

Laboratory of Precision Machining, Reverse Engineering and Biomechanics (PMREB Lab)





Machining processes:
computer numeric control and conventional



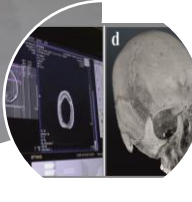
Reverse Engineering



Additive Manufacturing



Composite materials



Biomechanics

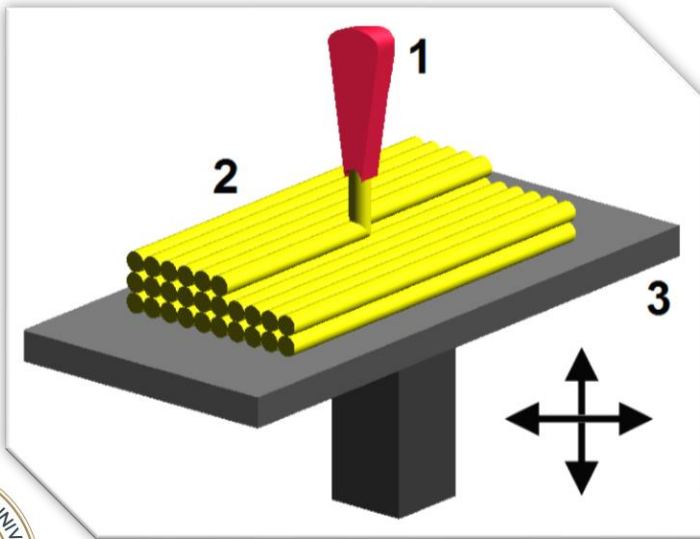




Introduction to Additive Manufacturing

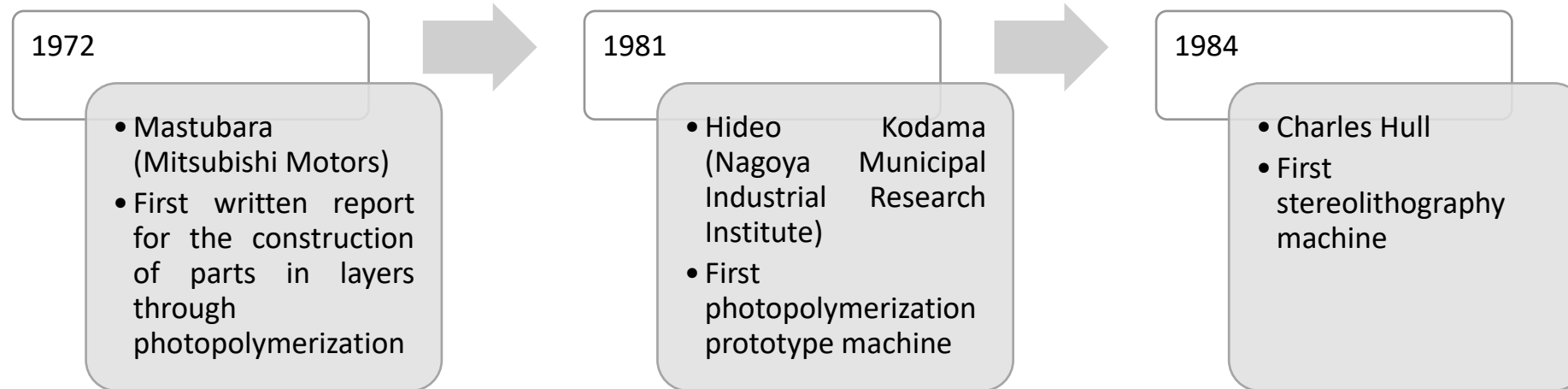
Definition

Additive Manufacturing, also known as 3D printing is a term which refers to a manufacturing process, in which the item is fabricated by depositing successive layers of material with specific geometry in space. The process is guided by a program formed in the computer.



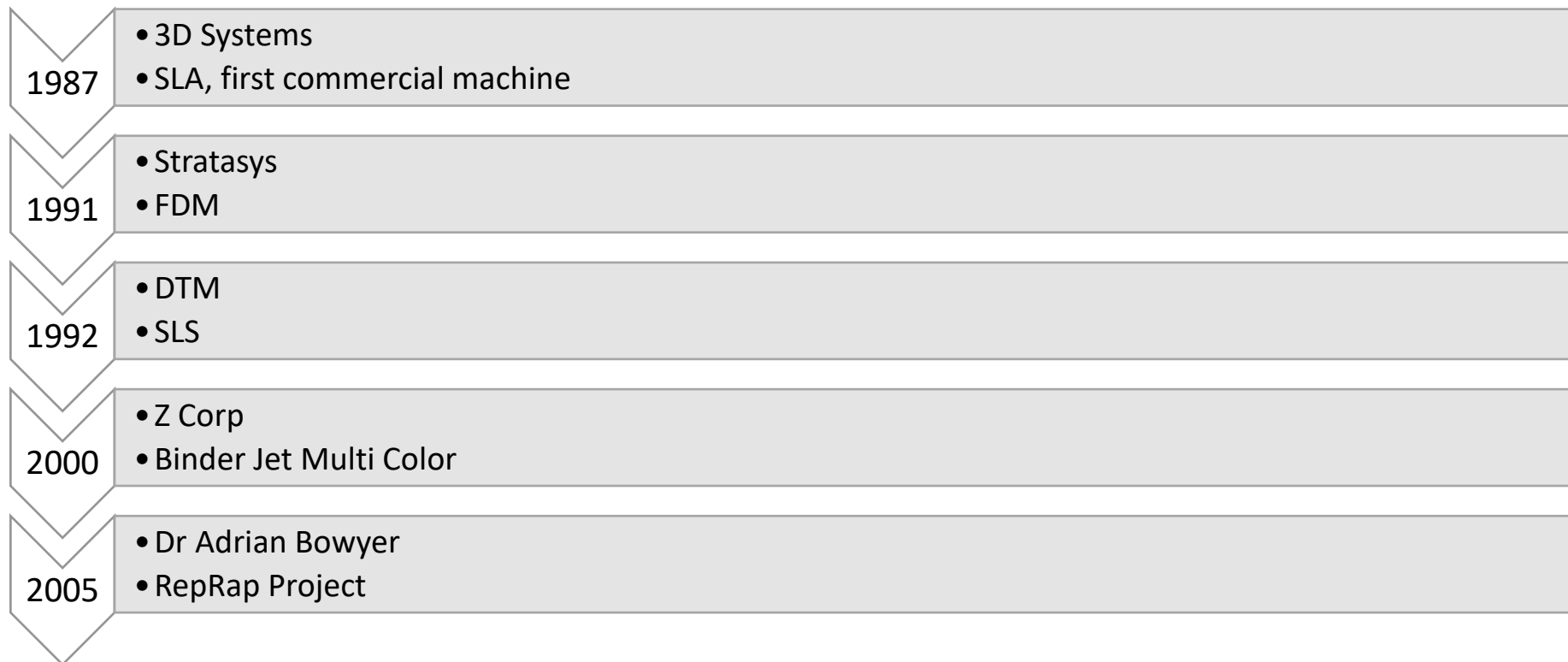


Historical information





Introduction of the different 3D printing technologies in the market





1984 (3D Systems SLA)



1991 (Stratasys FDM)



1992 (DTM SLS)



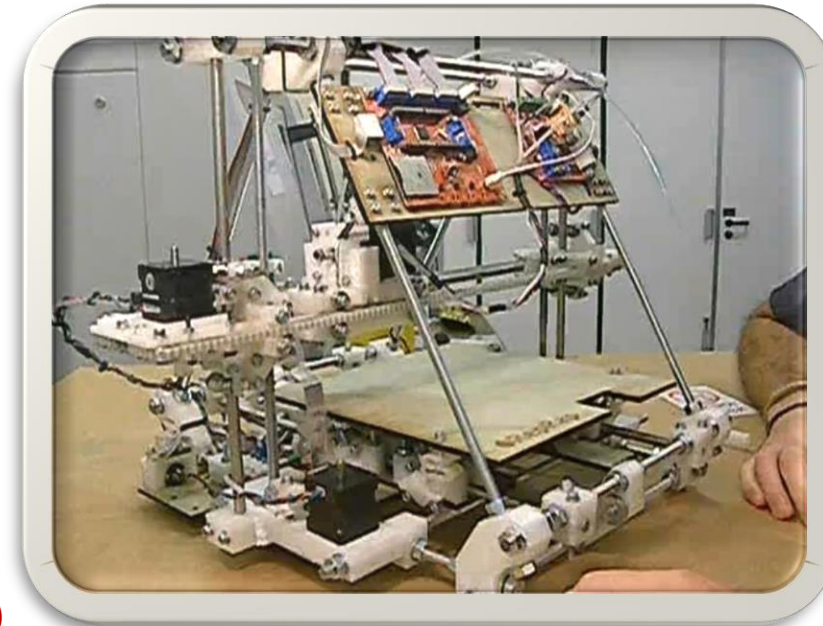


2000 (Z- Corp 1st Full Color 3D Printer)





2001 (1st Desktop 3D Printer)



2005 (RepRap Project)



2008 (Online 3D Printing)

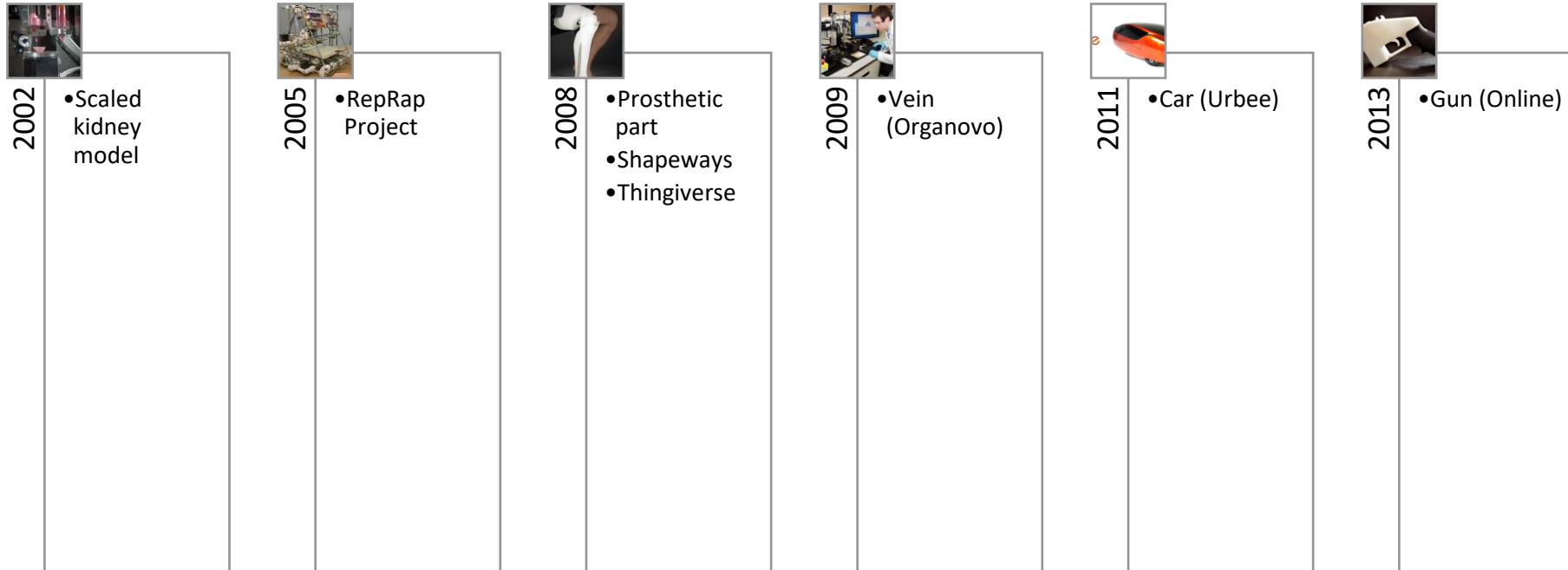
Thingiverse

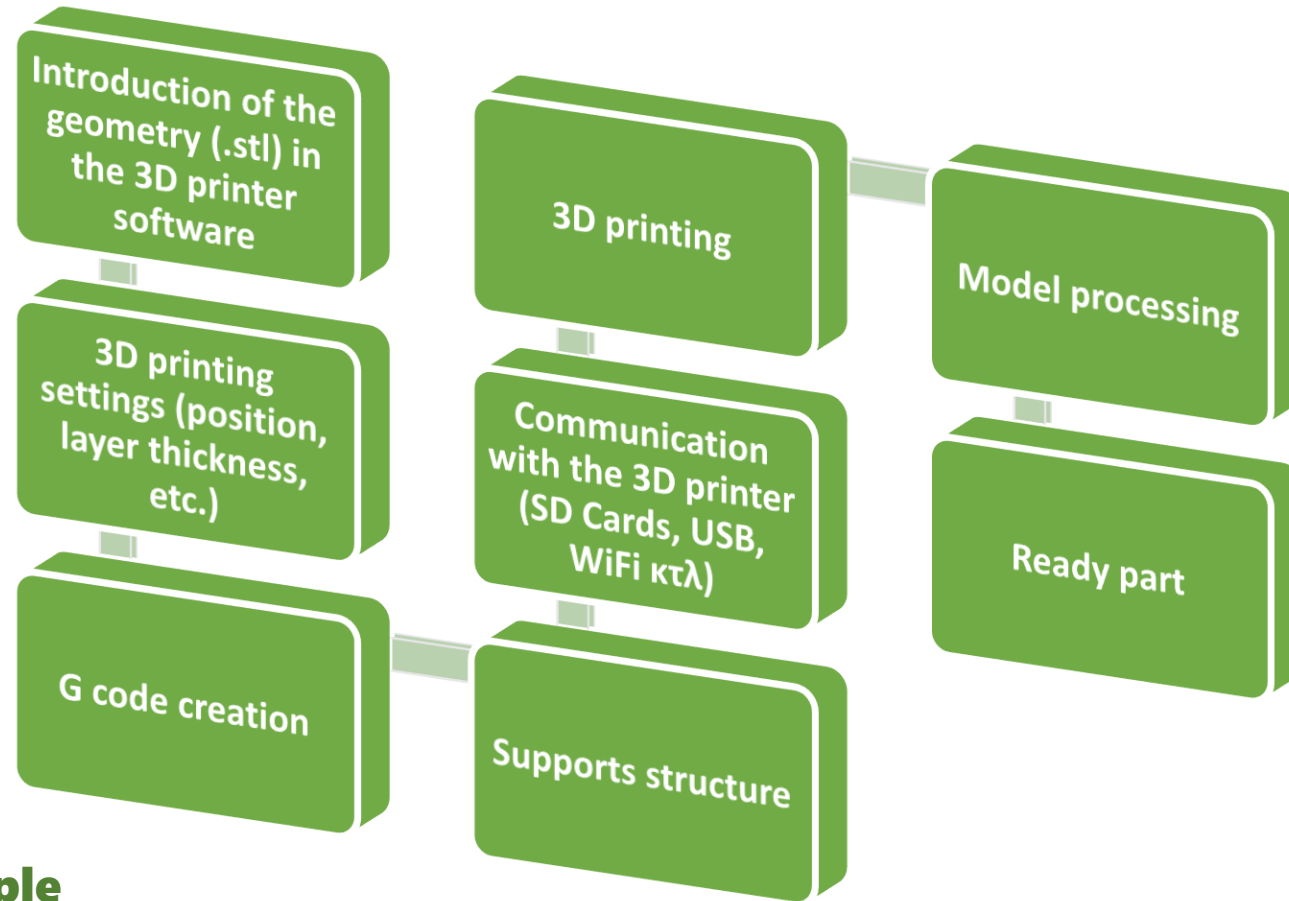
shapeways





Milestones





Operating principle





Geometry file

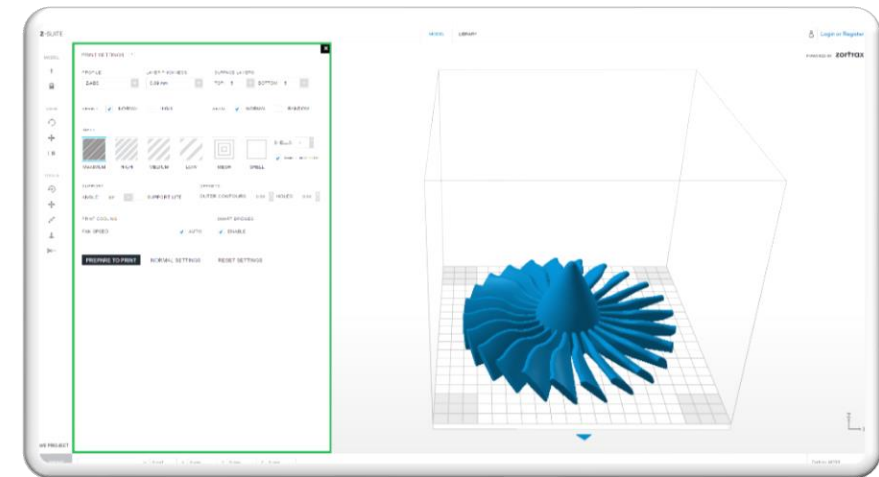
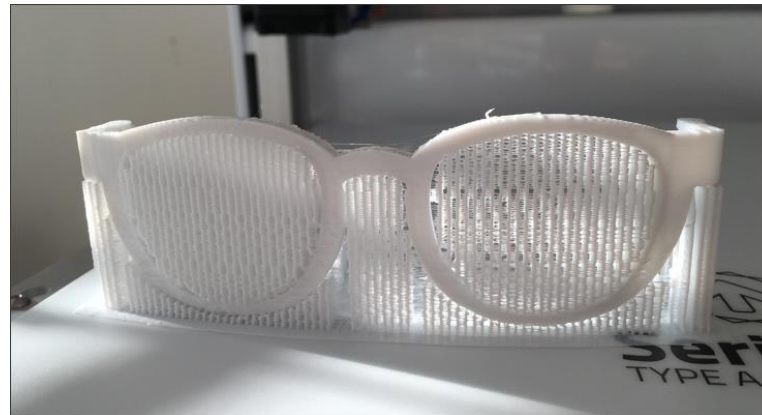
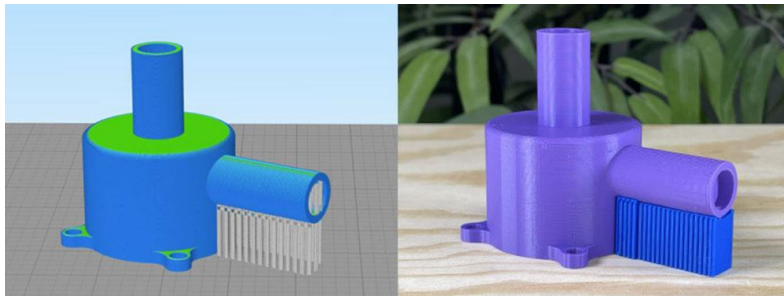
- .stl or .obj file (geometry in triangles form)
- Files that most CAD platforms can create
- File ready for 3D printing, no processing is required





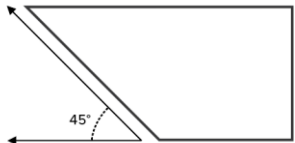
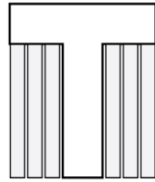
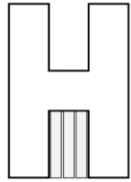
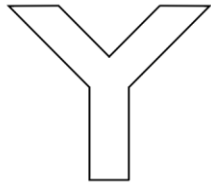
File processing

- Positioning of the geometry in the machine bed.
- 3D printing settings: space and geometry restrictions, orientation, time and material saving.
- 3D printing settings: servo machines speeds, temperatures, setting (extruder, bed, chamber), flow control, infill density and pattern, layer height, air flow, etc.
- Supports structures

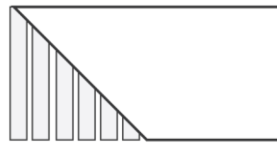




Supports-Orientation



Overhang of less than 45 degrees
No support is needed



Overhang of more than 45 degrees
Support is needed

- 40° Surface slope
- Soluble or manual removal
- bridging, cooling tune, etc.

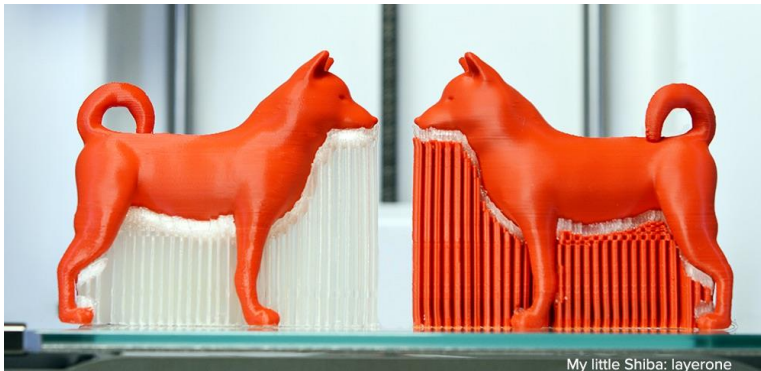
FFF



SLA



SLS



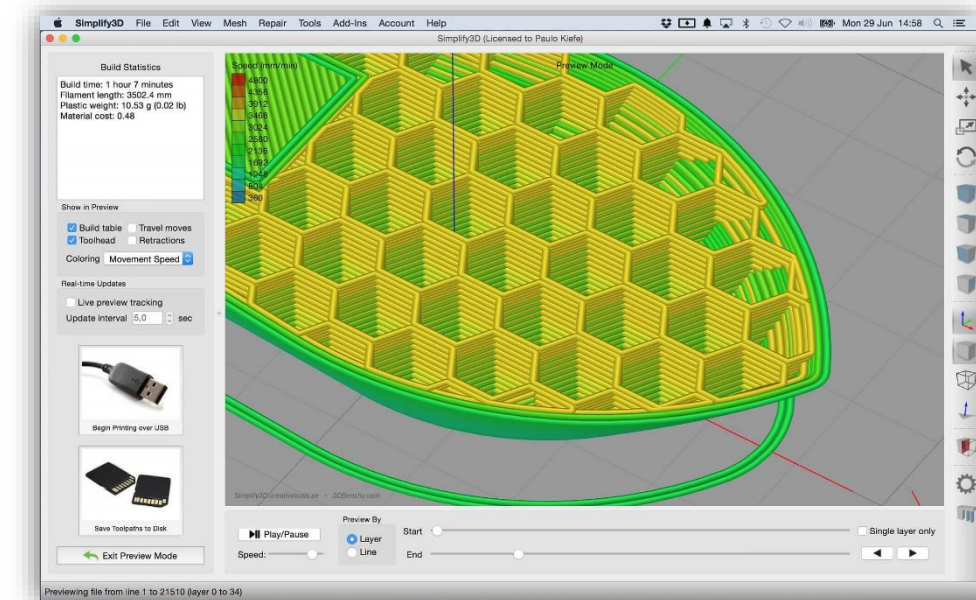
My little Shiba: layerone





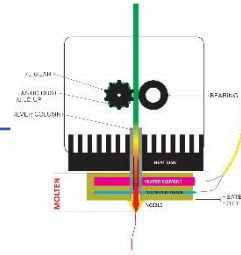
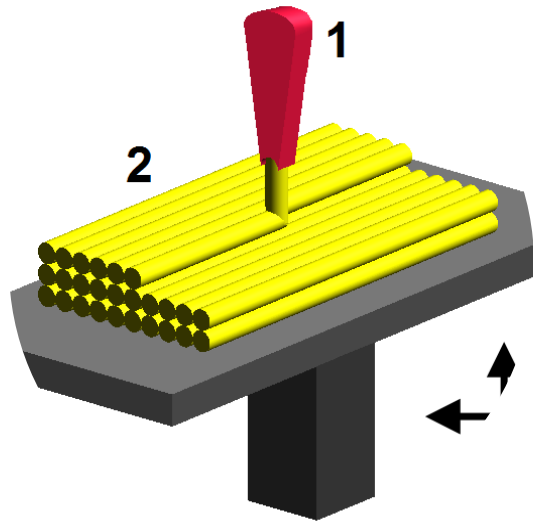
G code

- Automated process
- .gcode file export
- The same programming language used in Computer Numeric Control machines
- Information in the G-code file: temperatures, positioning, speed
- SD card, USB ή WiFi for communication with the 3D printer

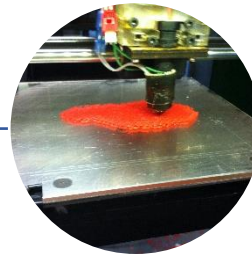




3D printing



The material is feed through a nozzle by gears



The head is moving in space in space to deposit the (almost) melted filament in the correct positions in space, to fabricate the required geometry



The bed is moving vertically for the formation of the successive layers, until the entire geometry is built



Part post-processing

- Supports removal
- Surface processing
- Processing of areas required in the assembly of the part
- Surface finishing
- Assembly





Ready part





3D Printing Global market

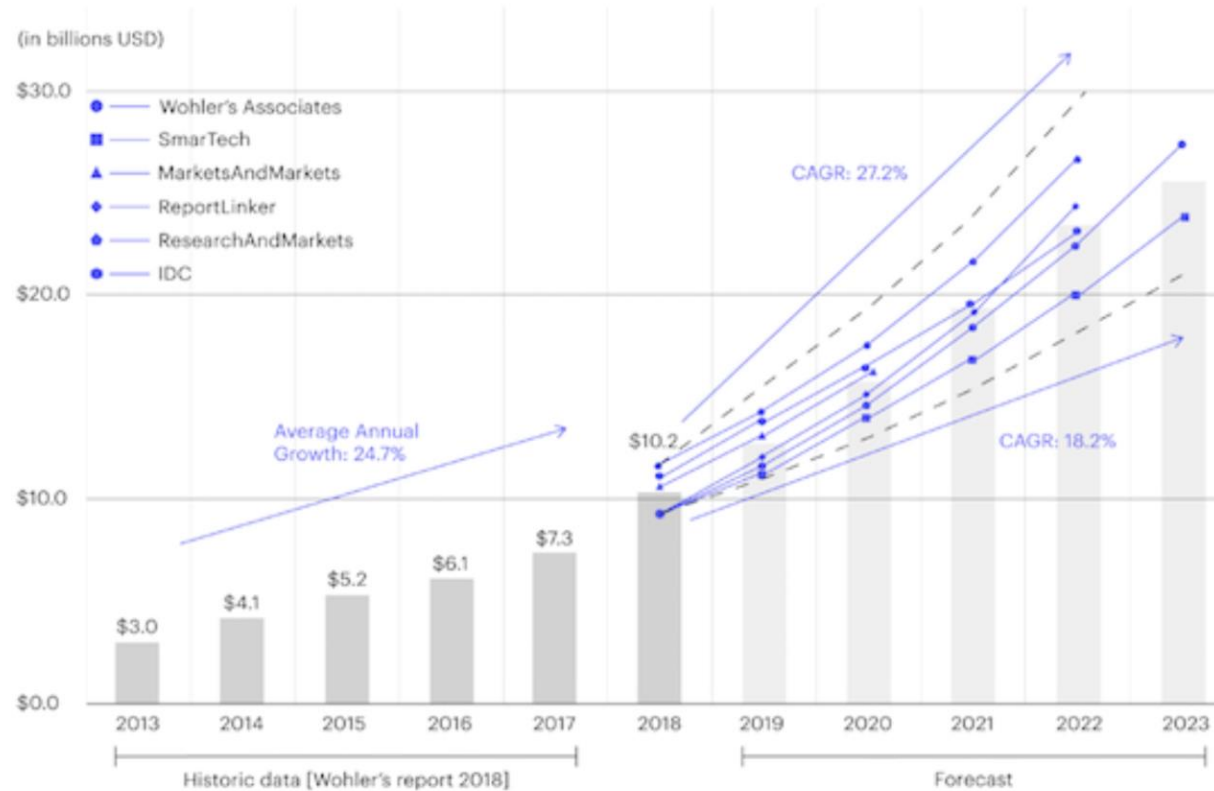
Milestone dates

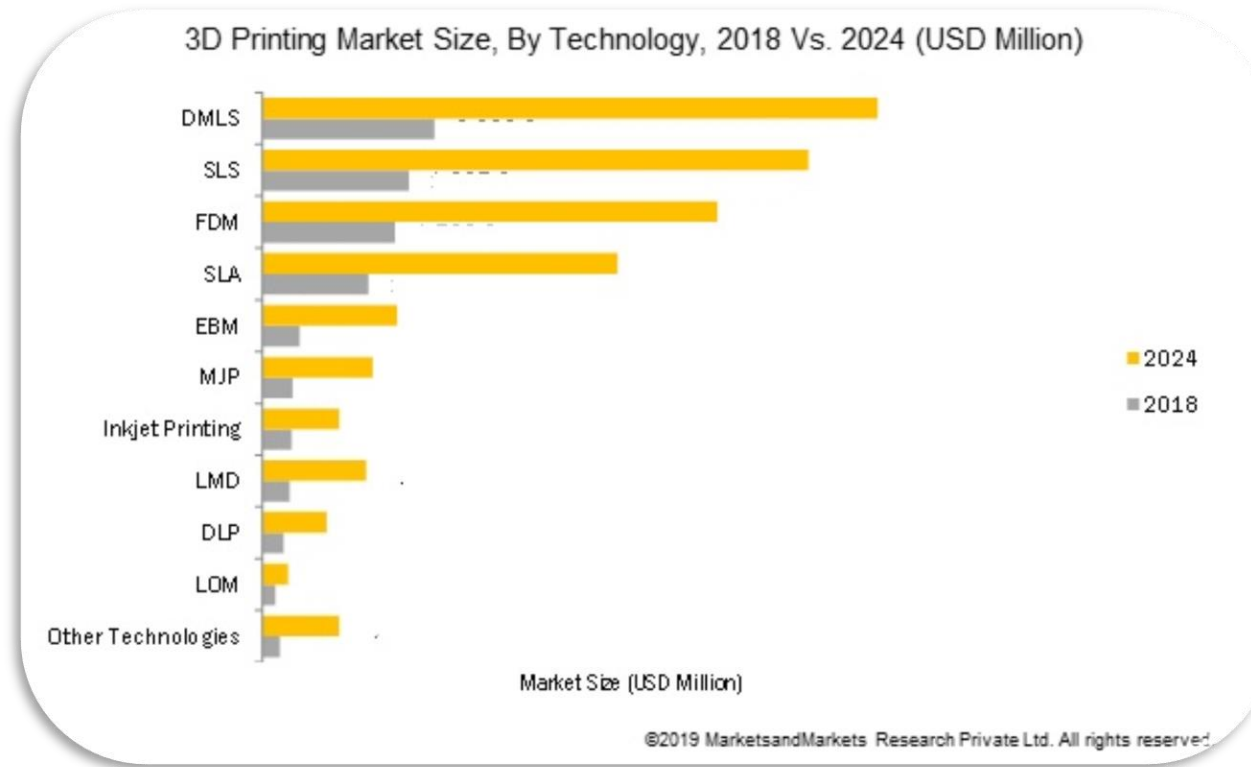
- 2008: RepRap Project
- 2012: Prusa i3
- Major machines cost decrease

30.000,00€ → 300,00€



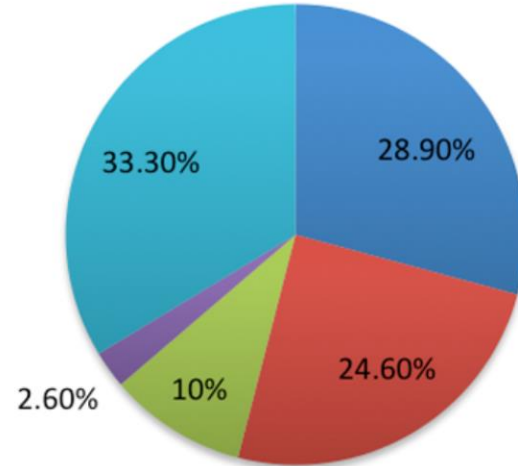
3D Printing Market Size & Forecast



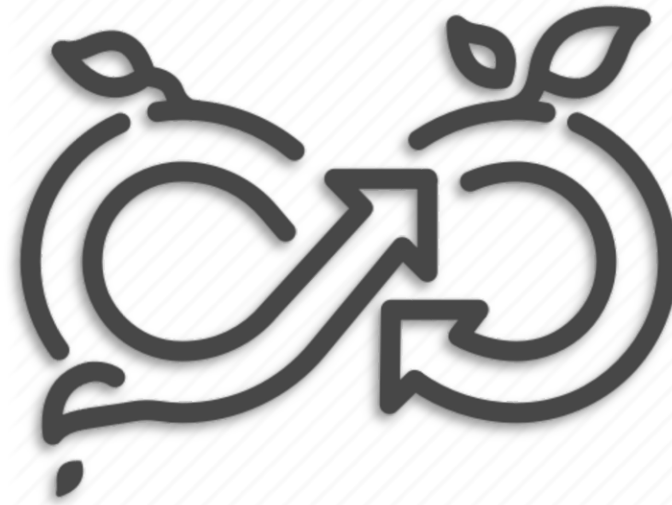




How Companies Use 3D Printing



- Experimenting to determine how to apply 3D printers
- Prototyping Only
- Prototyping and production
- Building Products that cannot be made from traditional methods
- Not implementing 3D printers



Sustainable Circular Economy and 3D Printing

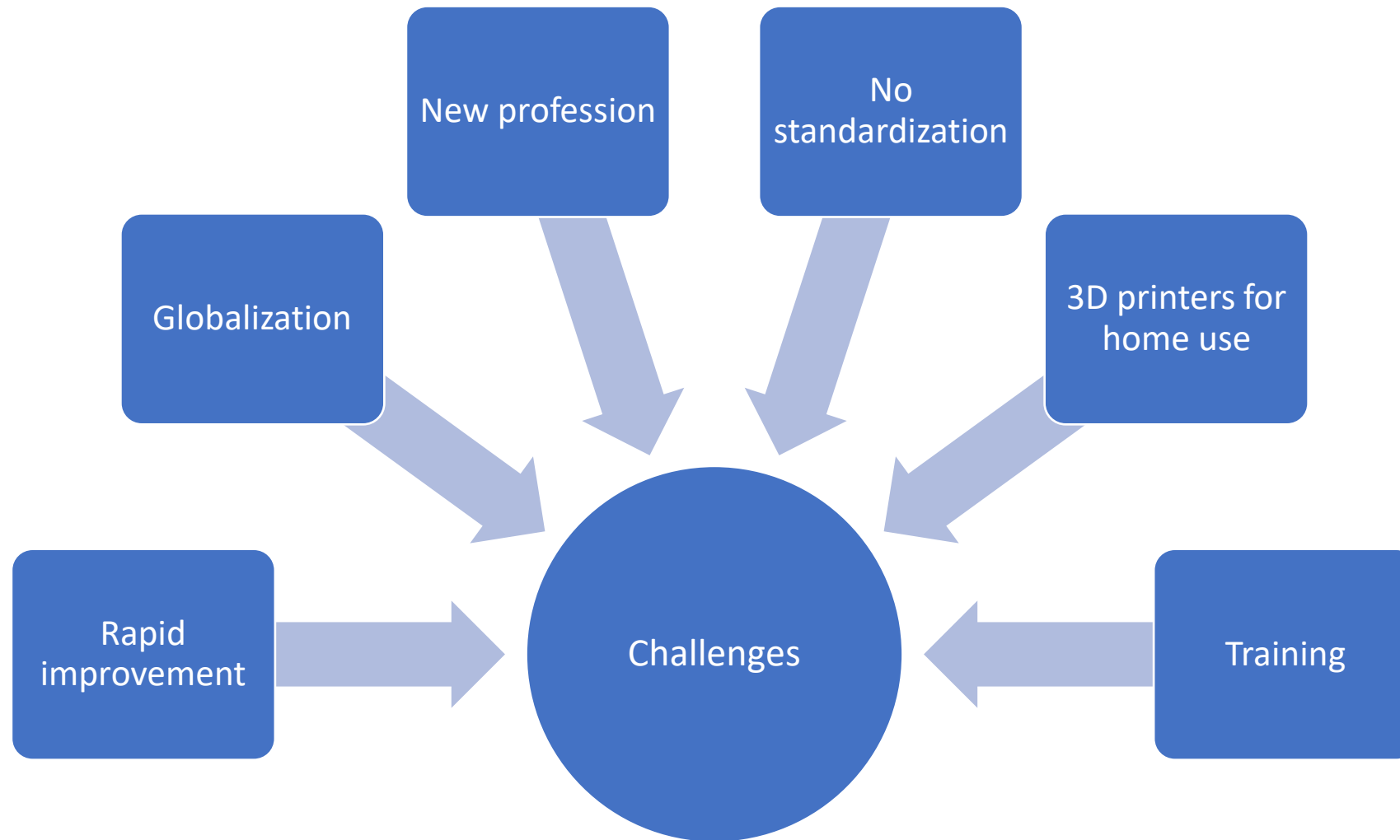




3D Printing Benefits

- Only the required material is used
- Sustainability by using recycled materials
- Ability to use composite polymers
- Distributed Manufacturing – Distributed Recycling Additive Manufacturing



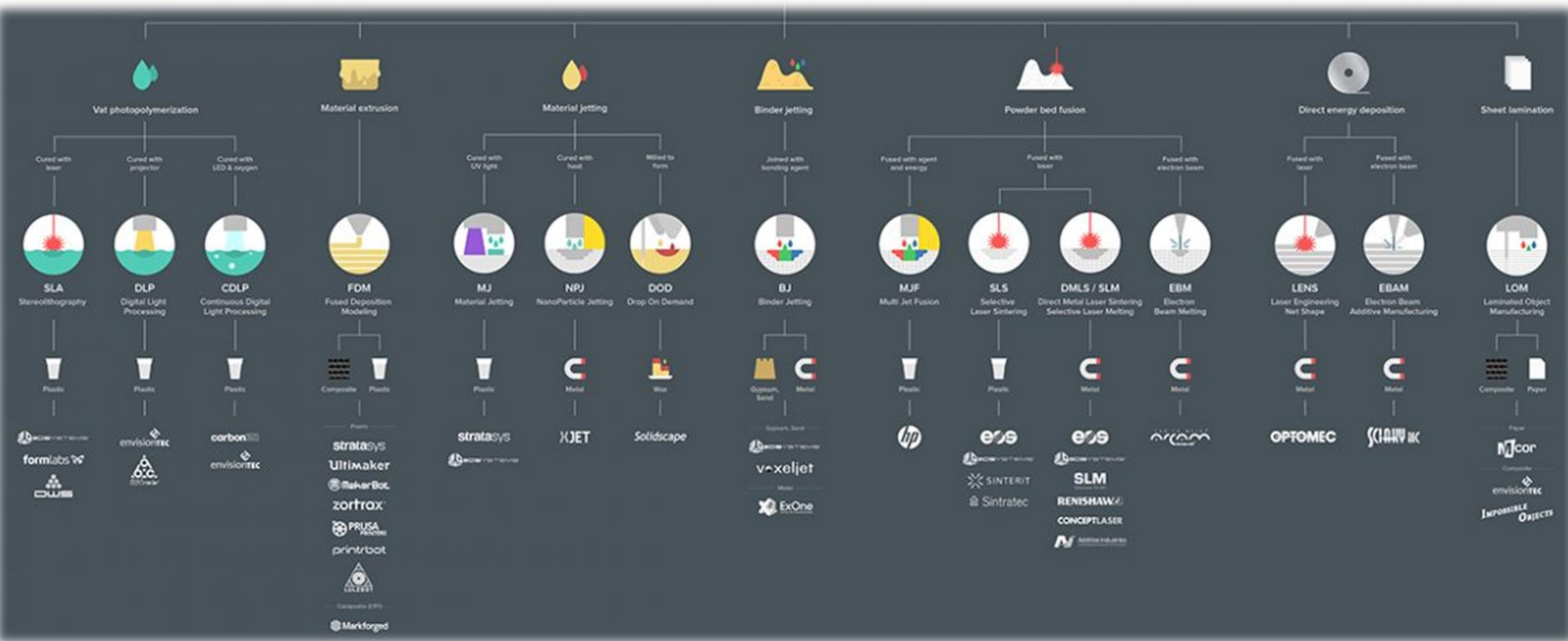




Disadvantages, issues

- Strength of the 3D printed parts, which is usually inferior to the parts built with conventional manufacturing.
- Not suitable for mass production.
- Safety issues in specific technologies.





Additive Manufacturing technologies

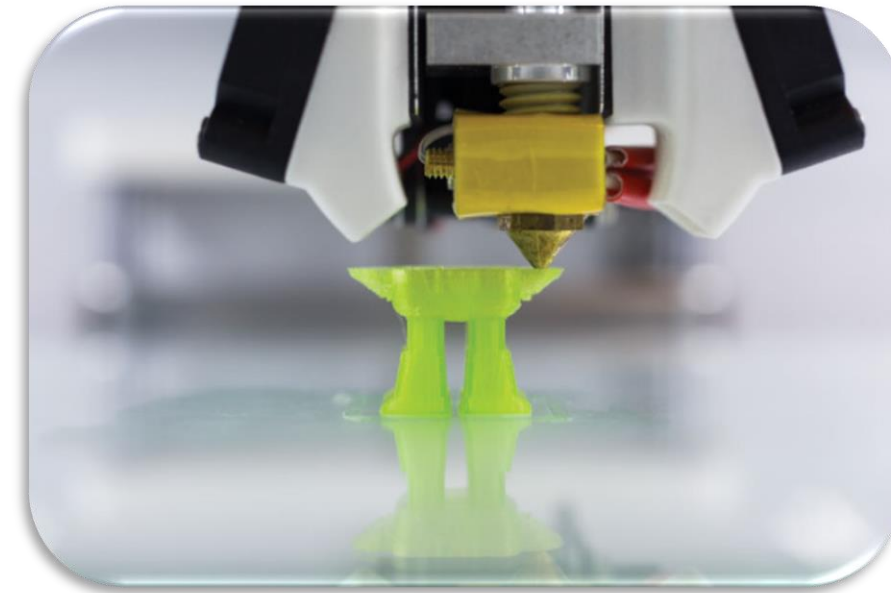


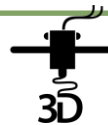
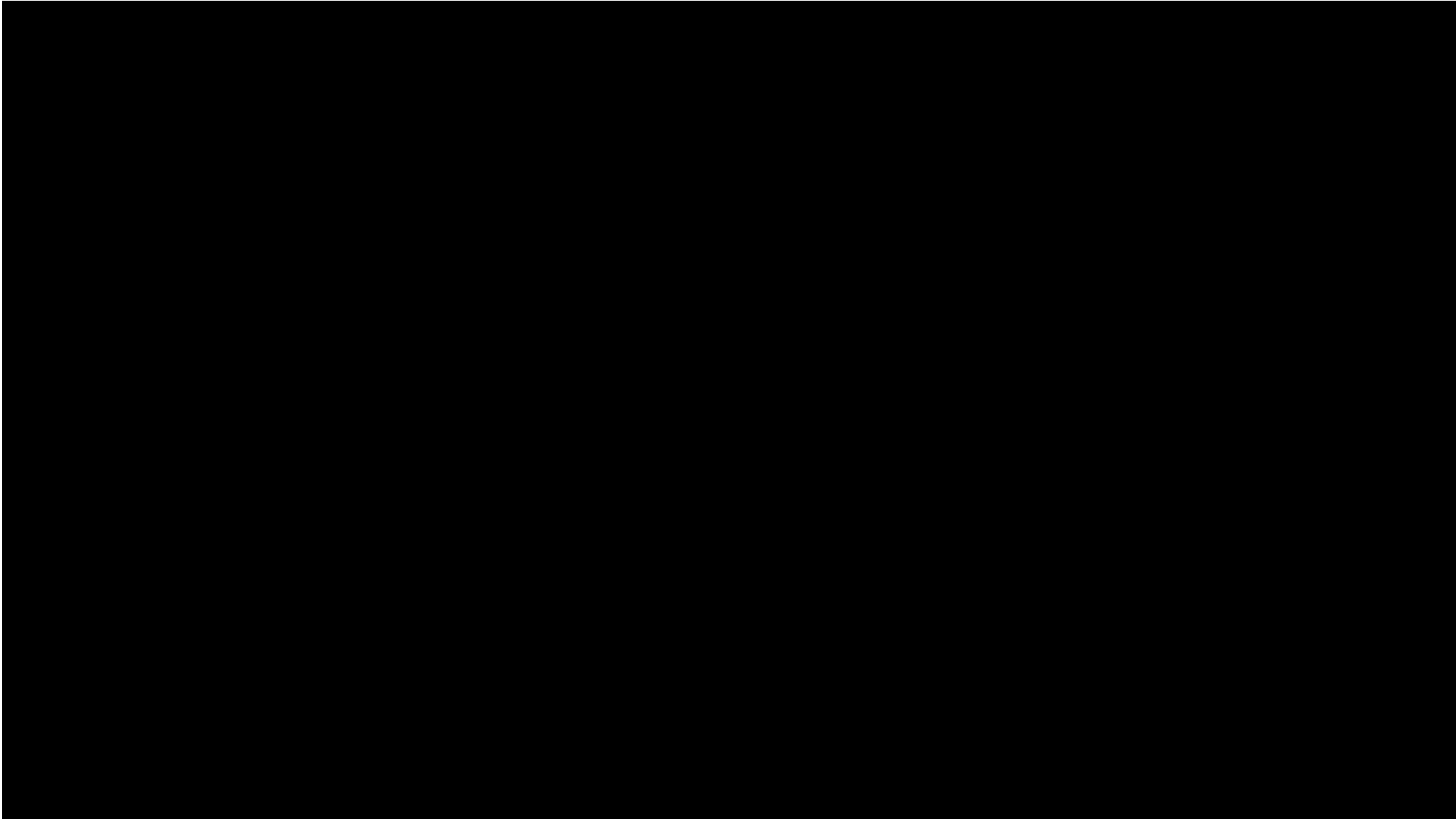


FFF

Fused Filament Fabrication

- Deposition of a heated thermoplastic
- Value for money method
- Average accuracy of 0.1mm



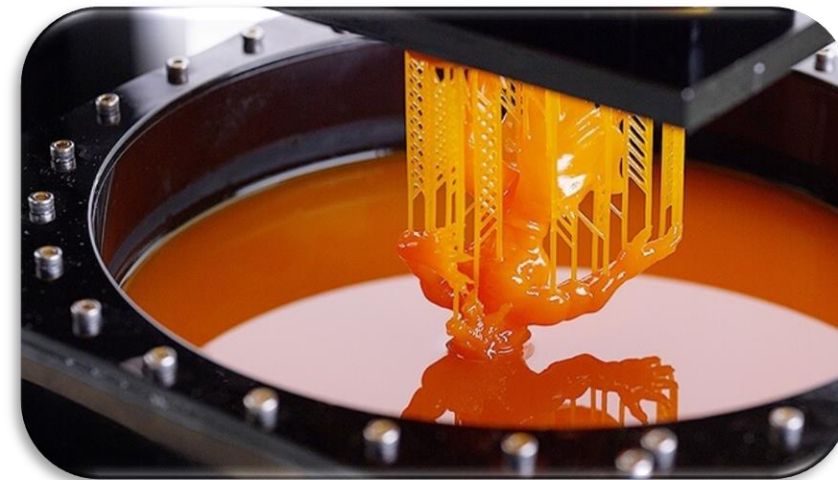


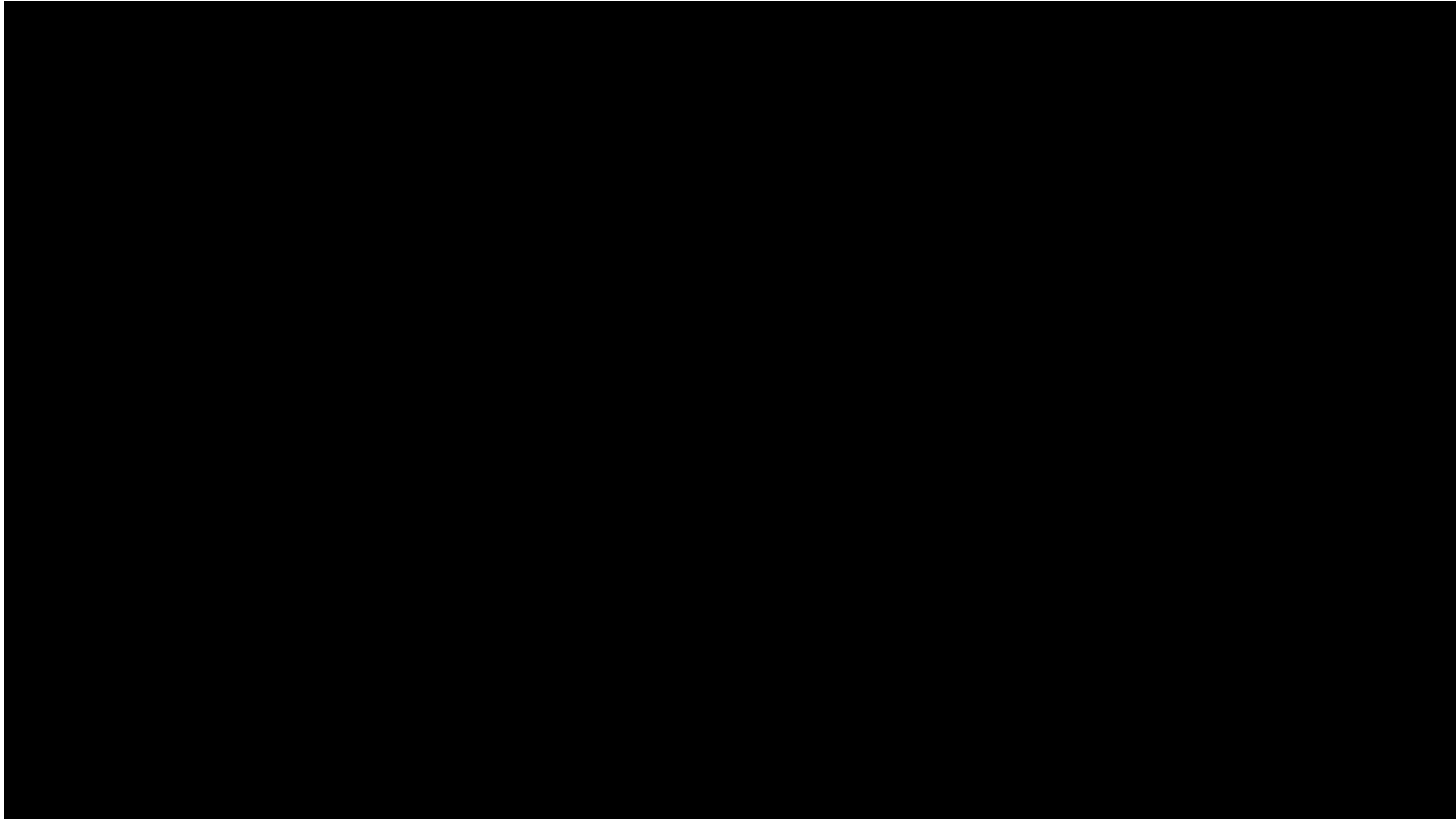


SLA

StereoLithogrAphy

- Photopolymerization method
- SLA, DLP, LCD
- Accuracy of 0.05mm



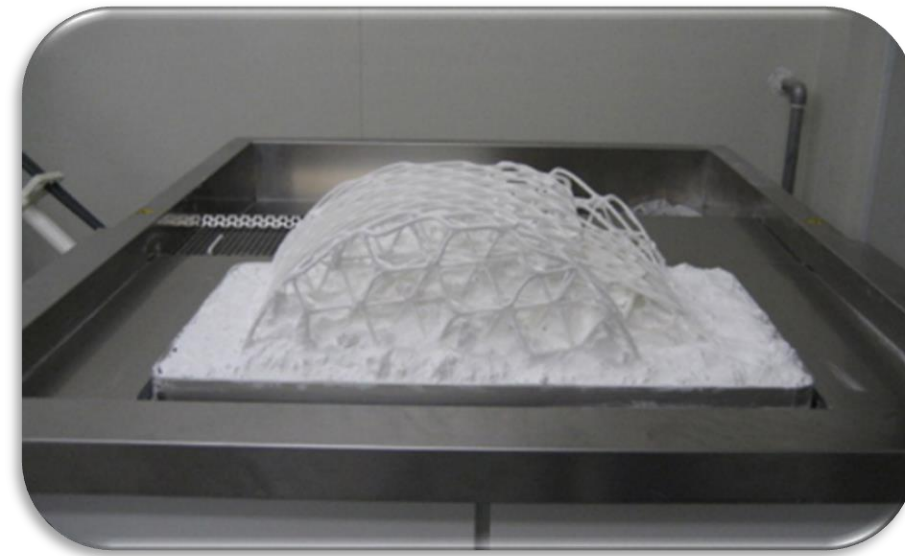


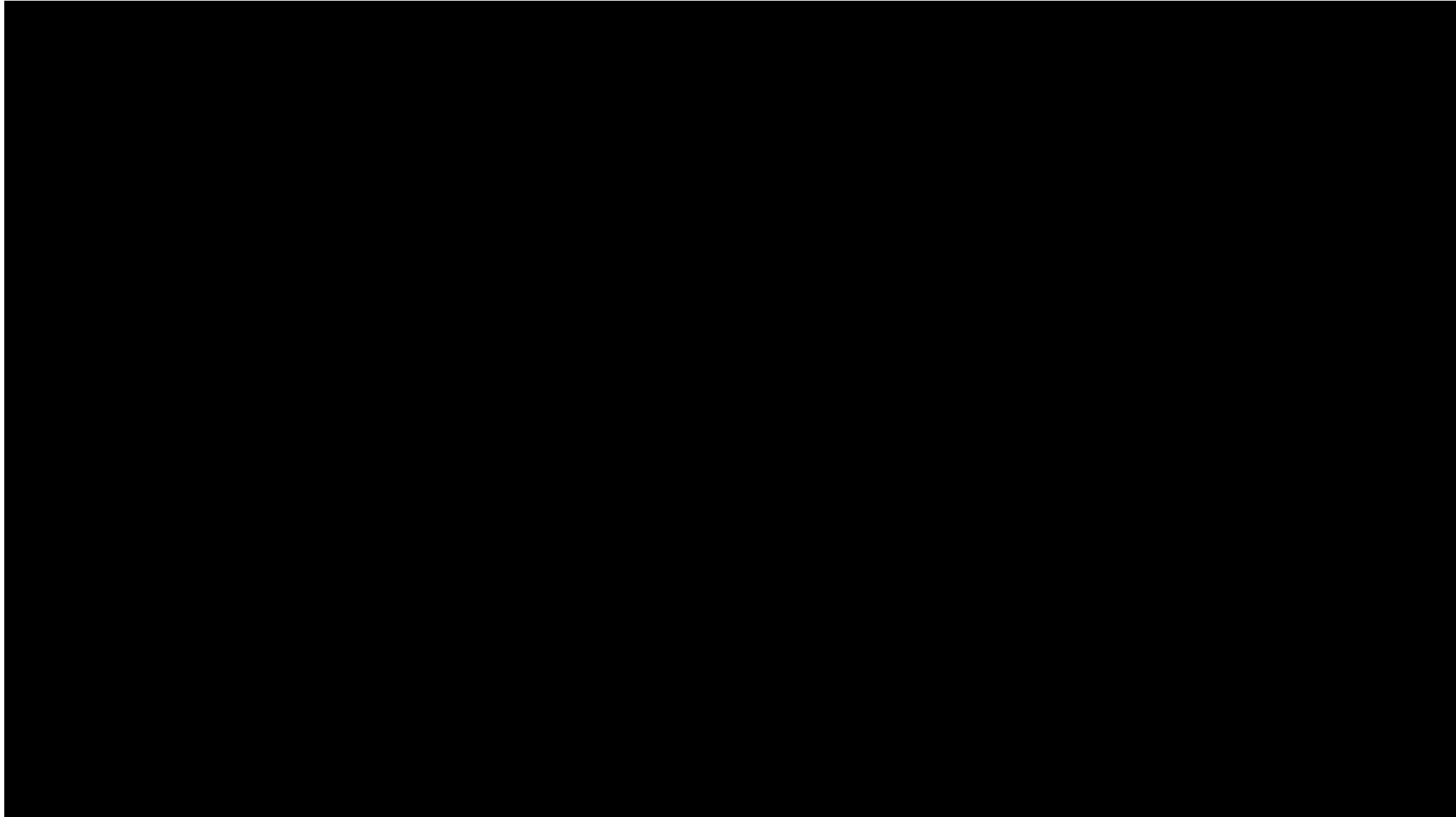


SLS

Selective Laser Sintering

- Powders sintering through the use of Laser



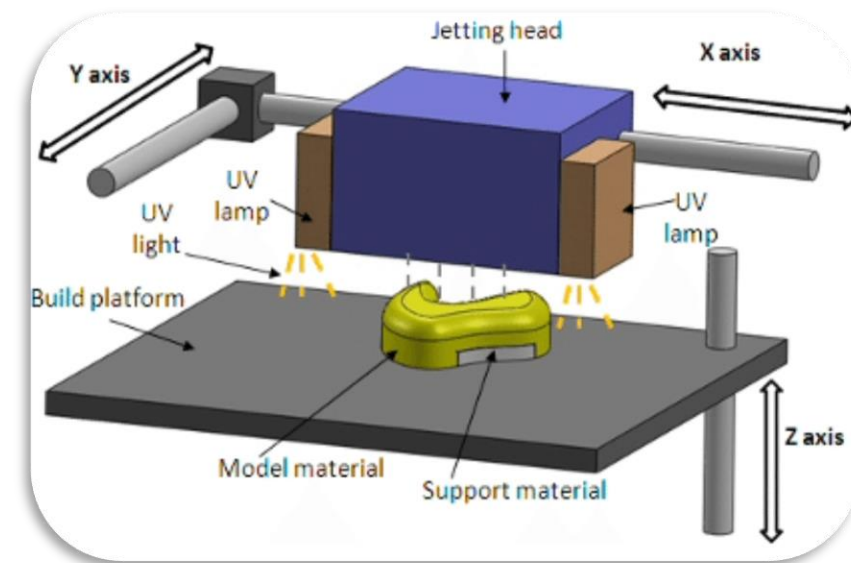


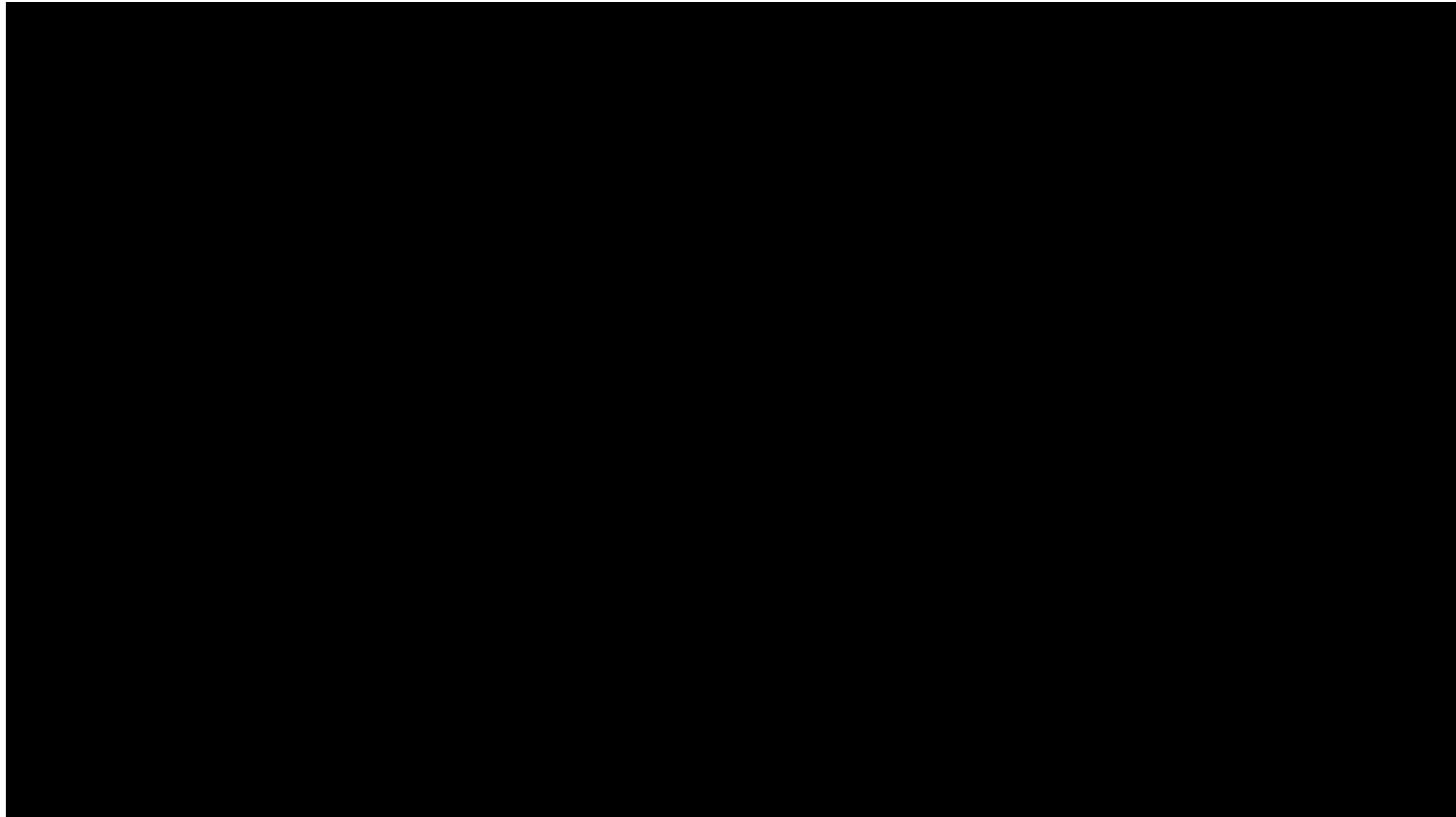


MJ

Material Jetting

- Materials depositing and photopolymerization
- Usually for wax molds creation





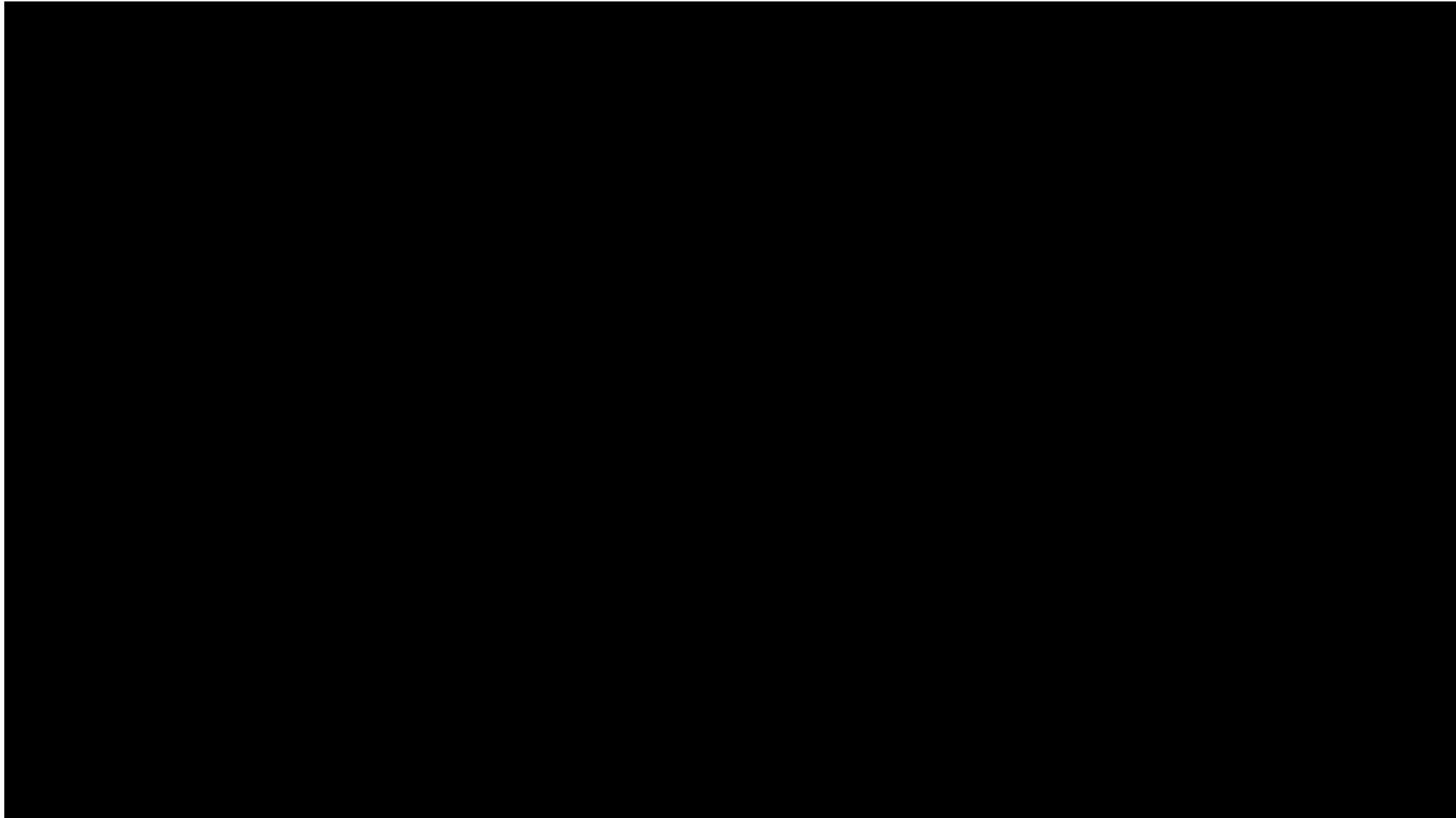


CJP

Color Jet Printing

- Selective depositing or spaying
- Limited number of materials
- High operational cost







MJF MultiJet Fusion

- Powder Bed technology
- Colored parts fabrication
- End-use Products





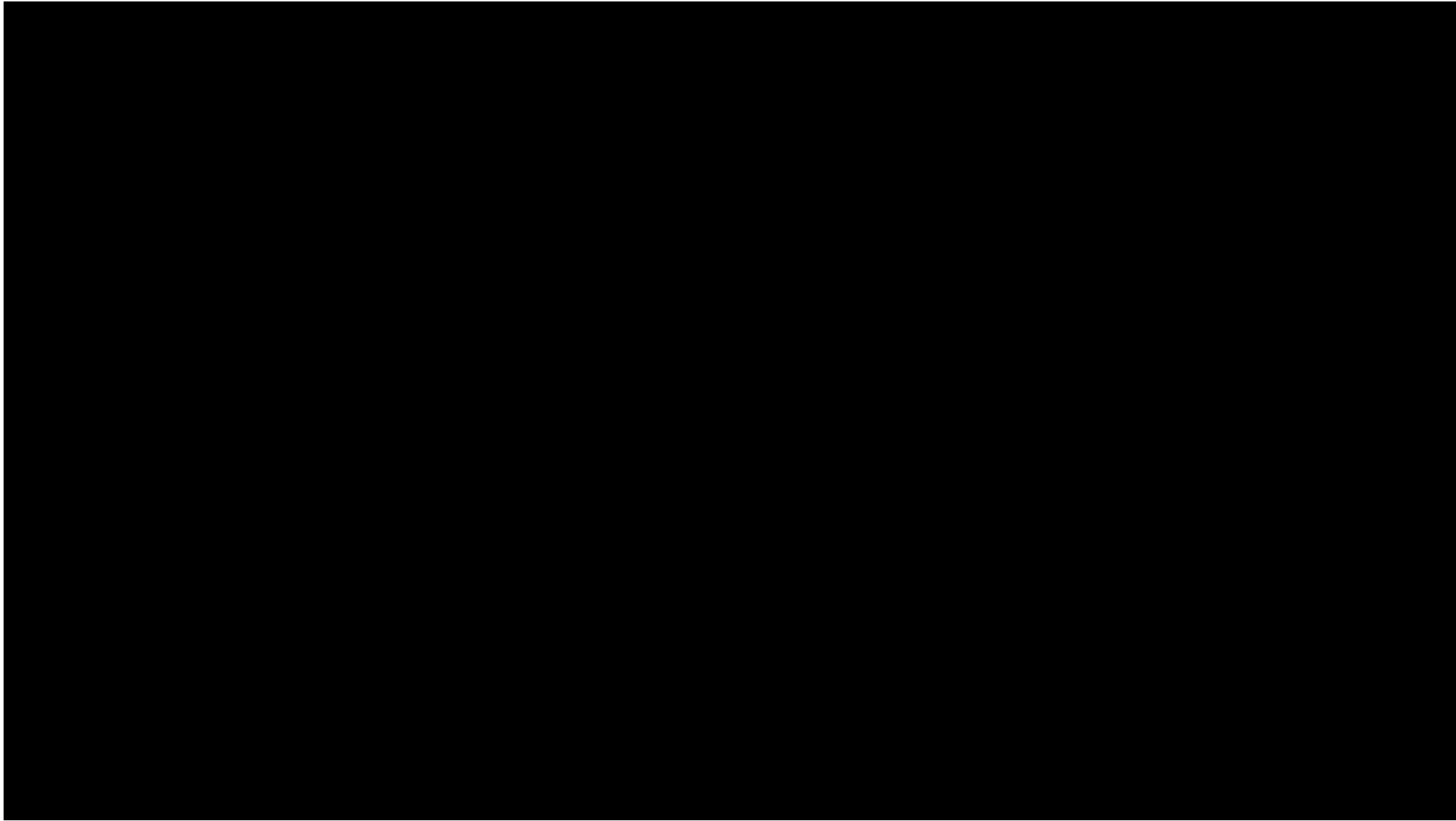


DMLS

Direct Metal Laser Sintering

- Powder Bed technology
- Metal parts in powder form
- Industrial use
- High operational cost







LOM

Laminated Object Manufacturing

- Paper is the raw material, which is ecological and cost-effective
- Laser based method
- It is now considered obsolete





RT Forum für e journal Rapid Technologie

