

# An Overview of Additive Manufacturing

Exploring the 7 Families of 3D Printing Technologies

Elliot SALDUKAITE – July 12th 2023



**"Hands for Ukraine" Project Creates 3D Printed Prostheses for Ukrainian War Amputees**

July 5, 2023

Additive manufacturing has often demonstrated its capabilities in the manufacture of prostheses of all kinds, and has played a big part in helping people in need. With the devastating aftermath of the war in Ukraine, where an estimated 10,000 people...



**The Next Generation of Timepieces: Panerai's 3D Printed Submersible Watch**

July 4, 2023

Advancements within the watchmaking industry continue to captivate enthusiasts, pushing the boundaries of tradition and embracing technological innovations. Panerai, a company with a rich history dating back to 1860, showcased their commitment to embracing change at the recent Salon International...



**The Best STL Files for the 4th of July!**

July 4, 2023

Independence Day, more colloquially known as the Fourth of July, is an American federal holiday commemorating the ratification of the Declaration of Independence on July 4th, 1776. It is celebrated across the country with fireworks, barbecues and more and, of...



**Barilla Has Introduced Spaghetti 3D, a New 3D Printed Spaghetti**

July 4, 2023

For Italians at home and abroad, no pasta is more iconic than spaghetti. Even in the United States, spaghetti is a staple in homes across the country with the long form of the noodles an endless source of inspiration for...



**3D Printing and Intellectual Property: Are the Laws Fit for Purpose?**

July 3, 2023

3D printing, like any other industry, is fraught with intellectual property law considerations at all levels. These range from 3D printing hobbyists who must

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**Top 12 Best 3D Software For Beginners**

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**The Top Low-Cost 3D Scanners on the Market in 2023**

March 16, 2023



**The Top Websites to Download Free STL Files**

March 17, 2020

# Who am I?

## 3Dnatives' Digital/Technical Content Specialist

- The largest international online media platform on 3D printing and its applications
- In-depth analysis of the market
- Over 1 million unique visitors per month
- Currently available in English, French, Spanish, German, Italian
- 3Dnatives offers a variety of services such as a 3D printing price comparison engine, B2B consulting and B2B brand content, event management and much more!

# An Overview of Additive Manufacturing

Exploring the 7 Families of 3D Printing Technologies

- Intro:
  - What Is additive manufacturing (AM)?
  - Why use AM?
  - How is AM different from subtractive manufacturing?
- Process:
  - How does AM work?
- 7 main families:
  - In which forms does AM come in?
- Mastering AM:
  - How to get better at using AM?
- The future of AM:
  - How will AM evolve and adapt?







Introduction

# Defining AM

Additive manufacturing (AM), also known as 3D printing, is a process that creates three-dimensional objects by stacking layers of materials on top of each other, based on a digital design file (3D model).



Introduction

# Advantages of Additive Manufacturing

- Allows for the creation of complex geometries
- Design flexibility
  - Customization & creation of unique parts
  - Doesn't require molds or tooling
- Can eliminate the need for assembly of multiple parts
- Reduces material waste and lead times
- Reduces costs





Introduction

# Additive vs. Subtractive

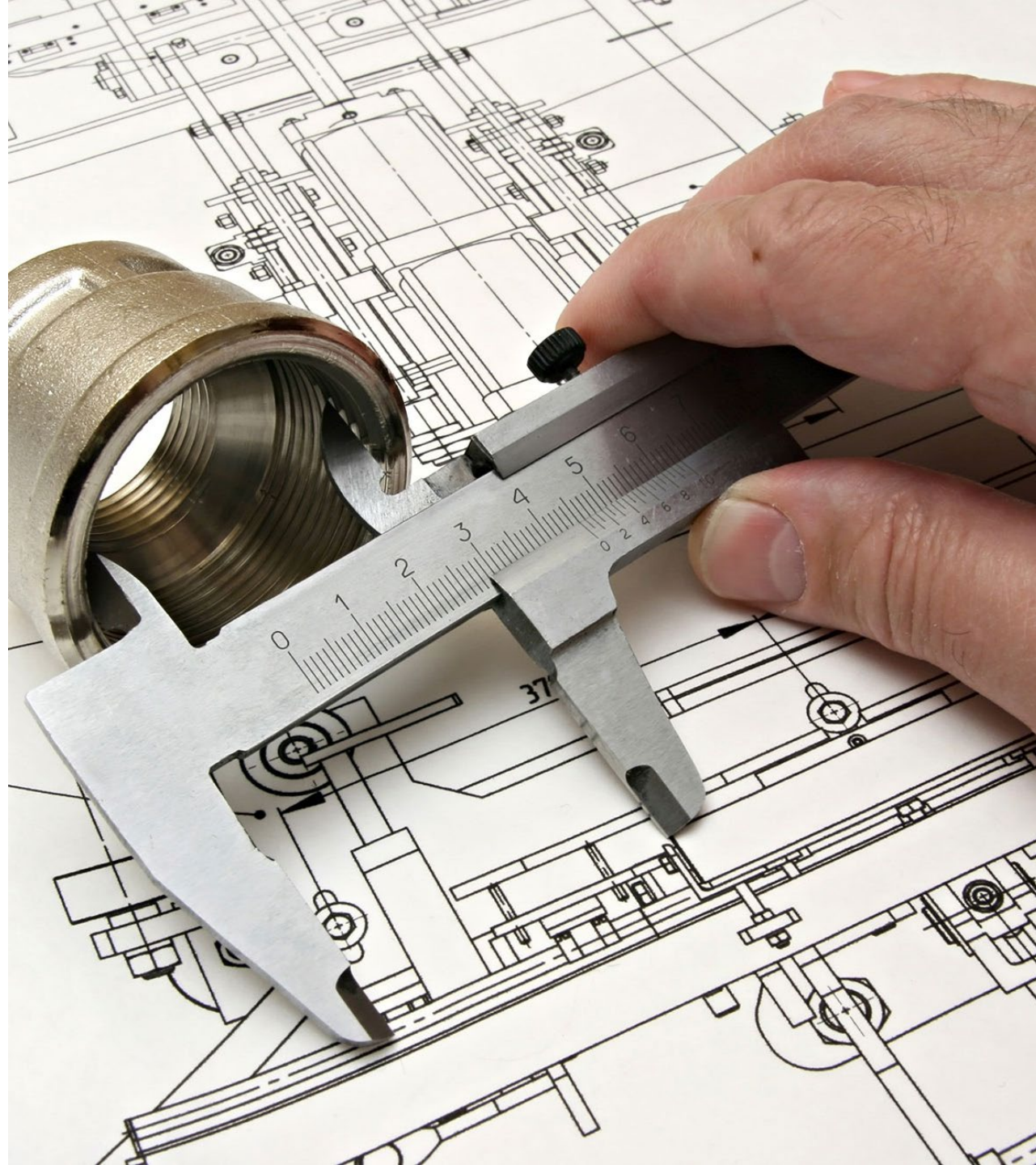
- Subtractive Manufacturing:
  - Removing material from a block or sheet:
    - Generates waste material
    - Limitations: complex shapes and designs
- Additive manufacturing:
  - Builds up material rather than removing it:
    - Can create complex shapes and geometries
    - Uses the exact amount of material
    - Can reduce material waste & save costs



A hand with dark nail polish is holding a yellow sticky note in the bottom right corner. The background is a wall covered with a grid of yellow sticky notes. A white rectangular box is overlaid on the left side of the image, containing text.

# 3D PRINTING PROCESS

4 GENERAL STEPS TO MANUFACTURE  
OBJECTS



## 3D PRINTING PROCESS

# CAD/3D Scanning/Online 3D Model Libraries

- Create a digital 3D model:
  - Computer-aided design (CAD)
  - 3D scanning
  - Online 3D model library
- The model is exported for the 3D printing preparation software (slicer)
  - Most used file formats:  
STL, 3MF and OBJ

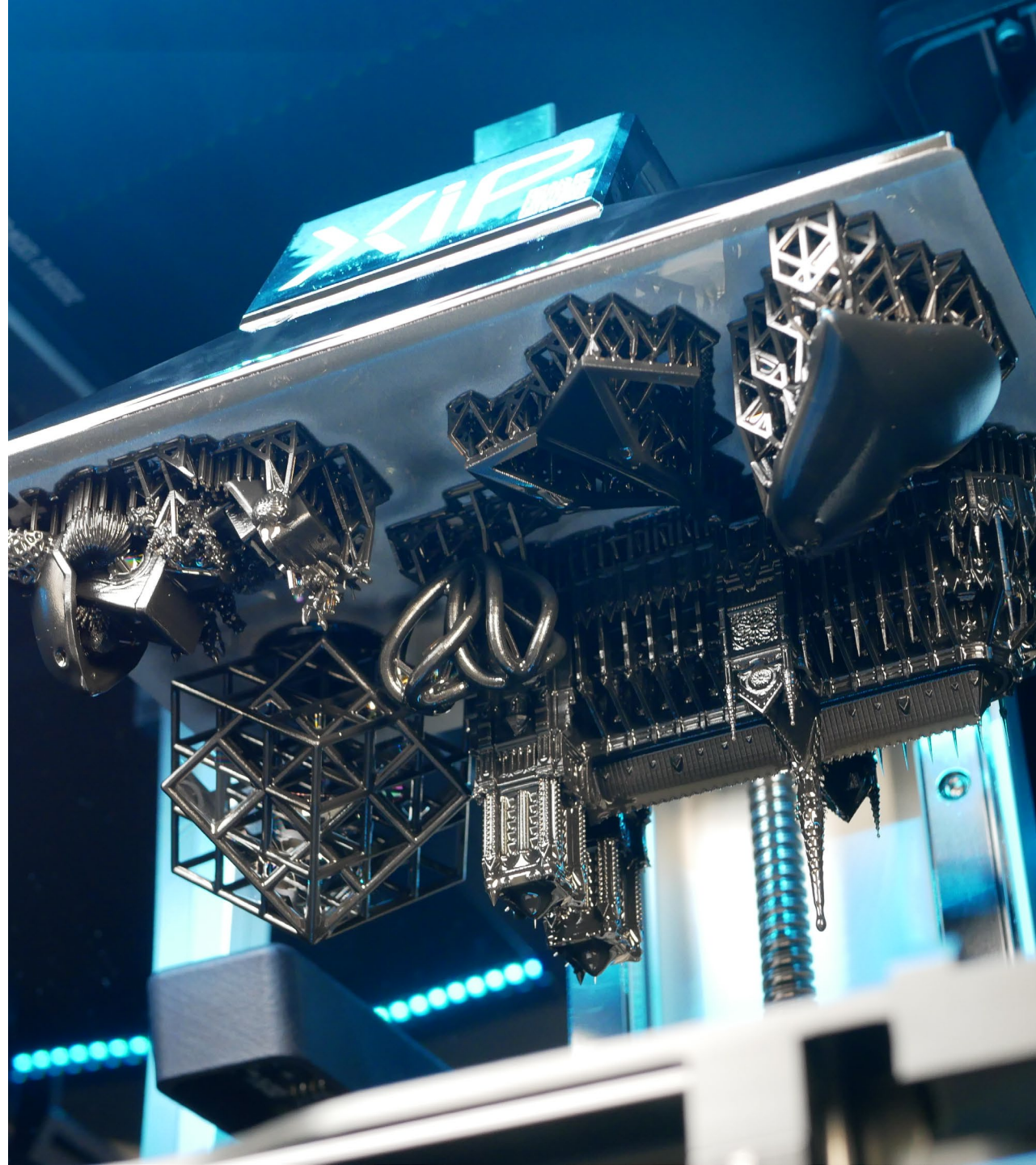


## 3D PRINTING PROCESS

# Slicing

- Slicer: 3D printing software is used to convert the 3D model into a machine-readable code
  - Slices the digital model into thin layers
  - Generates instructions for the 3D printer
    - Based on the parameters specified by the user





## 3D PRINTING PROCESS

# Printing

(Includes Machine Set-Up & Part Removal)

- The 3D printer builds the object layer by layer according to the instructions generated by the software
  - It deposits, cures, melts, sinters or binds material (plastic, metal, ceramics, ...) onto the build platform, into a vat of resin or on a bed of powder



## 3D PRINTING PROCESS

# Post-Processing

(Assembly may be required before final use)

- Not always mandatory (depends on the technology and desired finish)
- Enables to achieve the desired finish or functionality
- Can include
  - Cleaning
  - Removing support structure
  - Sanding
  - Polishing
  - Painting, ...





# The 7 Main Families of Additive Manufacturing

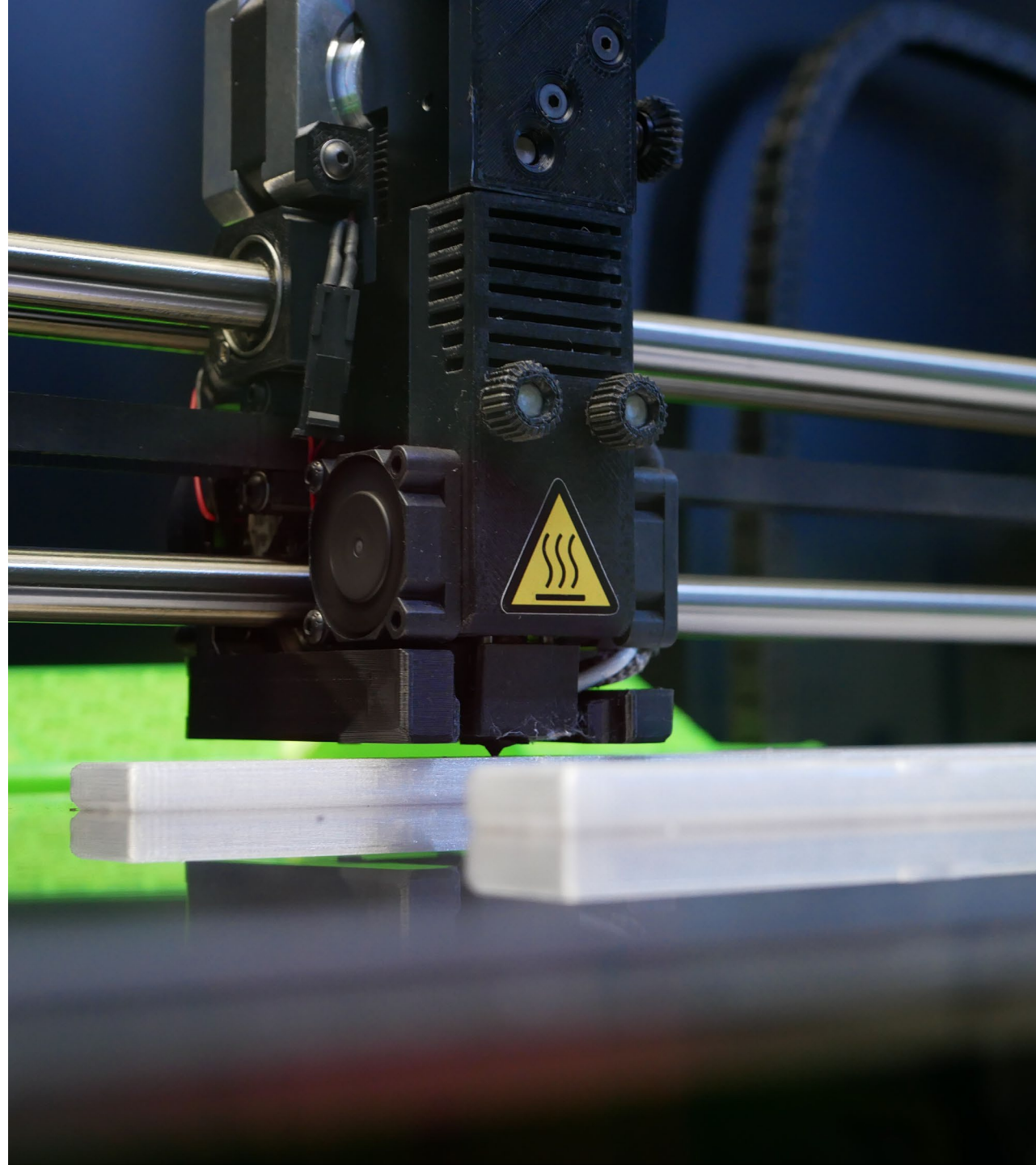
A GENERAL CLASSIFICATION OF THE TECHNOLOGIES AVAILABLE



The 7 Main Families of AM

# Material Extrusion

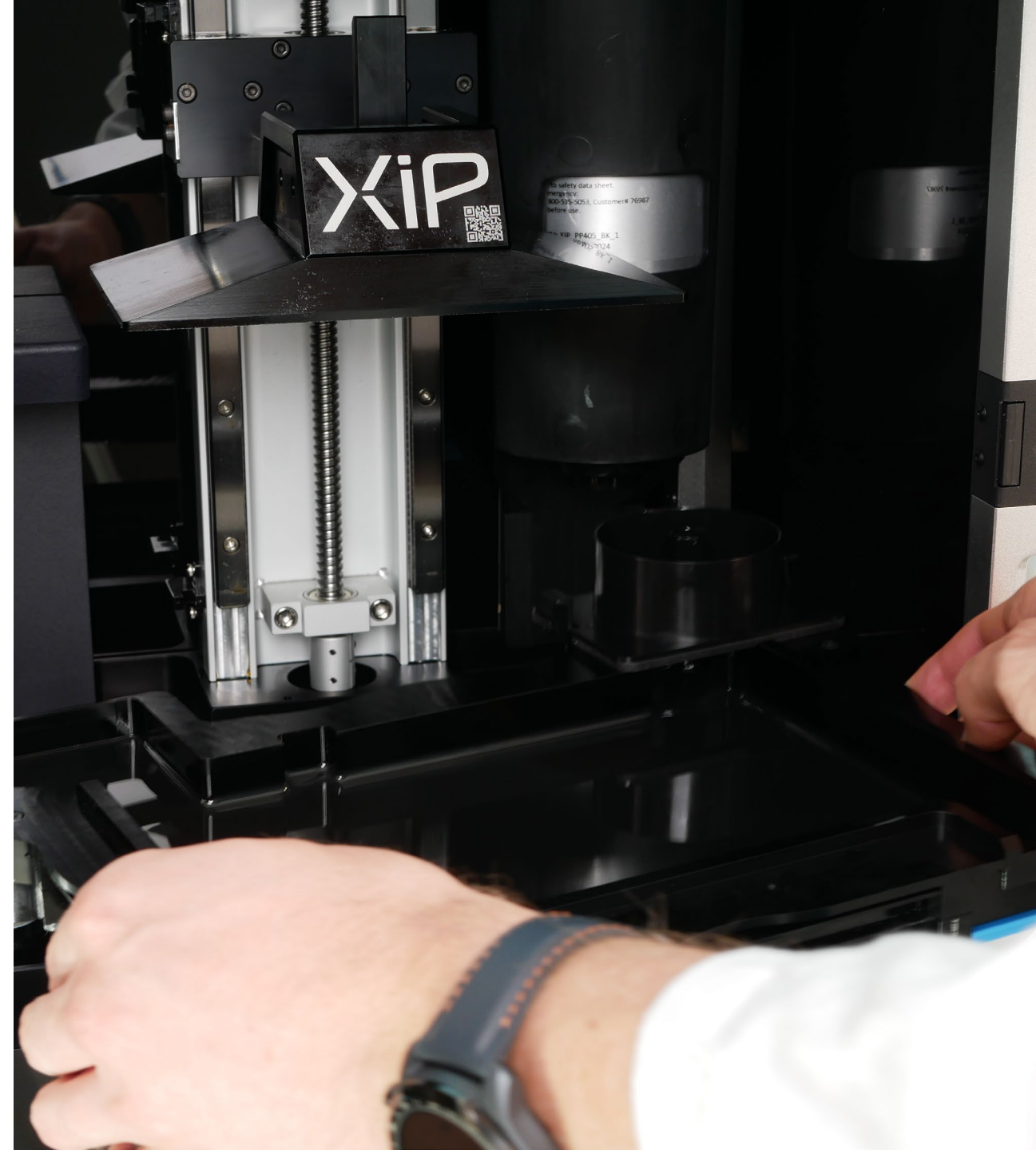
- Applications: prototyping, production parts, jigs and fixtures, molds and tooling
- Industries: automotive, aerospace, medical, consumer goods
- Most common technology: FDM/FFF



The 7 Main Families of AM

# Vat Photo-polymerization

- Applications: prototyping, dental models, jewelry
- Industries: dental, jewelry, medical
- Most common technologies:
  - SLA
  - DLP
  - MSLA

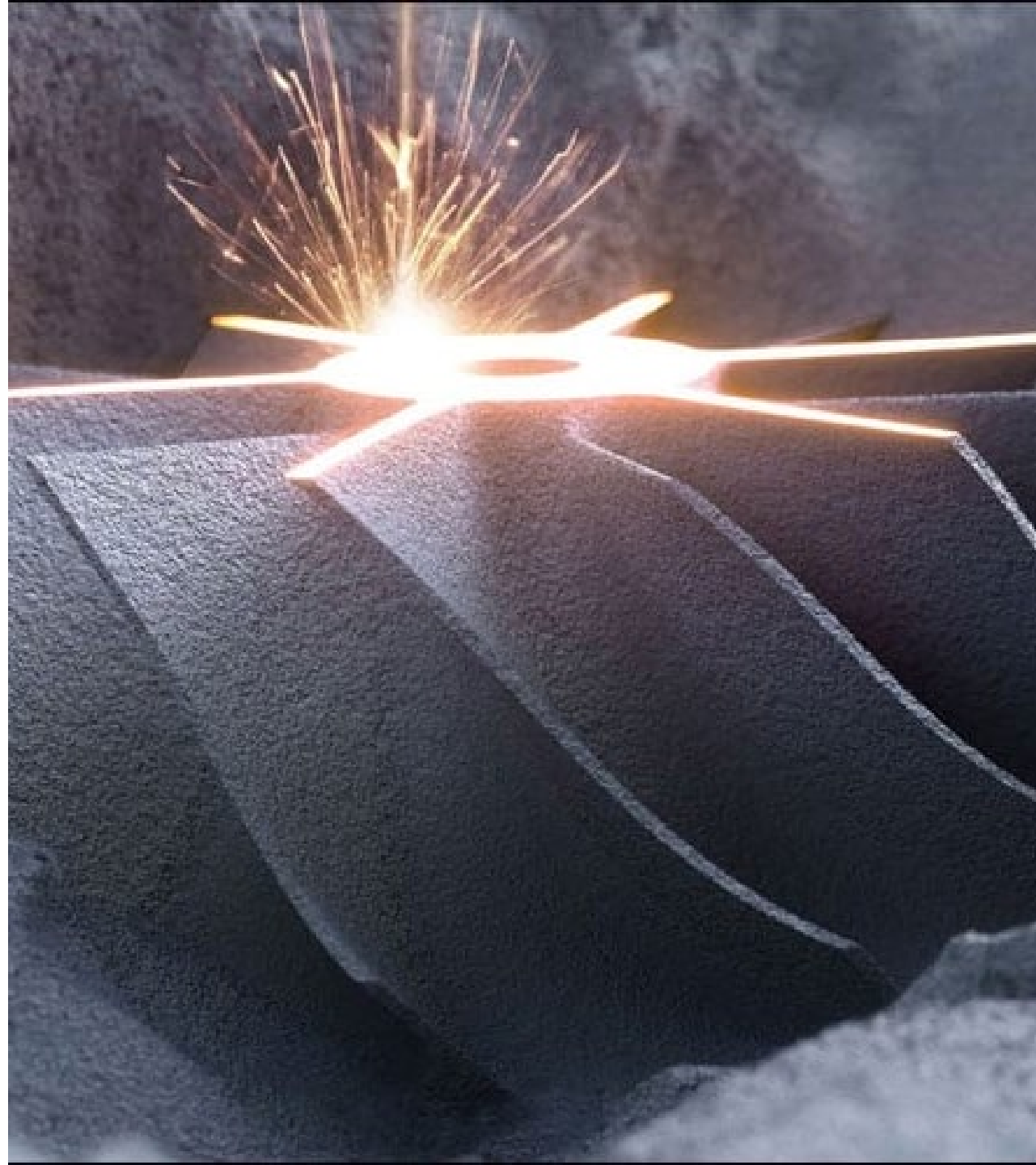




The 7 Main Families of AM

# Powder Bed Fusion

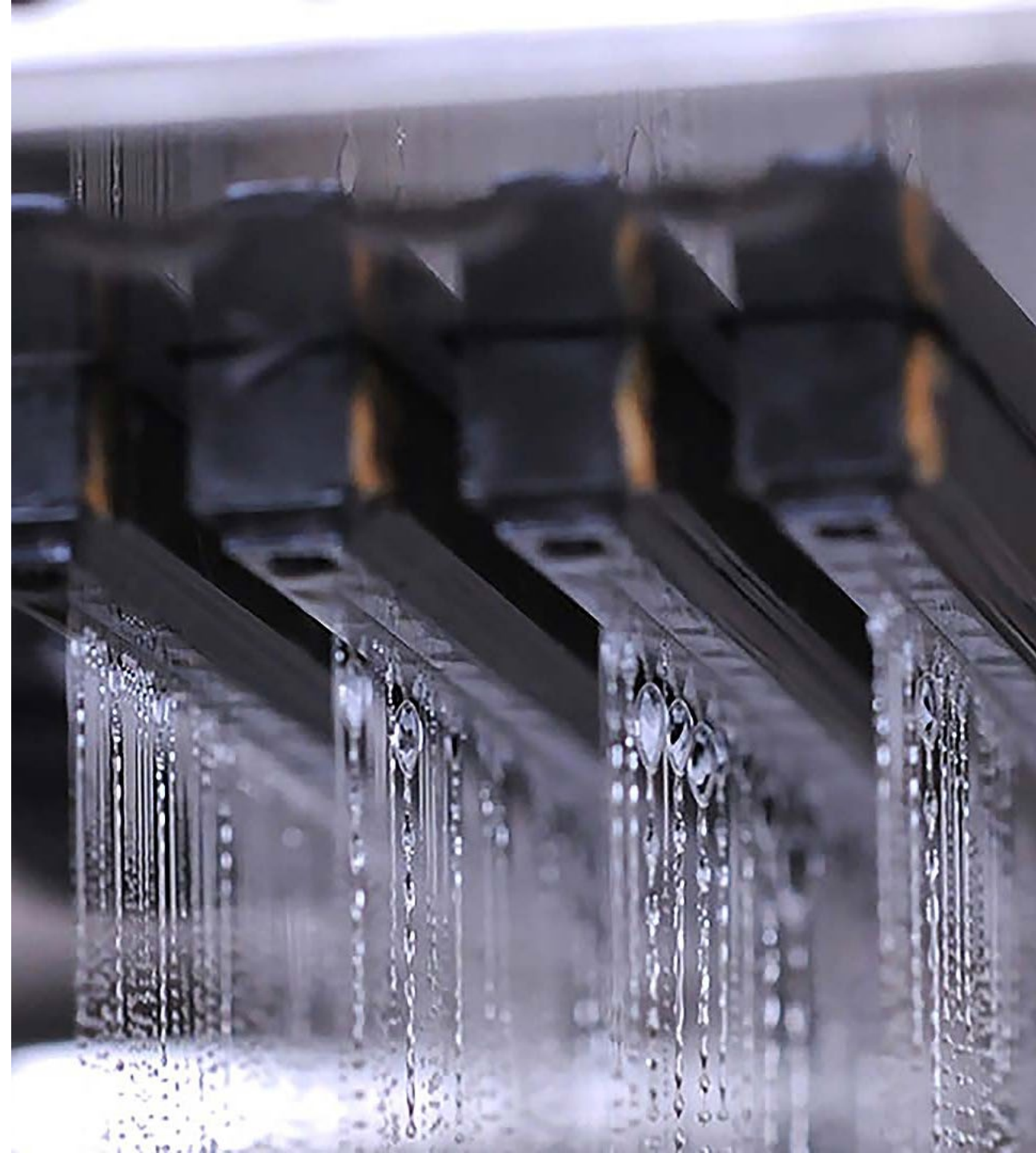
- Applications: prototyping, production parts, aerospace components, dental prosthetics
- Industries: aerospace, medical, dental, automotive
- Most common technologies:
  - Polymer:
    - Selective Laser Sintering (SLS)
  - Metal:
    - Direct Metal Laser Sintering (DMLS)
    - Electron Beam Melting (EBM)



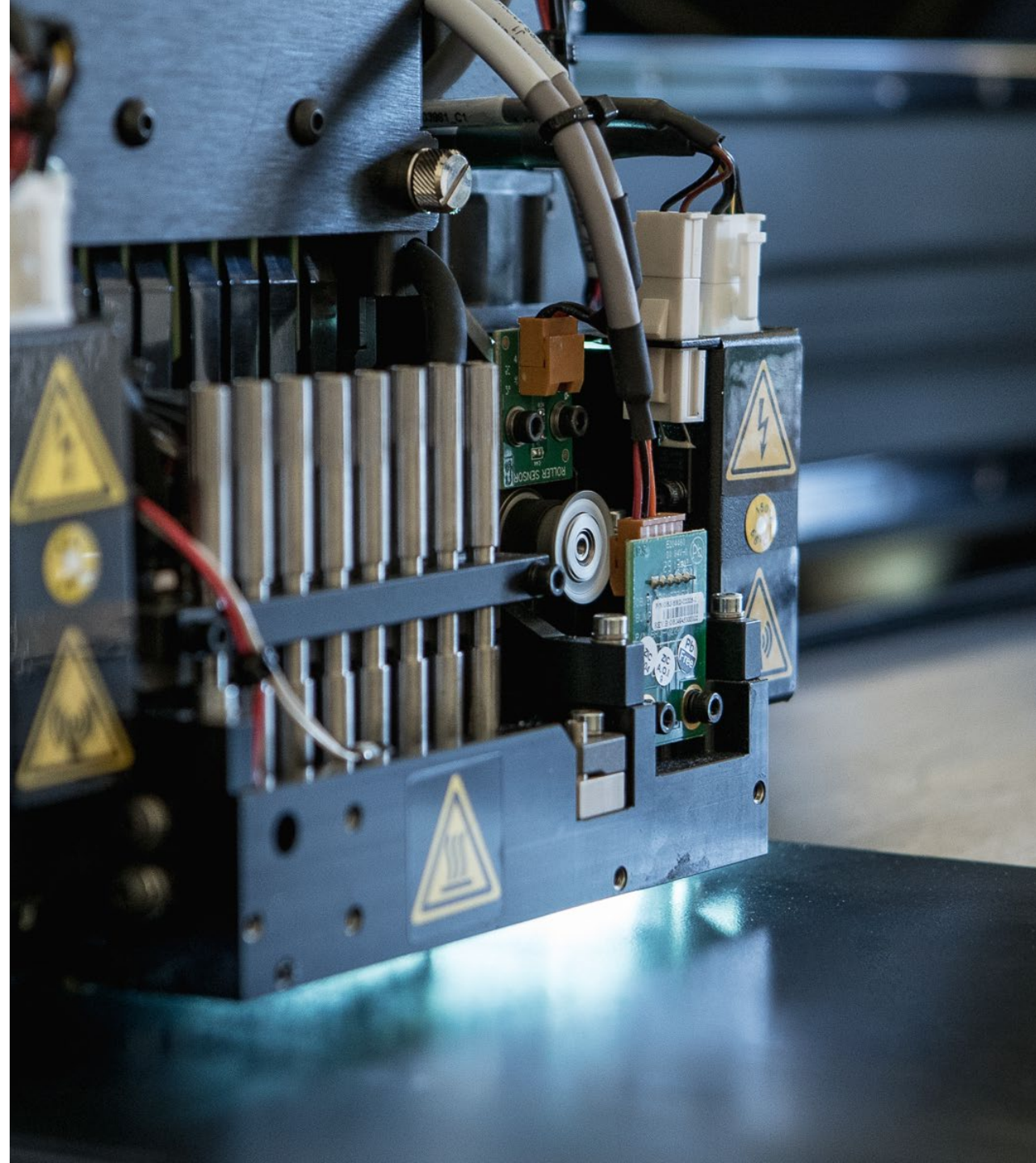
The 7 Main Families of AM

# Binder Jetting

- Applications: prototyping, small parts, jewelry
- Industries: jewelry, consumer goods
- Most used materials:
  - Sand
  - Metals
  - Ceramics







The 7 Main Families of AM

# Material Jetting

- Applications: prototyping, small parts with high resolution and accuracy, dental models
- Industries: dental, medical, consumer goods
- Most common technologies:
  - Polyjet
  - MultiJet Printing (MJP)

The 7 Main Families of AM

# Directed Energy Deposition

- Applications: repair, modification, adding features to existing parts
- Industries: aerospace, defense, automotive
- Most common technologies:
  - Electron Beam Additive Manufacturing (EBAM)
  - Laser Engineered Net Shaping (LENS)
  - Wire Arc (ex: Wire Arc Additive Manufacturing)







The 7 Main Families of AM

# Sheet Lamination

- Applications: prototyping, architectural models, packaging
- Industries: architecture, packaging, consumer goods
- Most common technology: Laminated Object Manufacturing (LOM)



# Mastering Additive Manufacturing

HOW TO SHARPEN YOUR SKILLSET AND  
ENSURE BETTER, REPLICABLE PARTS





Mastering AM

## Main parameters and factors affecting quality and performance of 3D printed parts

- Layer height and thickness
- Print speed and temperature
- Material type and properties
- Part orientation and support structures
- Post-processing and finishing techniques

Mastering AM

## Tips and best practices for choosing and using 3D printing technologies

- Determine the intended use and requirements of the part
- Research and compare the material compatibility of each 3D printing technology
- Consider the cost and availability of materials and equipment
- Test and optimize print settings and parameters

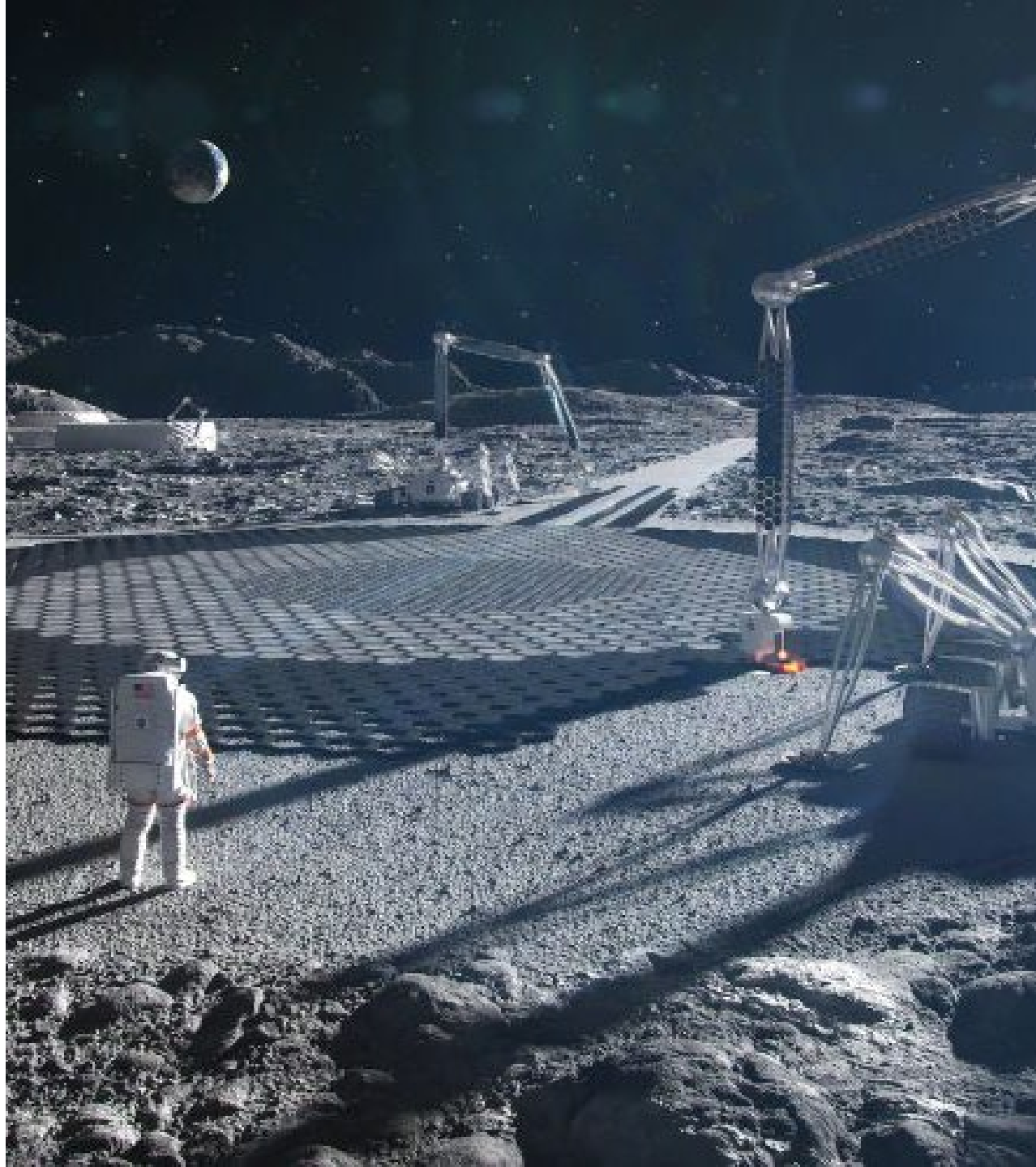




A hand holding a glass sphere against a sunset background. The sphere reflects the sunset and the hand holding it. The background is a blurred sunset over a body of water.

# The Future of Additive Manufacturing

A REFLECTION ON THE EVOLUTION OF AM AND ITS IMPACT



The Future of Additive Manufacturing

## Current trends and developments in AM research and innovation

- Bioprinting and tissue engineering
- Large-scale and high-speed printing
- Hybrid and multi-material printing
- Sustainability and circular economy
- Outer space manufacturing

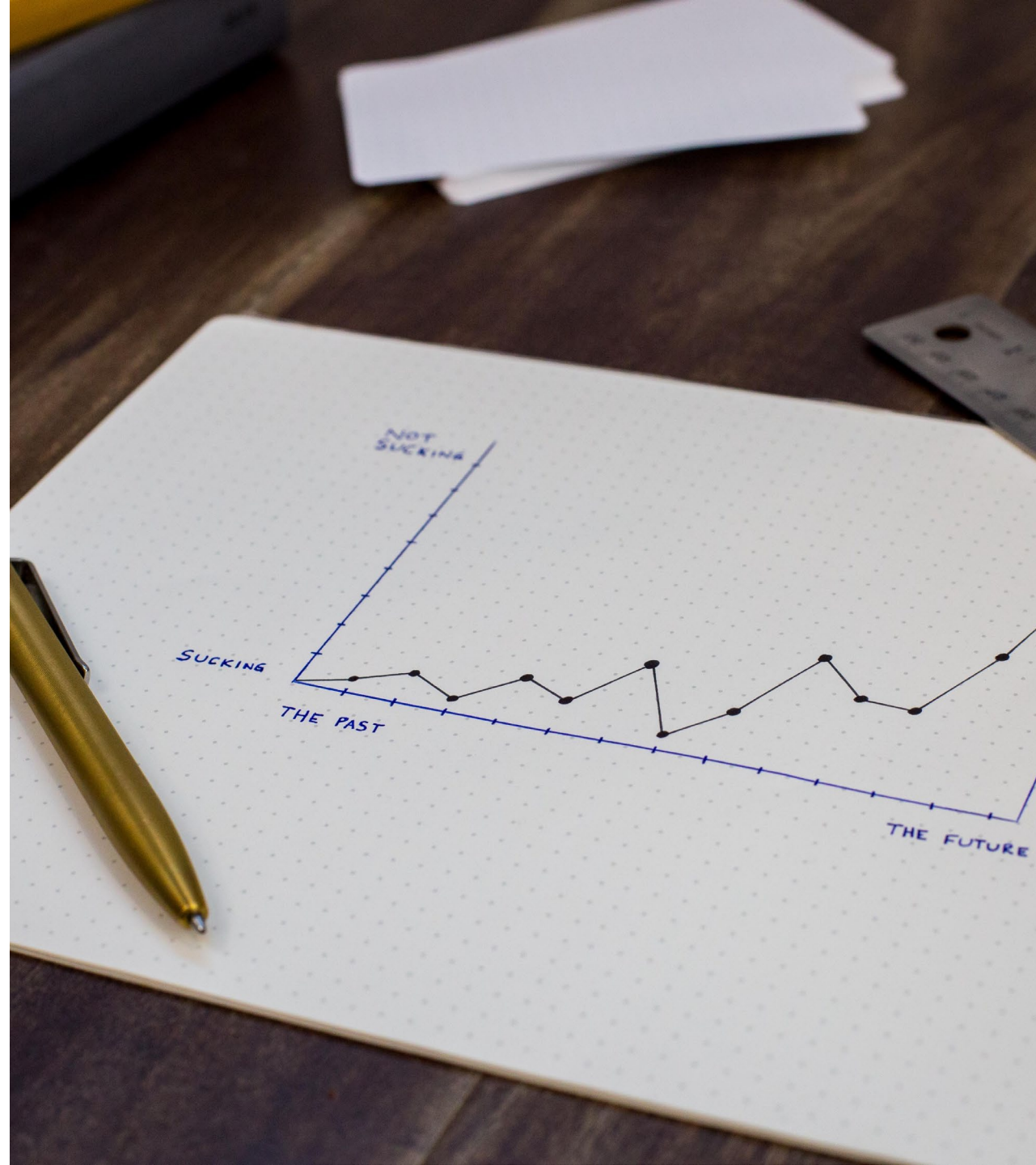


The Future of Additive Manufacturing

## Potential impacts and opportunities for society and the environment

- Reduced waste and emissions
- Localized and decentralized production
- Increased access to customized products and services
- Improved healthcare and medical treatments



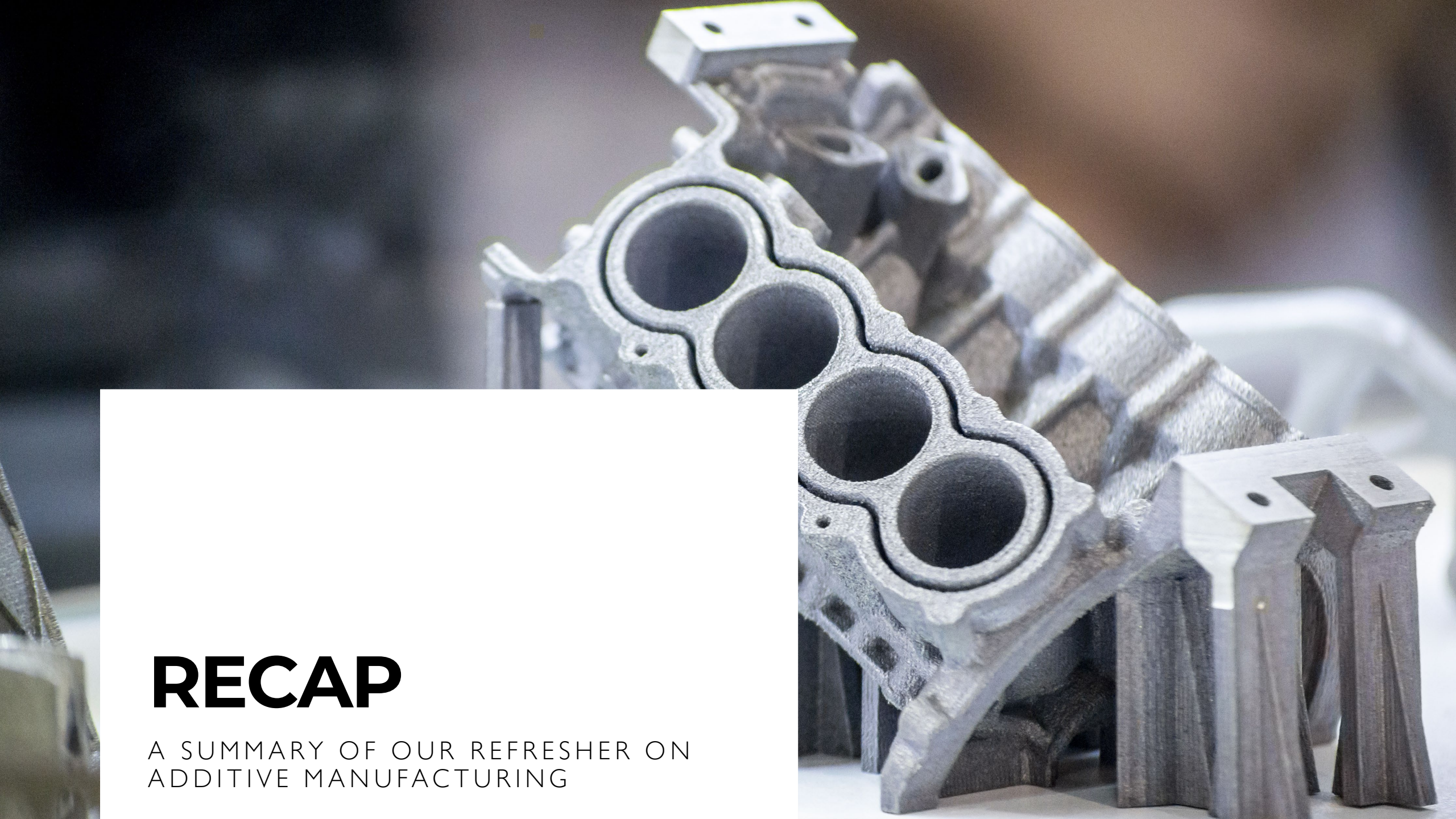


The Future of Additive Manufacturing

## Challenges and limitations to overcome for AM to become more widespread and accessible

- Cost and scalability of materials and equipment
- Lack of standardization and certification
- Intellectual property and regulatory issues
- Technological and skills gaps





# RECAP

A SUMMARY OF OUR REFRESHER ON  
ADDITIVE MANUFACTURING



Recap

# Additive Manufacturing and its benefits

- Definition and principles of AM
- Advantages over traditional manufacturing methods
- Potential for innovation and creativity





Recap

# The 3D printing process & the 7 main AM families

- A general process consisting of four steps
  - CAD or 3D Scanning
  - Slicing
  - Printing
  - Post-Processing
- 7 AM families
  - Material Extrusion
  - Vat Photopolymerization
  - Powder Bed Fusion
  - Binder Jetting
  - Material Jetting
  - Directed Energy Deposition
  - Sheet Lamination





Recap

# Applications and industries of 3D printing

- Aerospace
- Automotive
- Healthcare
- Jewelry
- Medical
- Construction...



# THANKS / Q&A SESSION

Thanks for taking part in this technical refresher all about AM



- [What Is Additive Manufacturing? - 3Dnatives](#)
- [3D Printing Materials Guide: Plastics - 3Dnatives](#)
- [3D Printing Technologies - 3Dnatives](#)
- [Additive and Subtractive Manufacturing: Complementary or Rivals? - 3Dnatives](#)
- [PBF vs. DED: Which Metal 3D Printing Process Should You Choose? - 3Dnatives](#)
- [Resins vs Powders: Which Material Family Should You Choose for 3D Printing?](#)
- [SLA vs DLP: Which Resin 3D Printing Process Should You Choose? - 3Dnatives](#)
- [Material Jetting vs. Binder Jetting: Which Jetting Process Should You Choose? - 3Dnatives](#)
- [PEEK vs PEKK: Which High Performance Material Should You Choose? - 3Dnatives](#)
- [Support Structures in 3D Printing: All You Need to Know - 3Dnatives](#)
- [STL vs. 3MF: Which Format to Choose for a 3D Model? - 3Dnatives](#)

Additional Resources

**Curated content to  
refresh or extend  
your knowledge on  
AM**



Additional Resources

# 3D Explained video series

- A series of scientific vulgarization videos aimed to help better grasp AM knowledge

