

# Additive Manufacturing (3D-Printing) & Life Long Learning

Drs. Ing. R. Abdoel (Ricardo)

Mini-Symposium 3D-printen: *“Wat heb ik daar aan?”*

- Additive Manufacturing Hype?
- AM Toepassingen en doelgroepen
- AM Technologieën en Proces
- Design for AM
  - Design Rules, Design Guidelines
- Impact op onderwijs en business
  - Kennis, Kunde, Vaardigheden
- Toekomstperspectief en ambitie

## The 3rd industrial revolution

CES 2014: MakerBot's new digital store is the 'iTunes' of 3D printing

3D Printers Will Soon Change The World, If It's Not Strangled In A Lawyered Up World

## 3-D Printing Will Change the World

ADDITIVE MANUFACTURING REINVENTING THE WAY WE WORK

## Why The Future Of 3D Printing Is Now

3D Printing Doesn't Live Up To The Hype Yet

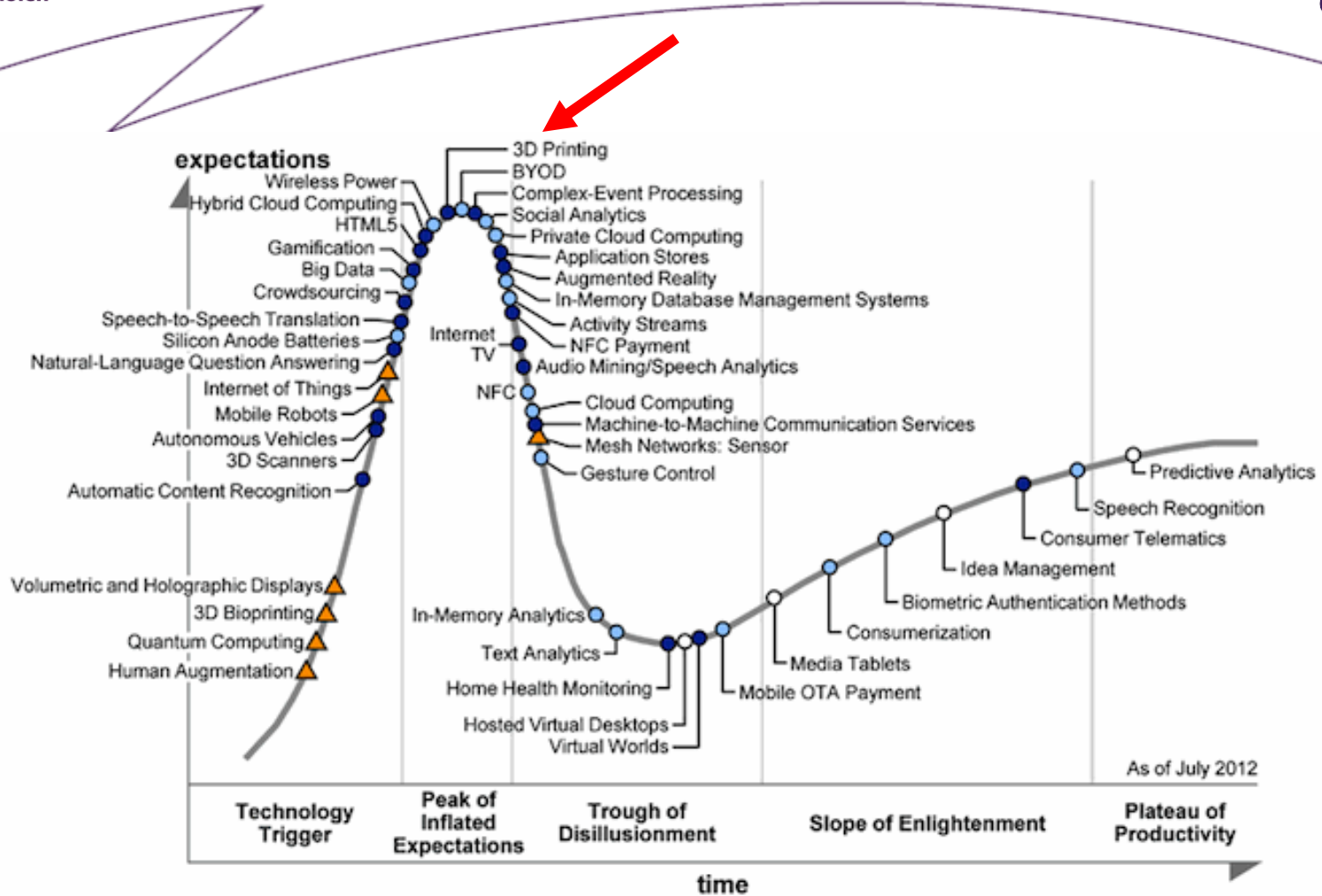
How is additive manufacturing adding value?

3D Printing: Hype vs. Reality

Please Feel the Museum: The Emergence of 3D Printing and Scanning

Is 3D-printing een hype?

# Gartner Hype Cycle

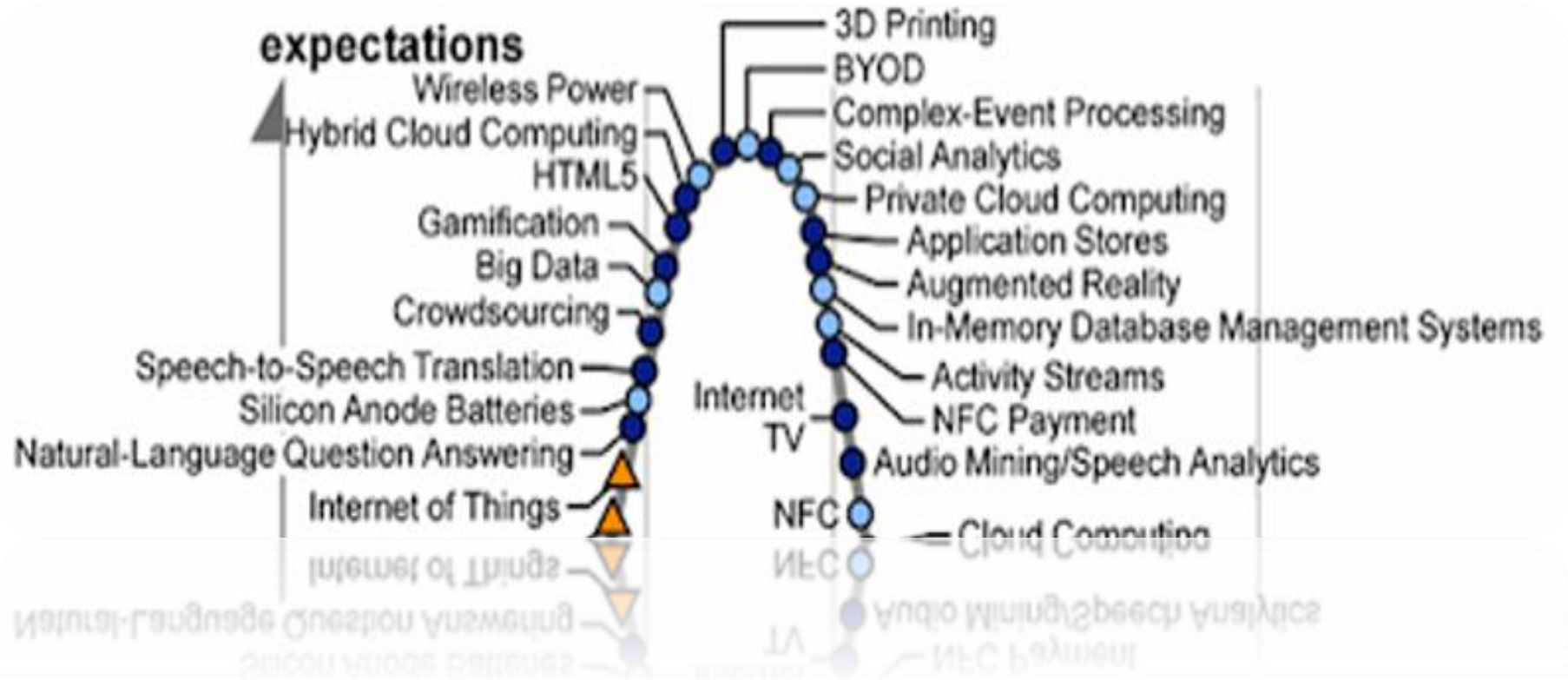


As of July 2012

Plateau will be reached in:

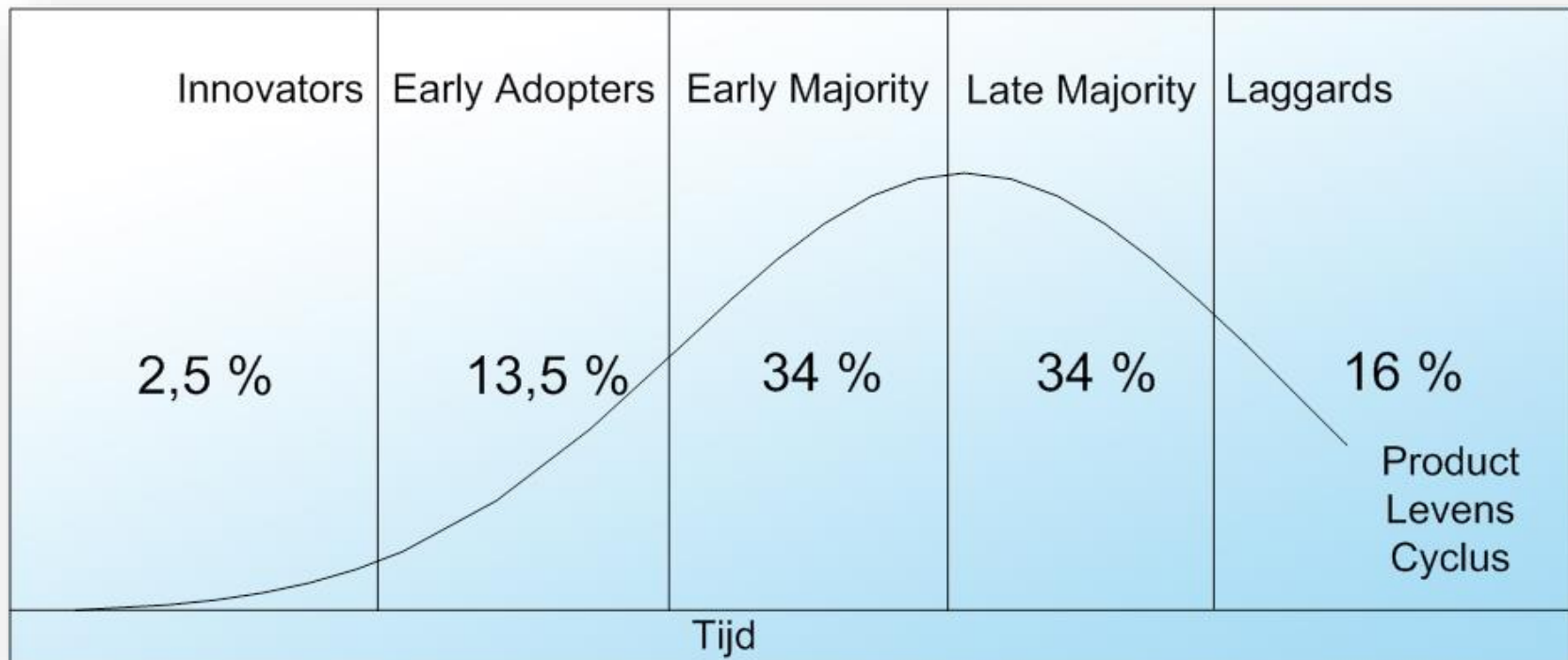
○ less than 2 years   ● 2 to 5 years   ● 5 to 10 years   ▲ more than 10 years   ⊗ obsolete before plateau

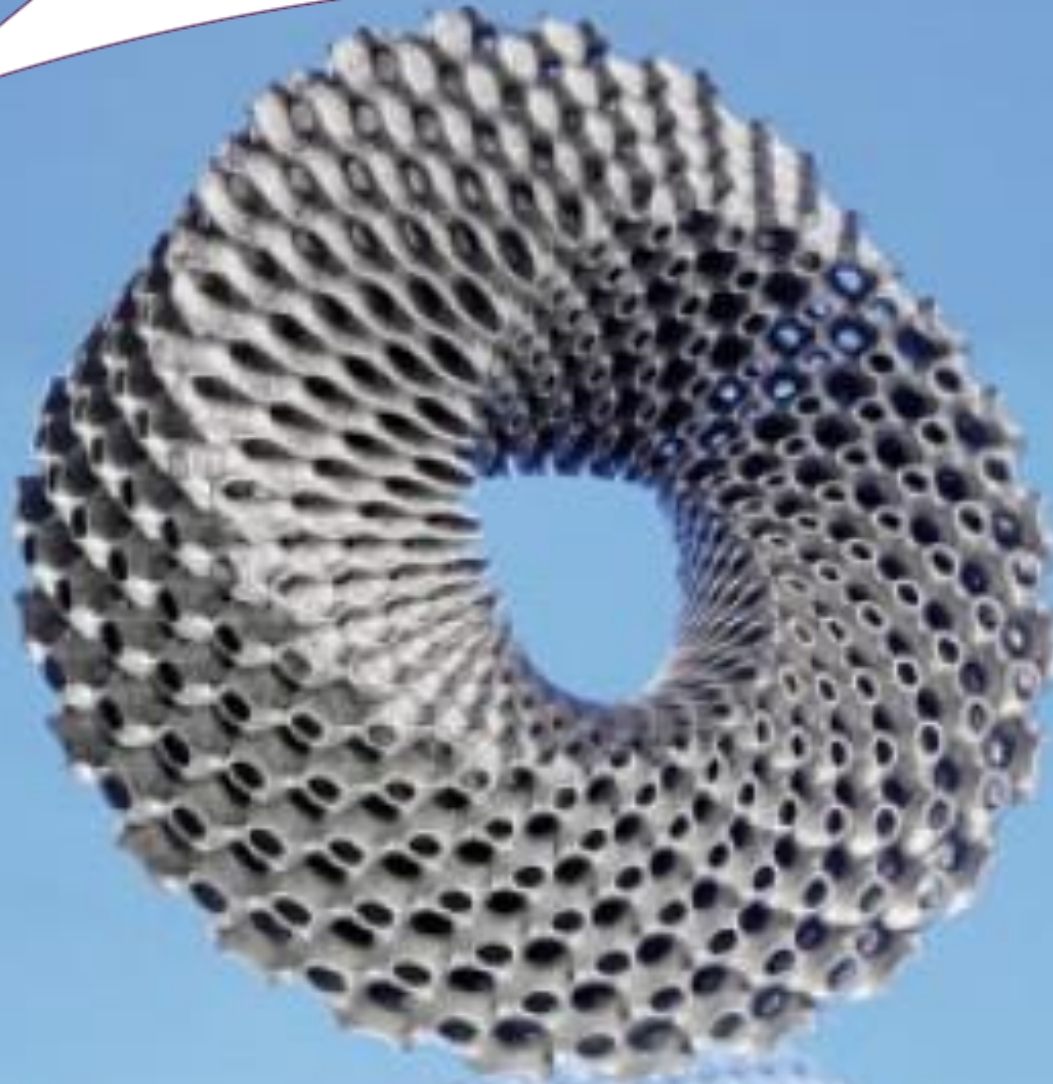
# Gartner Hype Cycle

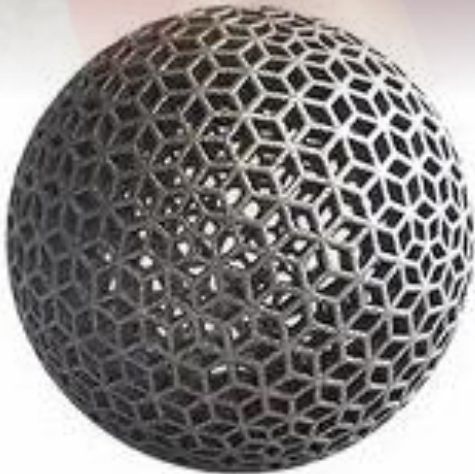
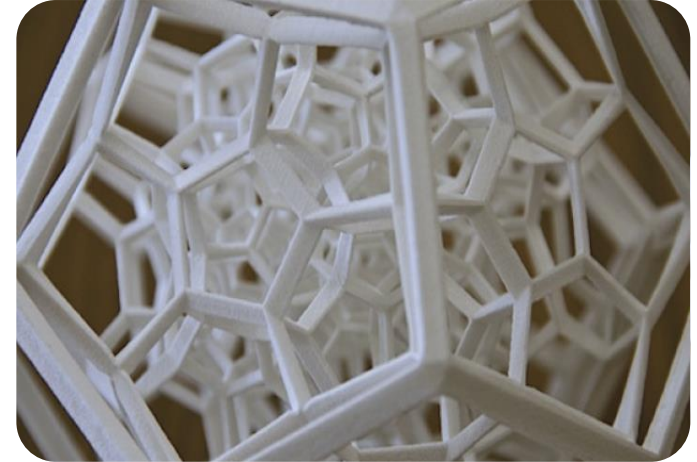




*(Rogers, 1995)*





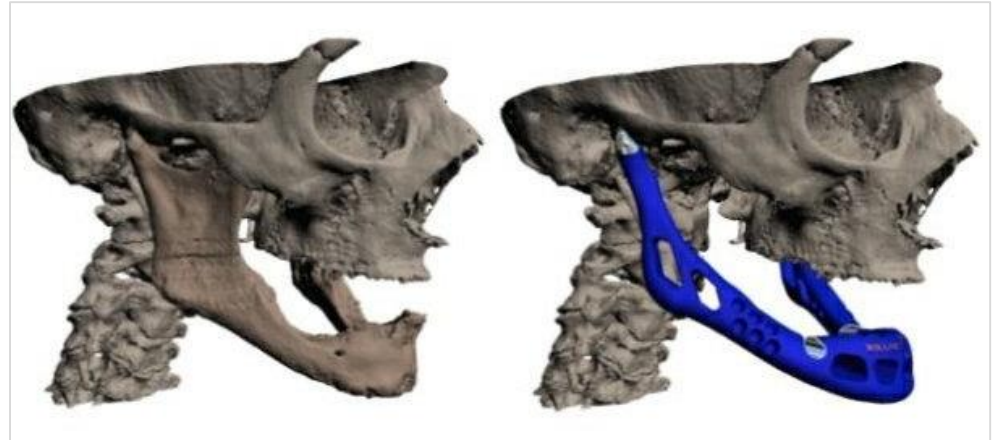






Penne pasta. Photograph: Linda Ny Lind for the Guardian



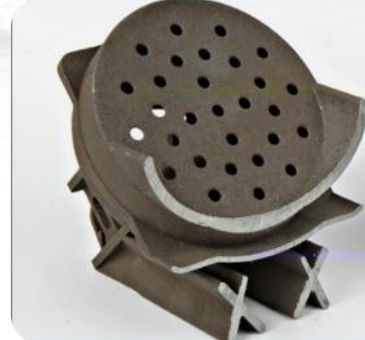
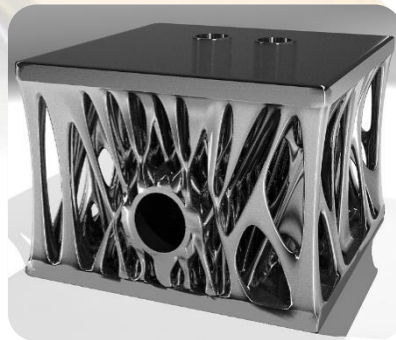
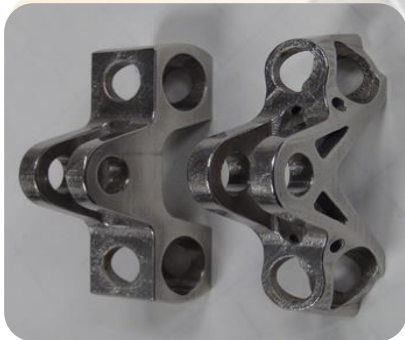
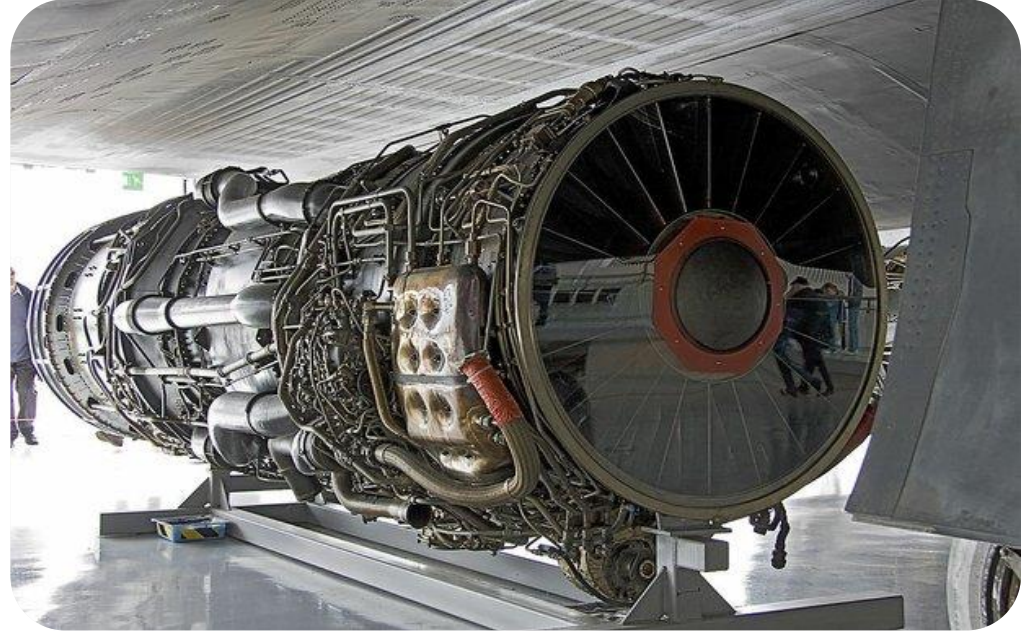




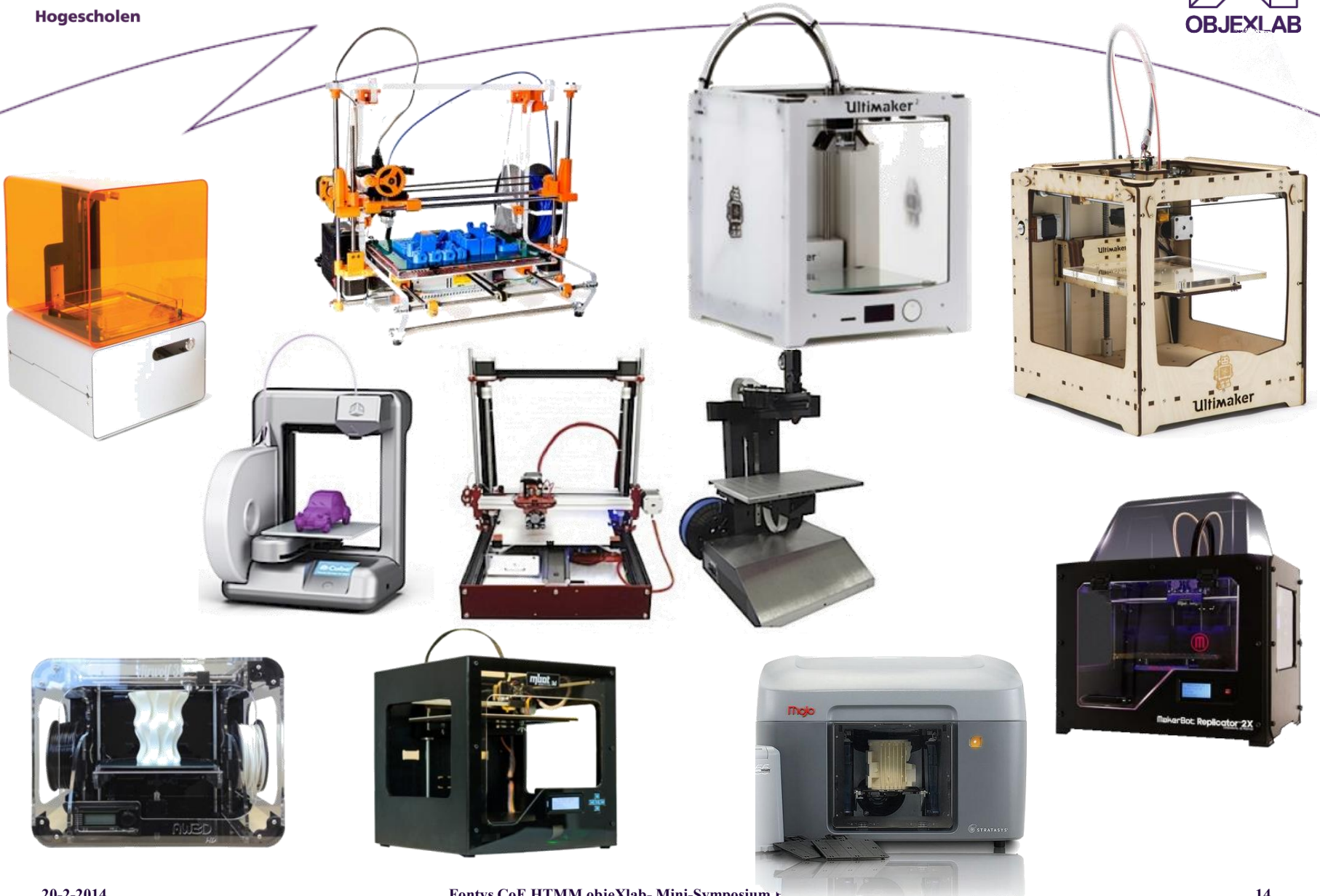








# 3D printers (consumers, personal)



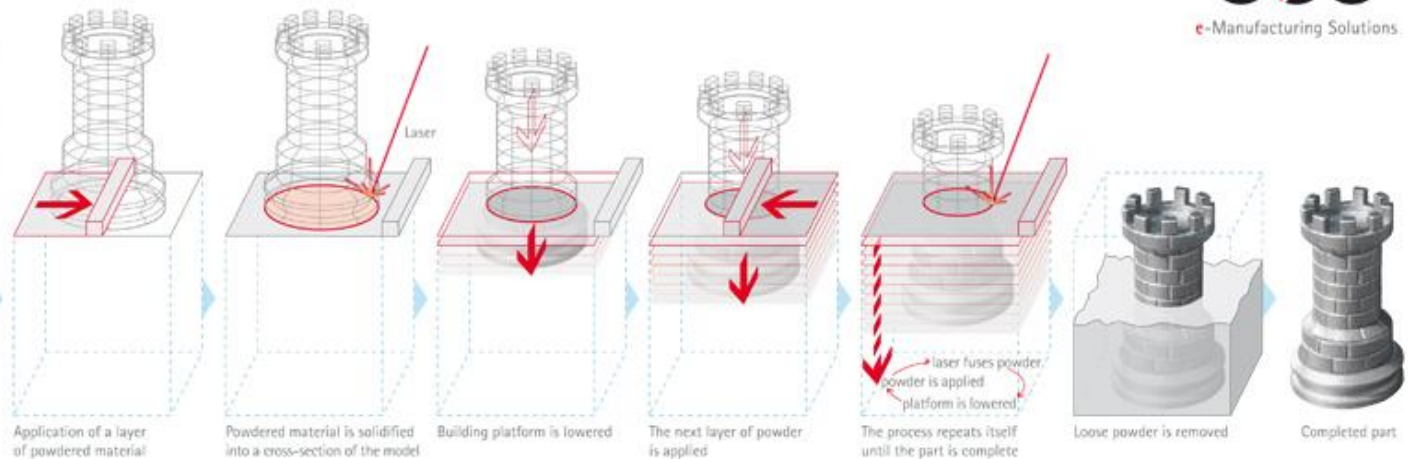


# 3D printers (industry, production)

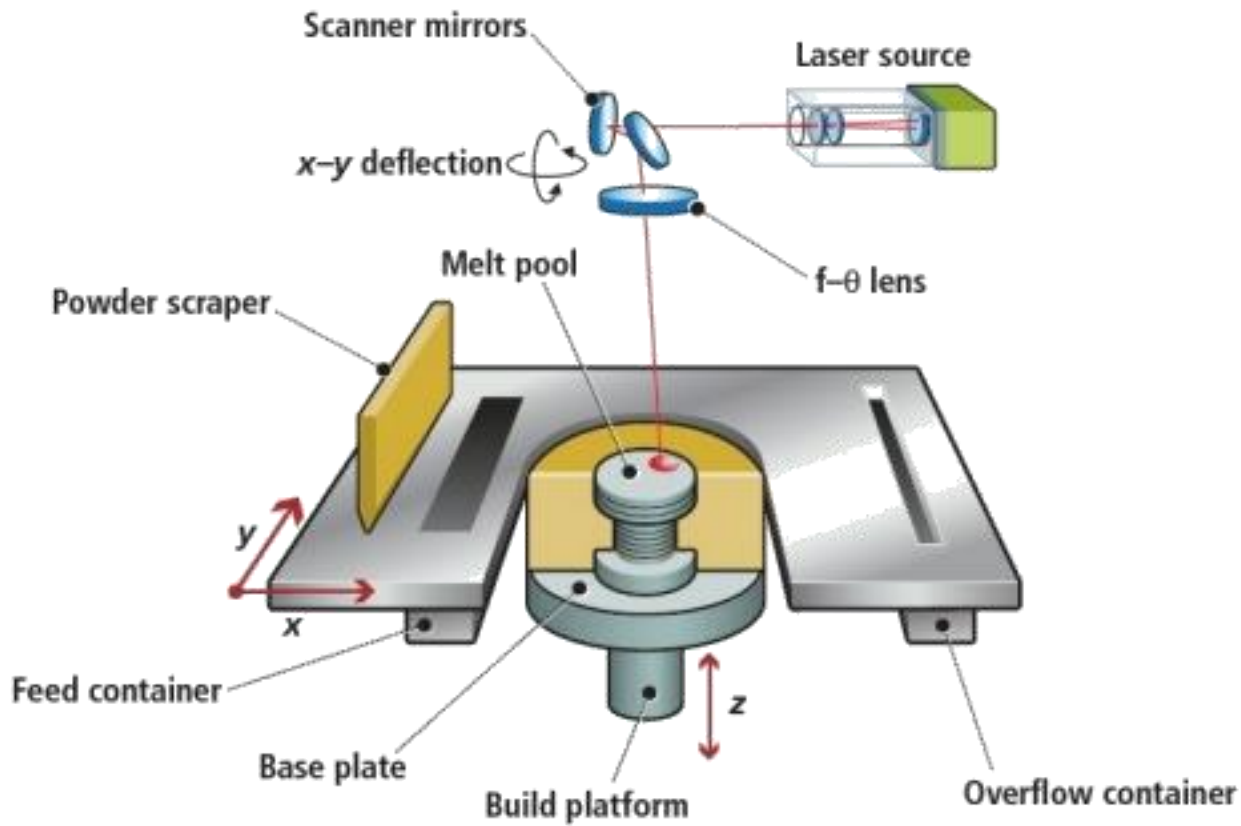


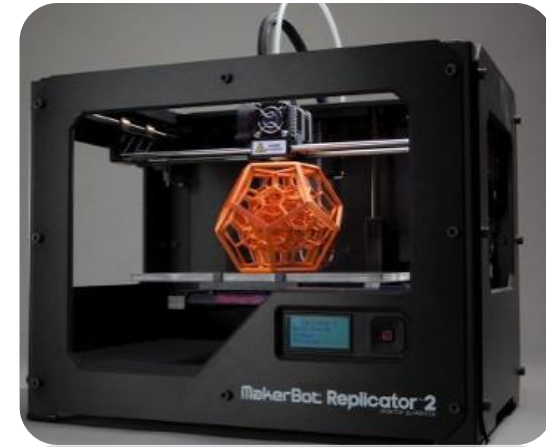
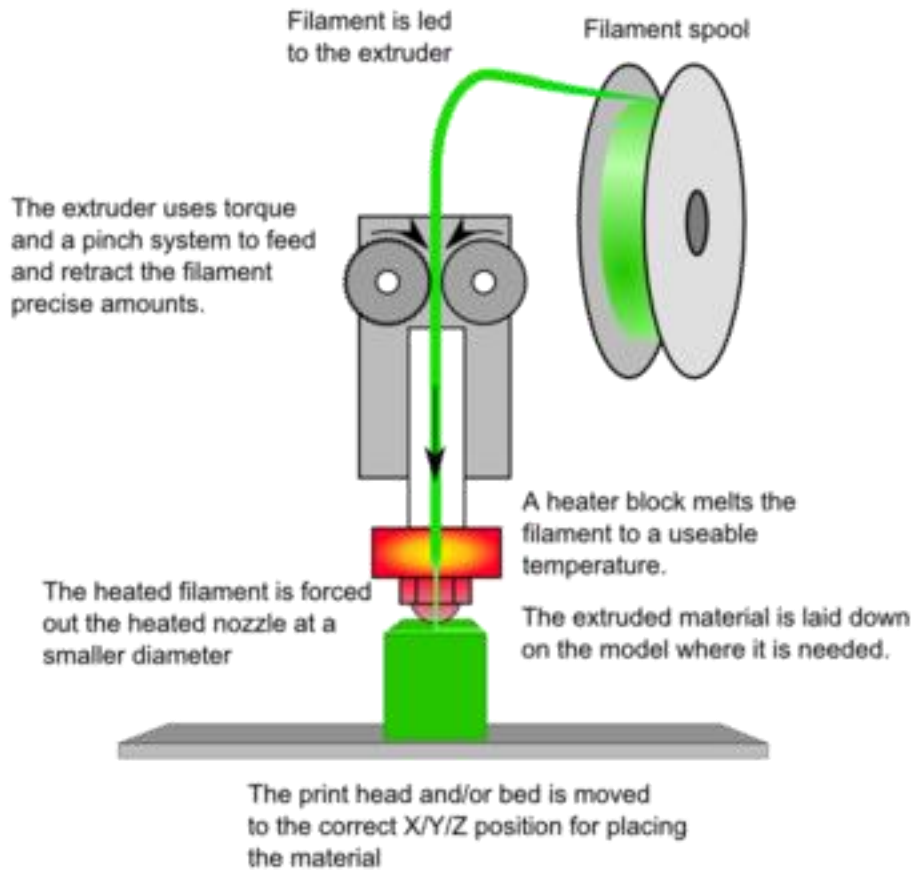
- SLS (Selective Laser Sintering)
- SLM (Selective Laser Melting)
- EBM (Electron Beam Melting)
- FDM (Fused Decomposition Modelling)
- WAAM (Wire and Arc AM)
- SLA (Stereo Lithography Apparatus)
- DLP (Digital Light Processing)
- SHS (Selective Heat Sintering)
- LOM (Laminated Object Manufacture)
- DMLS (Direct Metal Laser Sintering)
- .....

## General functional principle of laser-sintering





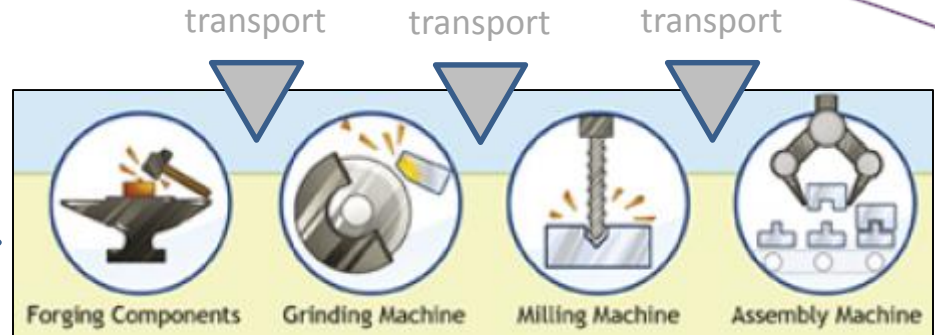




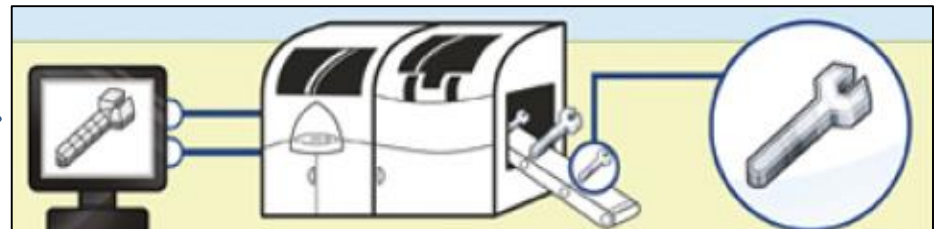
# Traditional versus AM Production (high end functional parts)



Traditional



Mass production

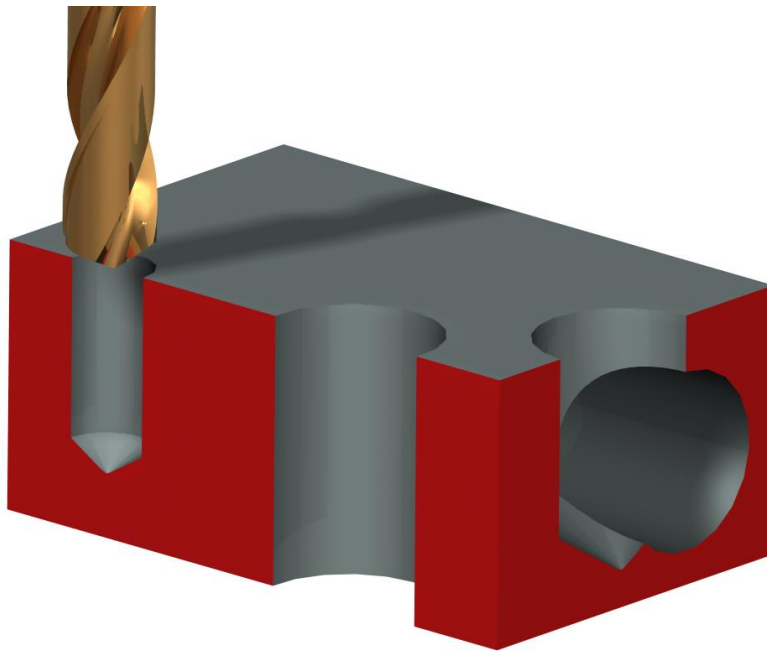


Low volume, high complexity  
High-end functional parts

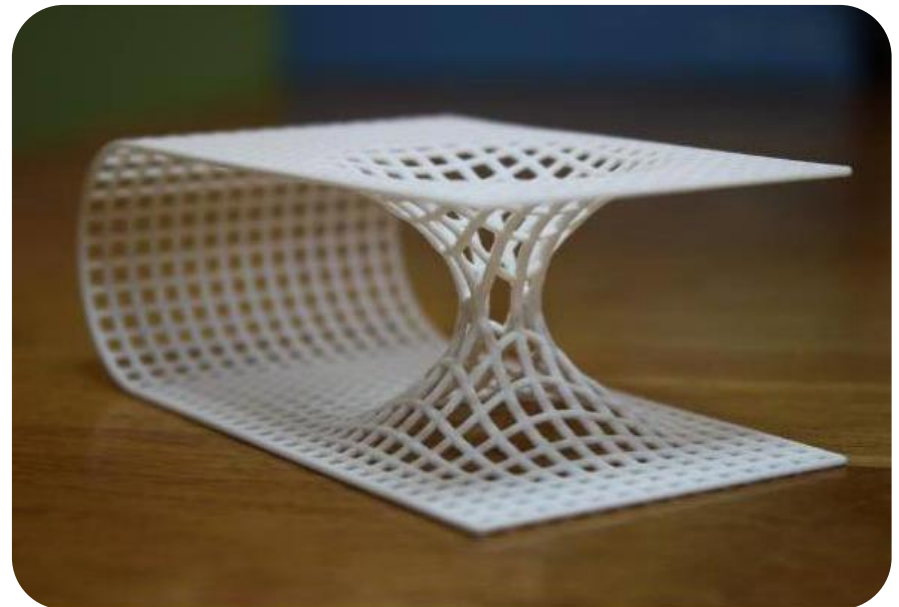
Supply Chain?  
Local versus Outsourcing?

## Denken en ontwerpen in 3D Design Freedom (3D - 4D)

Gat boren (subtractive)

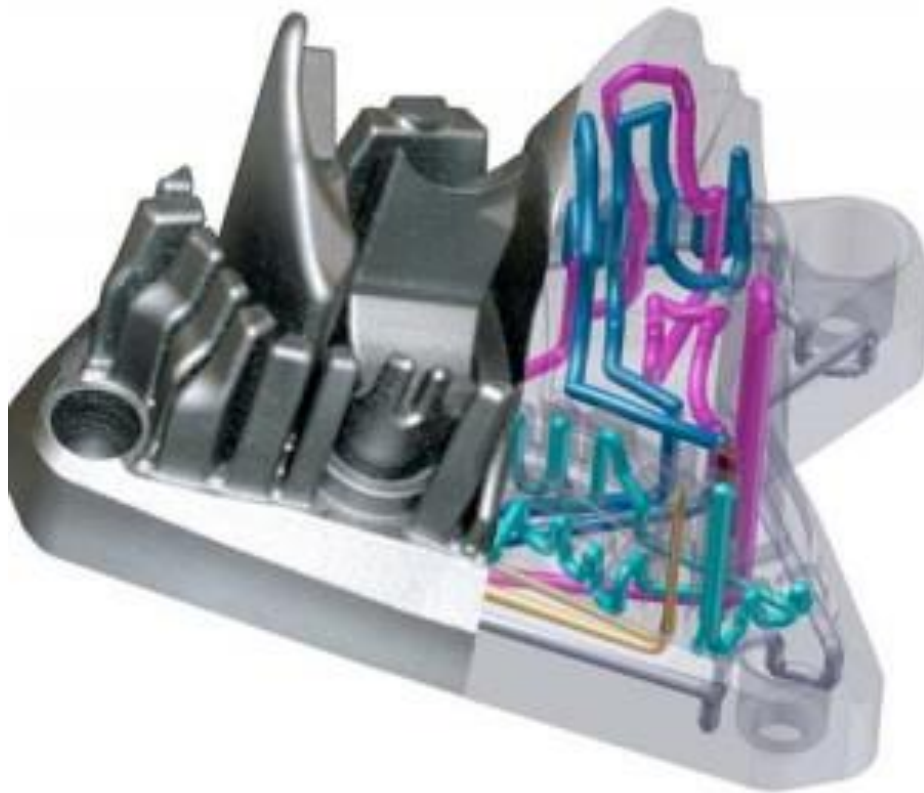


Gat opbouwen (additive)





## Manifolds and Channels

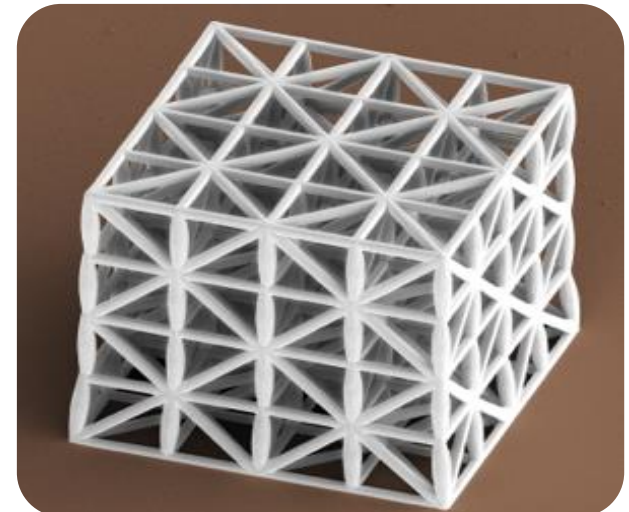
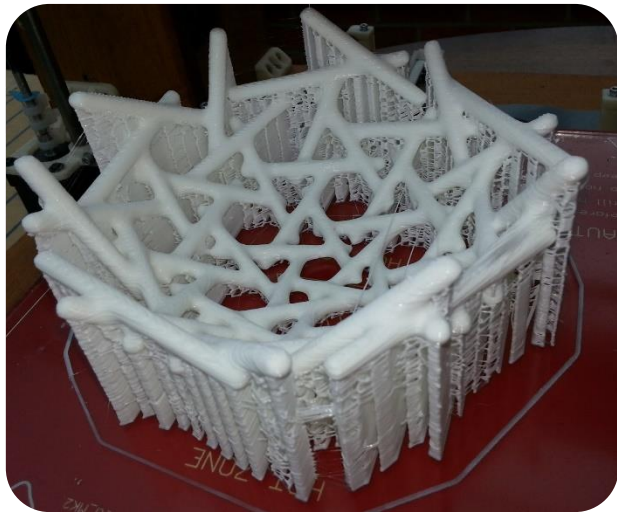


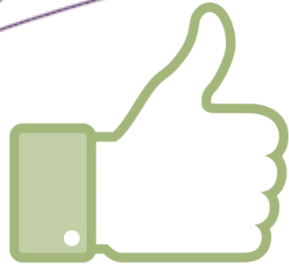
## Design with support structure



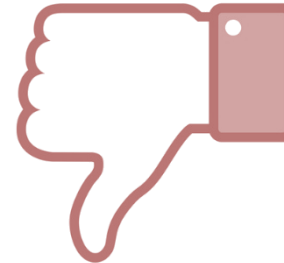
The most suitable build direction?

Topology optimization → nature





- **On-demand** manufacturing
- Low / Zero waste (recycle, re-use)
- No stocks
- High flexibility (**freedom of design**)
- Short development cycle
- Small series
- **Personalization**
- Very short distribution
- Supply chains
- Energy saving
- **New Business models**
- .....

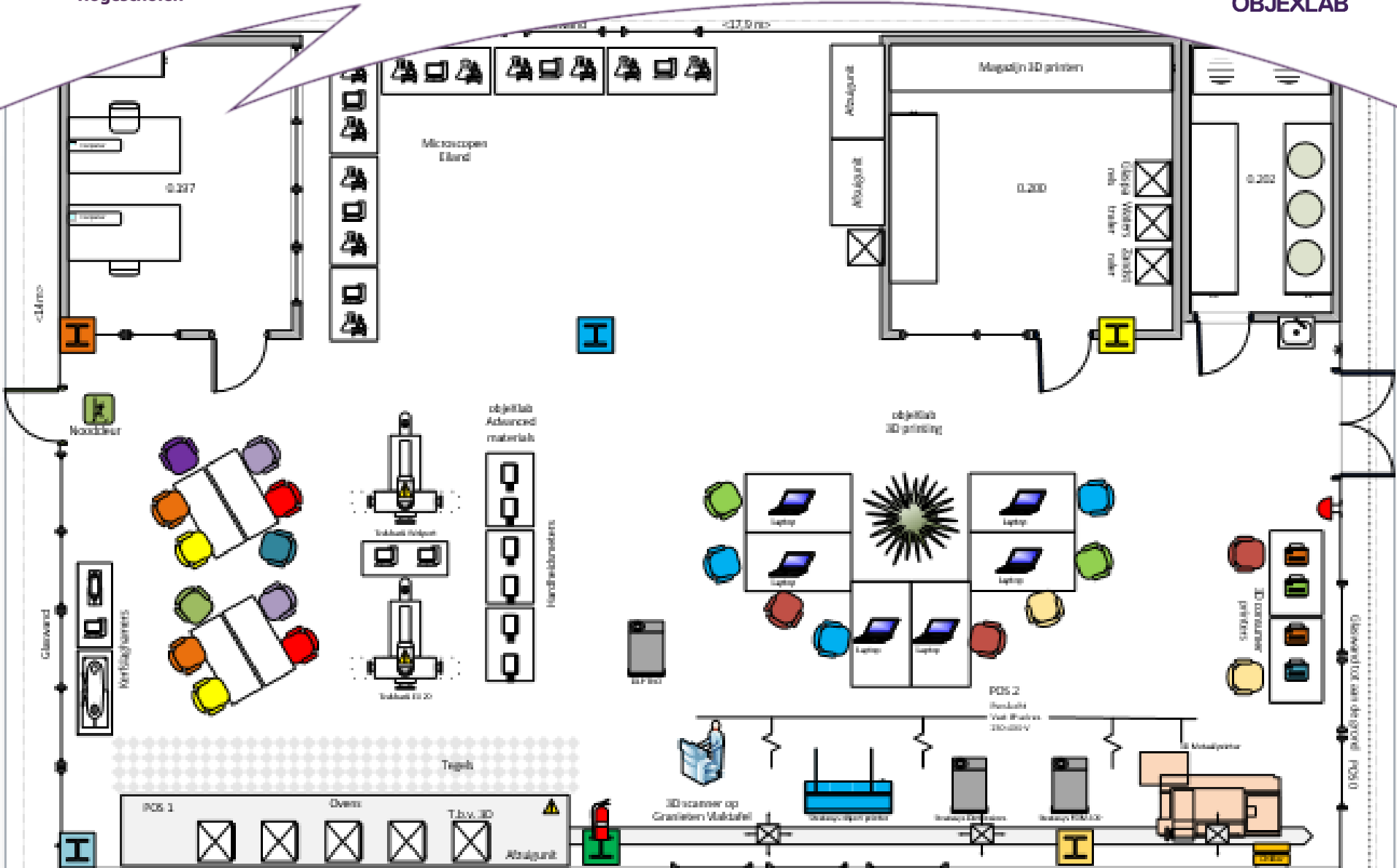


- Mass customization
- **Complex** 3D design en engineering
- **Software**
- **Hype**
- Lots of initiatives
- No standards
- Lots of parameters
- **Niche market** (lab, consumer)
- Price
- **Build Volume**
- **“First time right?”**
- .....



- Awareness
- Nauwkeurigheid producten conform specificaties
- Reproduceerbaarheid en Productiesnelheid
- Materiaaleigenschappen (consumable, product)
- Nieuwe materialen en Multi-materialen
- Thermische invloeden tijdens printen en bij eindproducten
- Maatvastheid en vormvastheid
- Procescontrole, monitoring
- Standaardisatie (NEN, ISO)
- Veiligheid (dampen, poeders)
- Topologie optimalisatie
- Opleiding en training





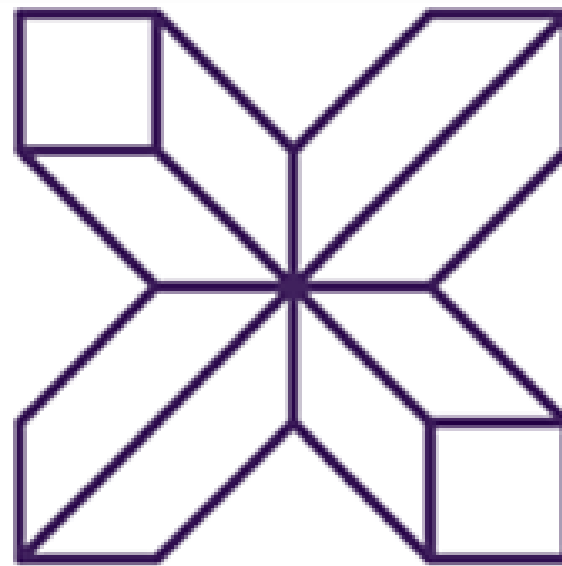
## Stage, afstuderen promotie

### Educatie:

- Opleidingen
- Cursussen
- Workshops
- Trainingen
- 🎯 • **VO, MBO, HBO, HBO+**

### Projecten:

- Prototyping
- Design & Engineering
- Nulseries
- 🎯 • **MKB, OEM, partners**



**Docenten, Lectoren,  
Studenten, Trainees**

### Toegepast Onderzoek:

- Design Rules, Guidelines
  - Thermisch gedrag
  - Test & Measurement
  - Parameteronderzoek
  - Producteigenschappen
  - Materiaaleigenschappen
  - 🎯 • **MKB, OEM en P in E**
- ### Demo Center:
- Promotie
  - Facility Sharing
  - Demo machines/processen
  - 🎯 • **Industrie**



AM basics &  
businesses

Design &  
engineering

Materials &  
processes

Additive  
manufacturing

Post  
processing &  
testing

- Introduction AM and application areas;
- AM Technologies;
- AM Machine Operations;
- Design Rules, guidelines for AM;
- Design of Experiments AM Machine Parameters;
- Lean Manufacturing and Supply Chain with AM;
- Thermal Engineering challenges with AM Machines and Production;
- Test and Measurement (destructive / non-destructive);
- Material properties of AM products;
- 3D scanning;
- Workshops



26-27 februari 2014



26-30 maart 2014



Henry Ford

*“People can have the Model T in any color, so long as it’s black.”*





**IBM Chairman  
Thomas Watson, 1943**

*“I think there is a world market for maybe five (5) computers”*





## Centre of Expertise High Tech Manufacturing and Materials

R. A. Abdoel (Ricardo), MSc., BEng.  
Rachelsmolen 1  
5612 MA Eindhoven  
Gebouw R1



[www.fontys.nl/htmm](http://www.fontys.nl/htmm)



@ricardoabdoel | @OBJEXLAB



facebook/coehtmm



0613440585



[r.abdoel@fontys.nl](mailto:r.abdoel@fontys.nl)

LinkedIn

