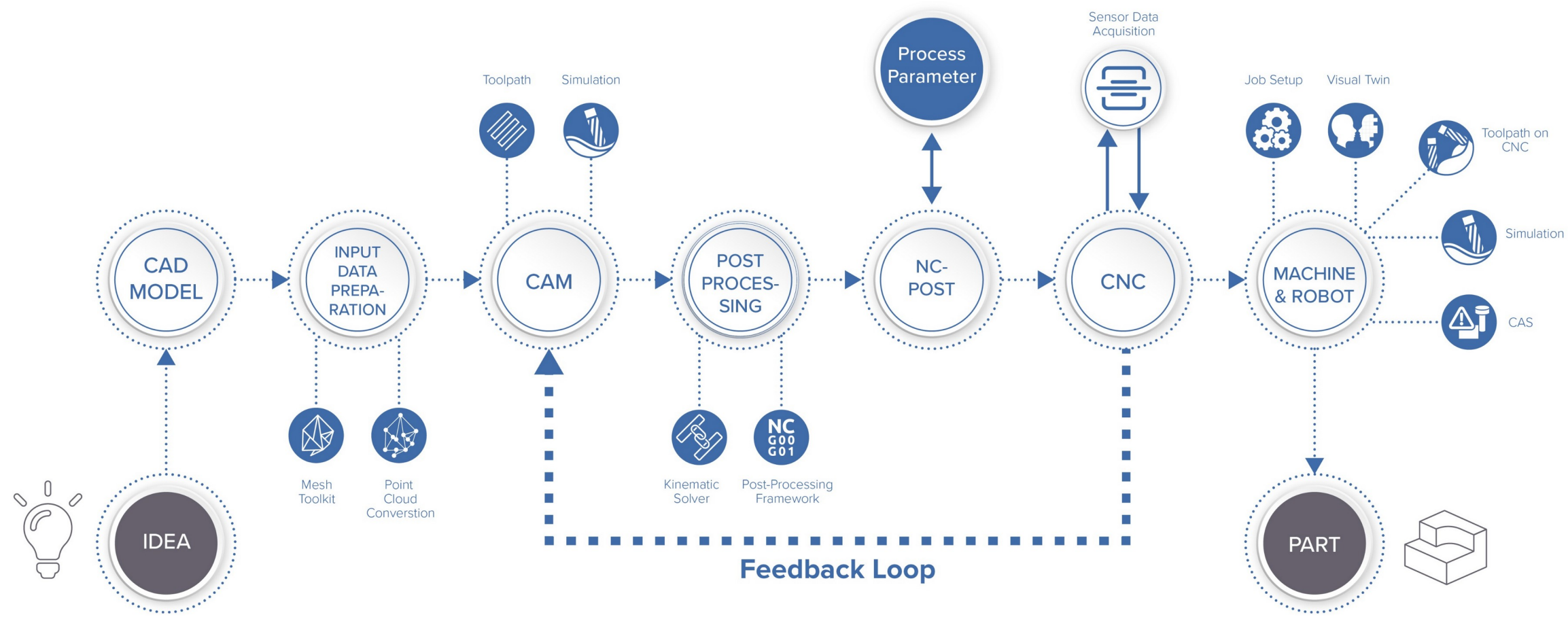
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Market Analysis and Product Focus

- Filament / Pellets
 - Polymer printing
 - Continuous Fibre Material Extrusion
 - Pellet Material Extrusion
- Powder
 - Powder Bed Fusion
 - Selective Laser Sintering
 - Binder Jetting
 - Laser cladding
 - Coldspray
- Wire
 - Direct Energy Deposition
 - Wire Arc Welding
 - Liquid Metal Printing
 - Wire Electron Beam Energy Deposition
 - Wire Laser Beam Energy Deposition



ModuleWorks process chain



Powder Bed Fusion

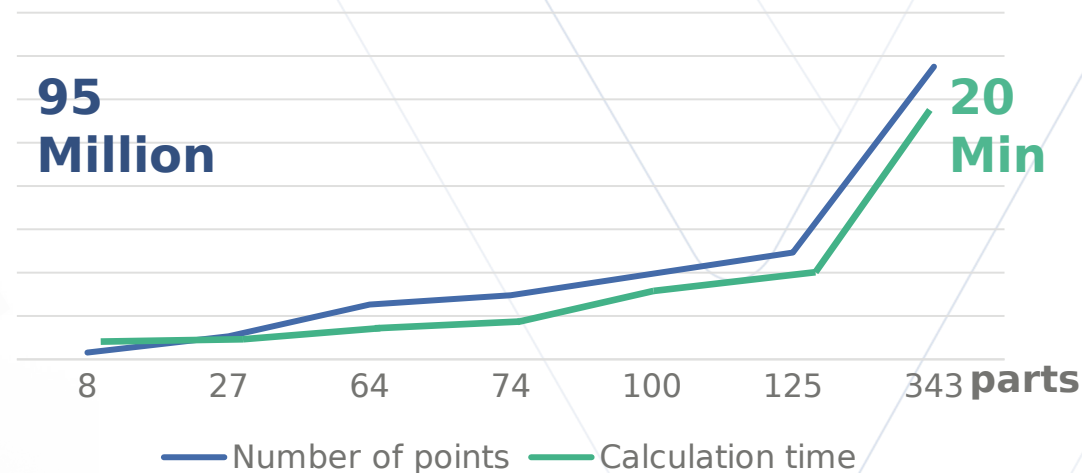
- Newest key developments:
 - **Extended calculation core** that can handle a huge amount of mesh data (>10GB)
 - **Streaming** ability from calculation to build file
 - **FileWriter** to write **binary** and **ASCII** file formats

Bike lever - Hybrid example
Build up with PBF Solution
Post machining with 5-Axis module



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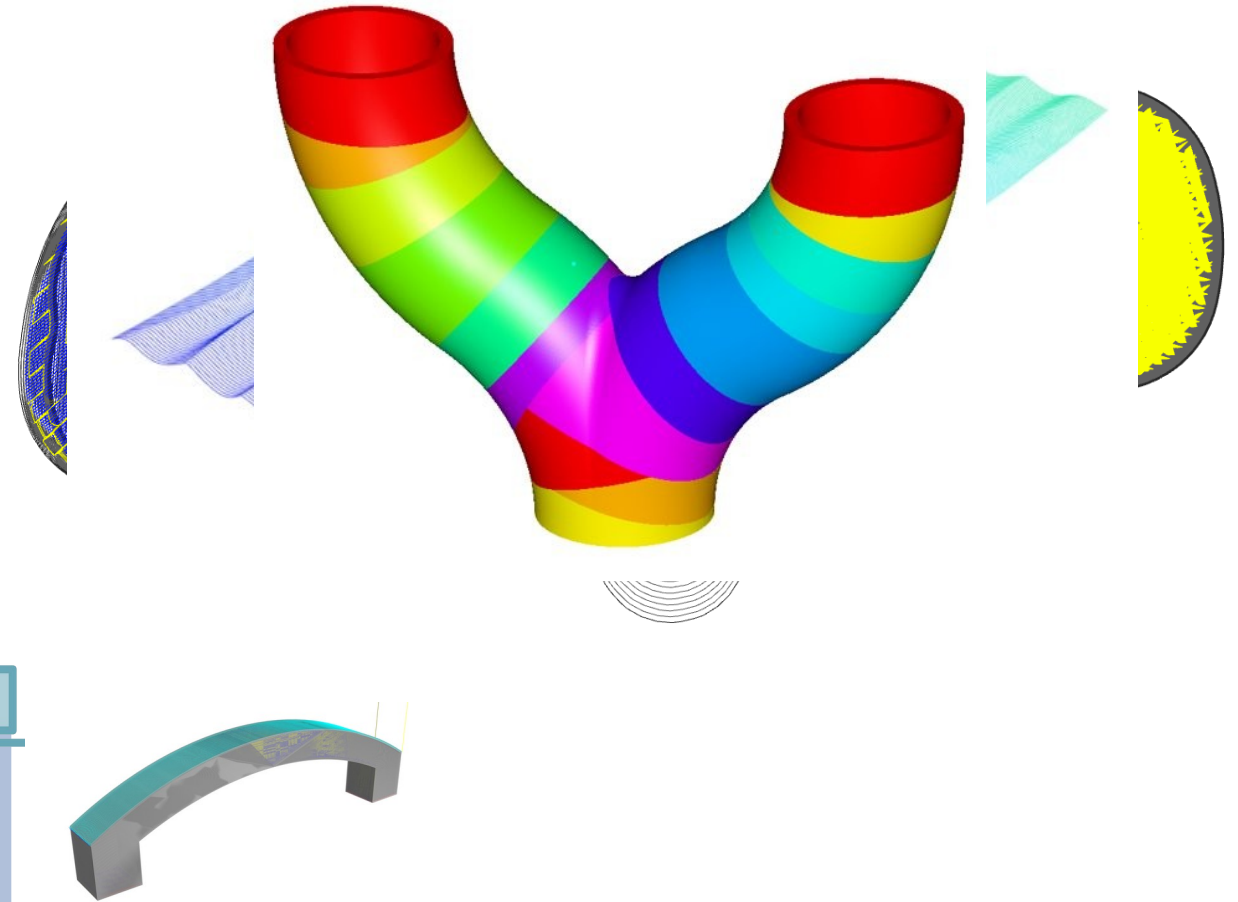
Number of points & calc time





MultiAxisAdditive

- Newest key developments:
 - **Multipart support** to print different areas in a part with different parameter sets
 - **Morph pattern** for continuous extrusion without linking
 - **Autosegmentation** for 3+2 to print **without support**
 - **Nonlinear printing** for up to 5-Axis simultaneous printing

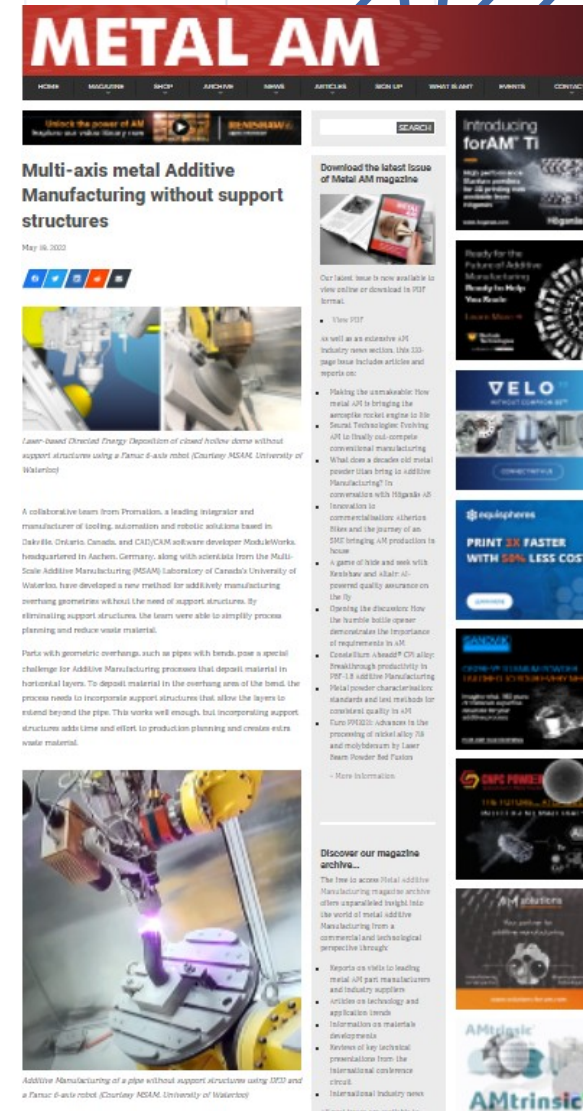


Building up a bridge without support
3+2 Segmentation
Nonlinear printing



- Newest key developments:
 - **Tool orientation along part geometry** to weld up complex shapes without support
 - **Oscilating patterns** (weaving) on free form surfaces
 - **Multi body concept** to use different parameters in different part areas

Building up a pipe and dome
See our PR-Story with University of Waterloo



Robotic Solution

- Newest key developments:
 - **Extensions** of the ModuleWorks **kinematic solver**
 - **Machine definition** extended to configure robot behavior
 - We build up a **robot library** with the most common robot models
 - Build up a **post library** for the most common controller types

Building up a curved structure
with 3+2 on an UR5 robot using remote TCP
Used manual slicing planes
Fanning to reduce stair step effects



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Thank you
for your attention



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