

3D printing the future

A catalyst for innovation and creativity

Olaf Diegel



Creative Design and
Additive Manufacturing Lab



A playground to explore and experience AM



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Additive Manufacturing Lab



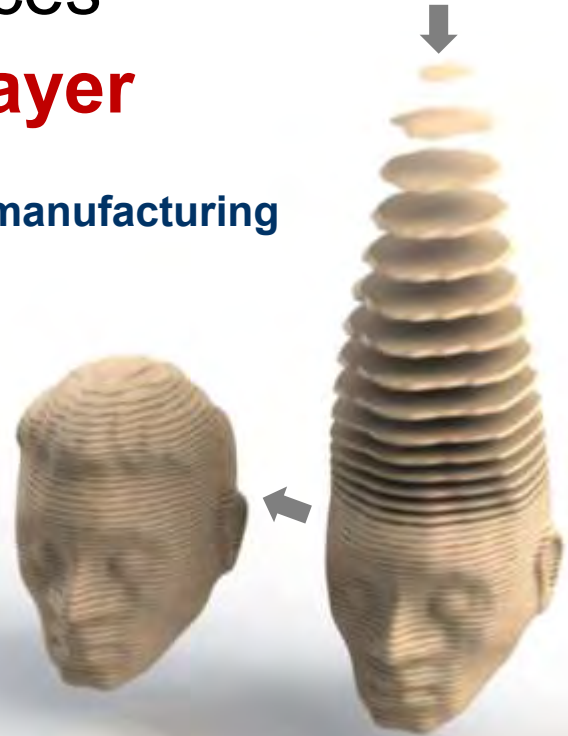
Additive manufacturing (3D Printing)

- Generate a **3D CAD model**
- Slice the 3D model into thin slices
- Machine builds it **layer upon layer**

Subtractive manufacturing

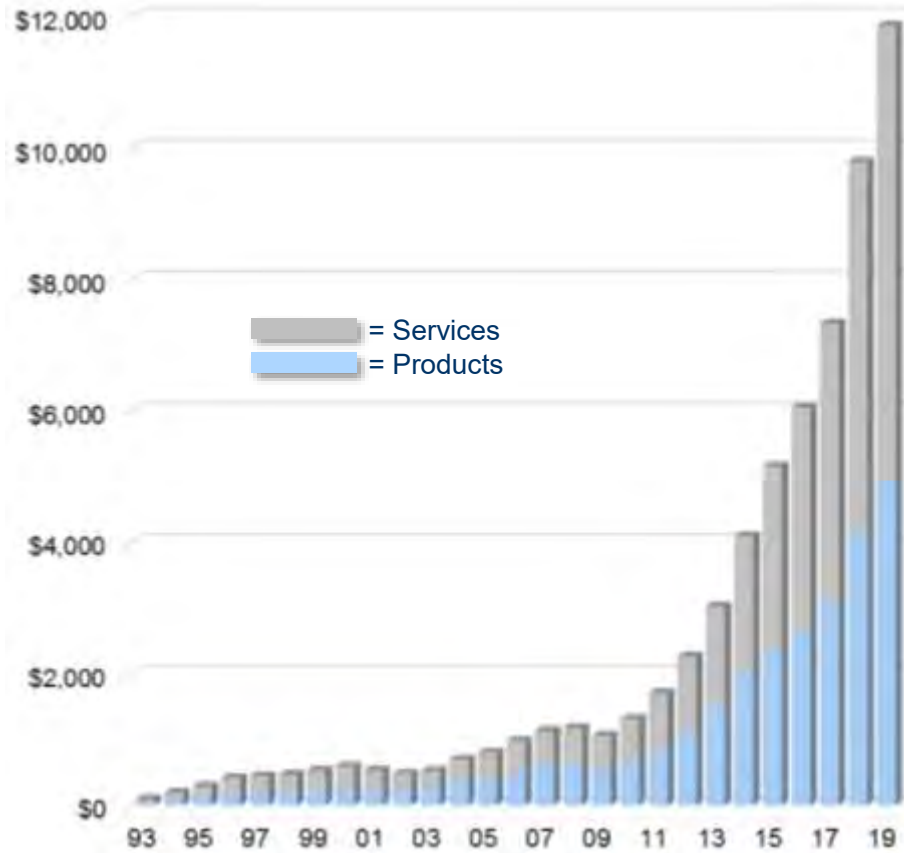


Additive manufacturing





Additive manufacturing industry growth



Source: Wohlers Report 2020

Unprecedented worldwide growth!
21.2% in 2019 to \$11.867 Billion.

Huge growth in AM, but **relatively low industrial adoption**. This adoption of AM is mostly driven by **big companies**. This is because AM is a **slow and expensive** technology, particularly is a part is not **designed for AM**

Many see it as a direct **replacement** manufacturing technology. **It is not!**

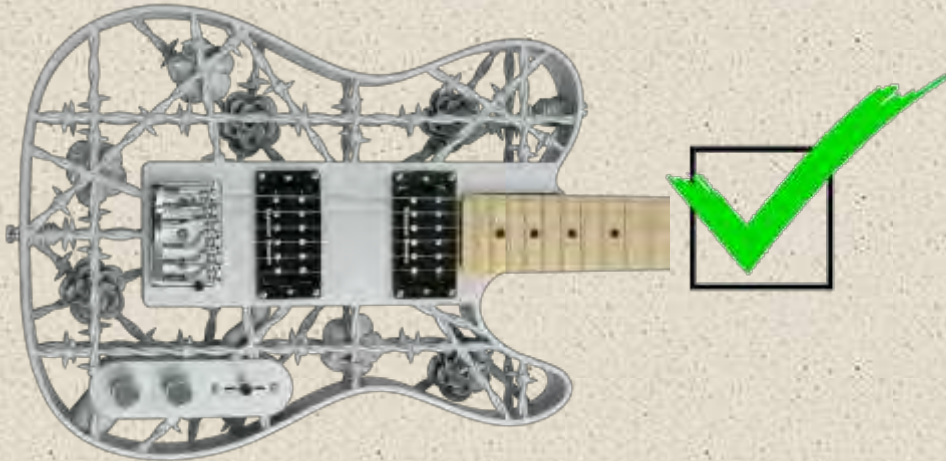
Reality check

- Additive Manufacturing (AM, or 3D Printing) will **NOT** replace conventional manufacturing.
- It is a **complementary** technology that, for **certain products**, and if used the **right way**, gives **huge advantages** over conventional manufacturing.
- **Not everything should be 3D printed! Only use 3D printing when it truly adds value!**

Advantage: complexity

The more **geometrically complex** a part is, the better suited it is to 3D printing.

But the converse is also true! **If a part is very simple, there may be better ways to make it!**



Art & Design



Bitonti & Schmidt



Gregor Kregar



Freedom of Creation



Aesthetic complexity



Courtesy of American Standard

Light-weighting: topology optimisation

Topology optimisation: using maths to remove whatever material is not contributing to improve the mechanical characteristics of a part



Solid Billet: 10.39gms



Solid Machined/Cast: 4.22gms

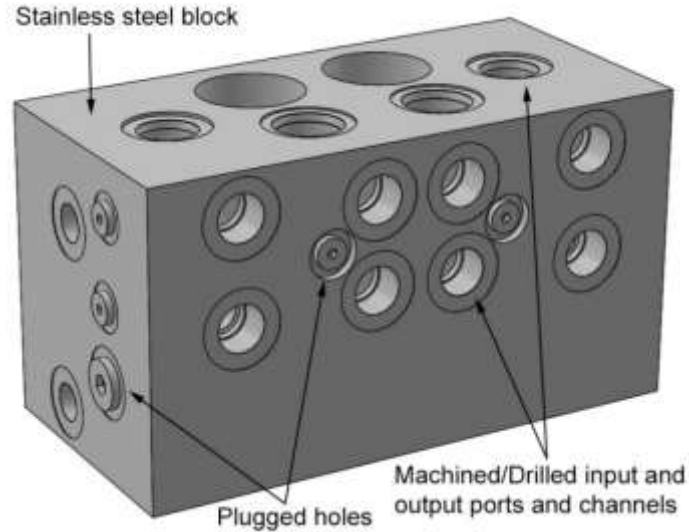


Topology Optimised AM: 0.95gms

Atlas Copco hydraulic manifold



Atlas Copco hydraulic manifold



Hydraulic manifold with weight reduced from 16.2kg to 1.42kg so over 90% weight reduction



Mass-customisation: medical



Inner-ear Hearing Aids, **60 million** produced since 2000



Surgical guides, **400,000+** to date



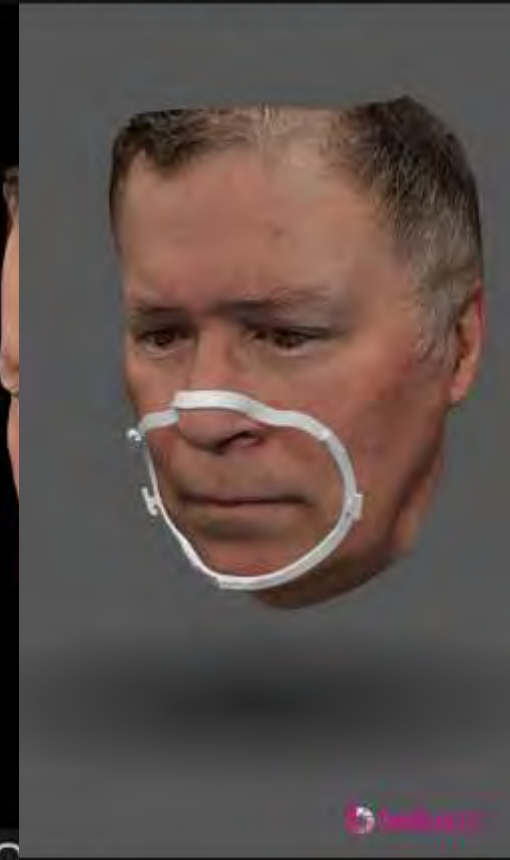
Hip replacement acetabular cups, **100,000+** produced to date



Dental copings, **6.8 million** / year



Dental aligners, **14 million** / year



Advantage: testing ideas with ease

The complexities of manufacturing make it difficult to test ideas. **3D printing removes this barrier** and allows ideas to easily, and quickly, be tested. This makes 3D printing a great **catalyst for innovation.**

Getting products to market at no risk



Courtesy of Jenna Makgill, AUT University

Rapid product development

- Less than 2 weeks from start to working proof of concept



iPad

10:42

90%



02:45



-40:54



iSound

iSound

Funerary sculptures

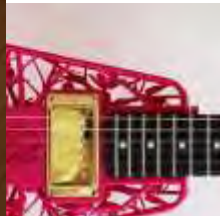


Courtesy of Anne Lindeboom

Entrepreneurship can be fun!

- Began as trial of technology in 2011.
- Evolved into side business over the following 2 years.
- Sold rights to 3D systems for 2 years in 2014.
- Regained rights in 2016.
- 83 guitars produced to date, 70 sold.
- Driven by passion rather than business (but the extra income is nice).

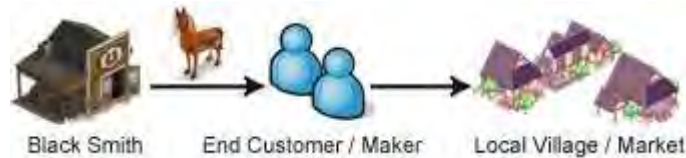
Products to market at no risk



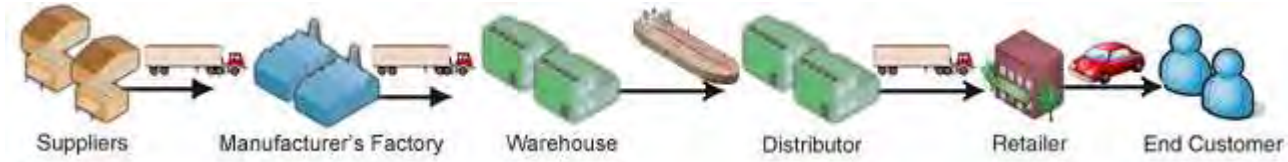


Additive manufacturing & the supply chain

- Yesterday



- Today



- Tomorrow

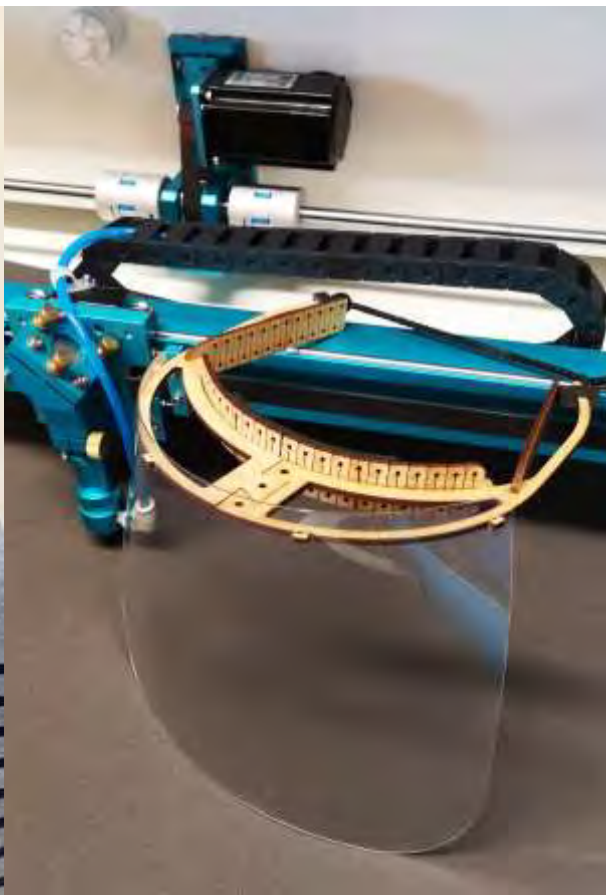


Can AM manufacture parts on-demand, where needed, when needed?

Spare parts: some scary numbers

- Worldwide estimates for spare parts in the automotive industry are around **\$750 Billion**, for household appliances **\$200 Billion**, etc.
- This represents around **10% of a years manufacturing revenue**.
- More than **60%** of all stocked spare parts have not been used in **3 years**. Some estimate that up to **70%** of them may **never be used**.
- **Spare parts tie up valuable capital that could be used much more productively in other areas.**
- There is interest around the world in AM for spare parts.

COVID19 Face shields



Myth

Just hit print and you are done.

- **The vast majority of 3D printing entails a large amount of **post-processing**.**
- **This can range from removing support material, to polishing, to machining, to coating, to heat-treating, to colouring, to sanding and painting, etc.**

- 2 hours of file preparation in Magics
- 30 minutes of file preparation in EOS Software
- 2 hours of machine preparation
- 9 hours of printing
- 2 hours of machine cleaning & preparation for next build
- 3 hours of stress relief
- 30 hours of cooling
- 15 minutes of bench saw
- 4 days to remove supports
- 4 days of filing, sanding, and shot-peening



So what's missing?

- We need **more materials**, **better surface finishes**, and **certifiable** processes
- We need **design tools** that will allow us to design safe products that are **optimized for AM**.
- We need to update our engineering and design education programs to include **design for AM**.



AM truly is AMazing...

Let your imagination run wild.

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