

COSMICMAKER



MANUFACTURING IN SPACE



How will we
manufacture
in space?



Imagine you're living in space and you need an item manufacturing?

You need new...

contact lenses and you want to increase their magnification

spectacle frames

dental crown

soles for your shoes, but with higher rebound

to replace a broken door handle and design it better,

an electrical connector,

a silicon carbide heat shield panel

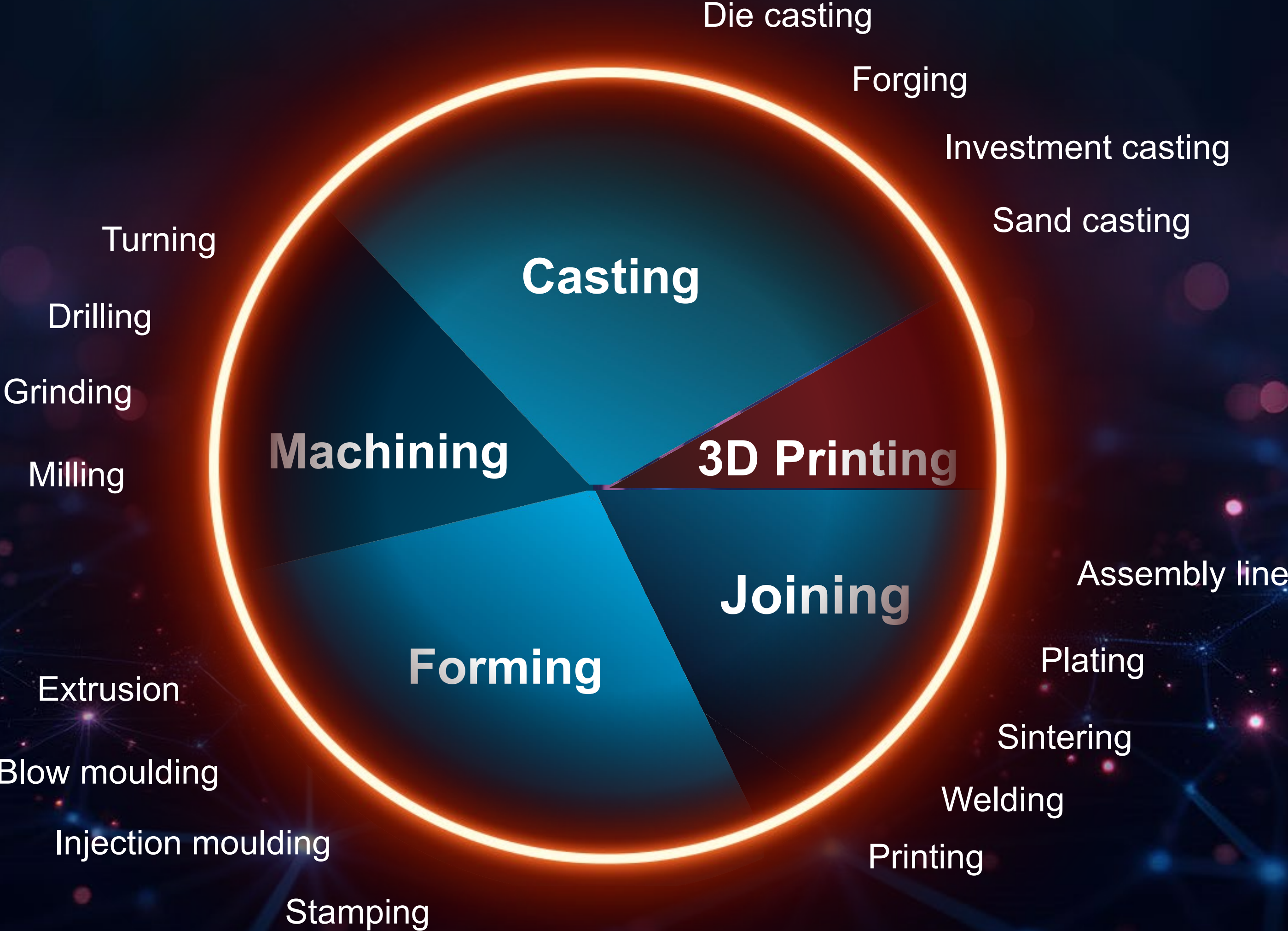
You agree any file modifications and hit 'make' and a few hours later you walk over open a hatch and there they are.

They are all made by one machine, but how does it operate?

How we manufacture on earth

These processes have all been finely optimised over decades to make a lot of items, with lots of waste, to achieve the lowest cost possible.

The slice for **Additive Manufacturing**, seems most suitable to manufacture in space.



If the annual volume of manufactured plastic in the world was a heaped teaspoon of sand then **Additive Manufacturing** would be just *one single grain*.

If you look at it by price it would be *25 grains* which tells you why AM doesn't scale.

These are the ways that AM works; laser melting powder, thermal binder sticking powder, hot plastic extruding or liquid hardening with light.

3D Printing Mechanisms

Powder is problematic in space, liquid resin delivers finer resolution and wider range of properties than thermoplastics, making resin the obvious choice.



Laser
SLA / SLS



Inkjet head
MJF / PBF



Extrusion
FDM / FFF



Light
LCD / DLP / SLA

Material used

Powder

Powder

Filament

Photopolymer

Final part

Metal
Thermoplastics



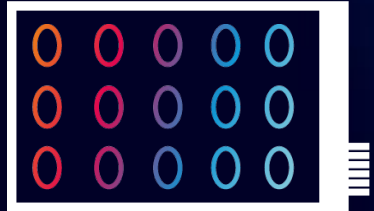
Metal
Thermoplastics

Metal
Thermoplastics

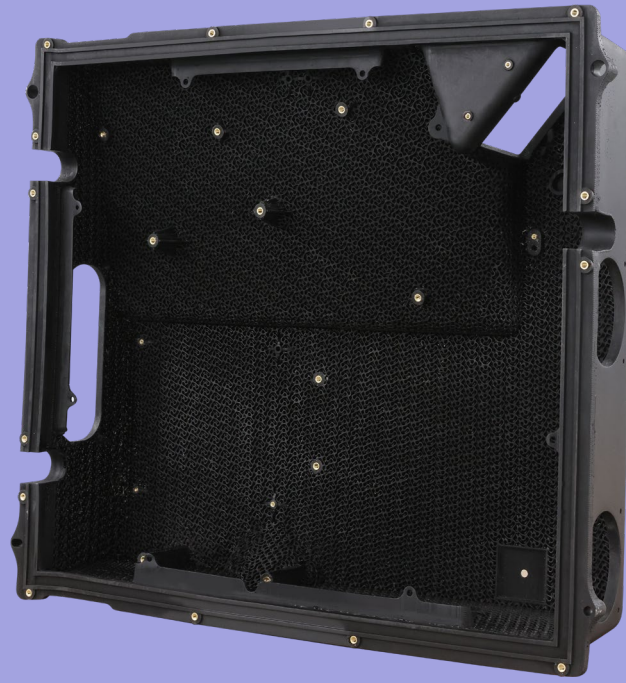
Metal
Ceramic
Thermosets

Methods of 3D resin printing

These are the methods of printing with resin; polymerising with lasers, DLPs or LCDs.
The only one that meets all the criteria for space is LCD, the dominant technology on earth with millions made every year is the right one for space.

	 Laser	 Digital Light Projector	 LCD
Low cost	NO	NO	YES
Low energy	YES	YES	YES
Low weight	NO	NO	YES
Small size	NO	NO	YES
Low heat	NO	YES	YES
Low maintenance	NO	NO	YES
High productivity	NO	NO	YES

CosmicMaker can make



Thermosets

All properties possible-
elastomeric, high temperature,
ESD, high impact etc



Composites

Fibre reinforced
polymer, ceramic
filled etc



Ceramics

Silicon carbide,
Alumina etc



Metals

Stainless steel,
Titanium etc

CosmicMaker is ESA funded.

We tested CosmicMaker in every orientation, including complete 360 degrees contra-rotational movement while printing, it works reliably.

Making everything from plastics to ceramics.



We don't want astronauts to have to become 3D printing technicians.
There is a better way...

An autonomous machine, with gantry moving between CosmicMaker nodes, all carrying out different processes, making different products; one for contact lenses and one for Silicon Carbide heat shields.

The fastest, most reliable LCD printing process integrated into an autonomous machine.

The gantry moves at 5m/sec, carrying out one operation every second.

Near to 100% Overall Equipment Efficiency.

It produces 2 tonnes of plastic a day, but its not the output that's important, it's the reliability.

We have created digital mass manufacturing.

In space, reliability is the criteria we should value the most.

