

**NATIONAL  
CENTRE**  
ADDITIVE  
MANUFACTURING

**mtc**  
Manufacturing  
Technology Centre

# How is Additive Manufacturing evolving?

**PA**  
PRECISION ACOUSTICS

 CIRCLE  
2 SUCCESS

BETTER CONNECTED. BETTER INFORMED

16-02-2022

# Your Speakers



**Sylvain Briand**

SW Regional Manager  
Manufacturing Support Services  
MTC



**Dr Farhan Khan**

Senior Research Engineer  
National Centre for Additive Manufacturing  
MTC



**Megan Jenkinson-Garner**

Research Physicist  
Precision Acoustics Ltd

# **The Evolution of Additive Manufacturing**

**Dr Farhan Khan**

Senior Research Engineer  
National Centre for Additive Manufacturing  
MTC

**WHO WE ARE**

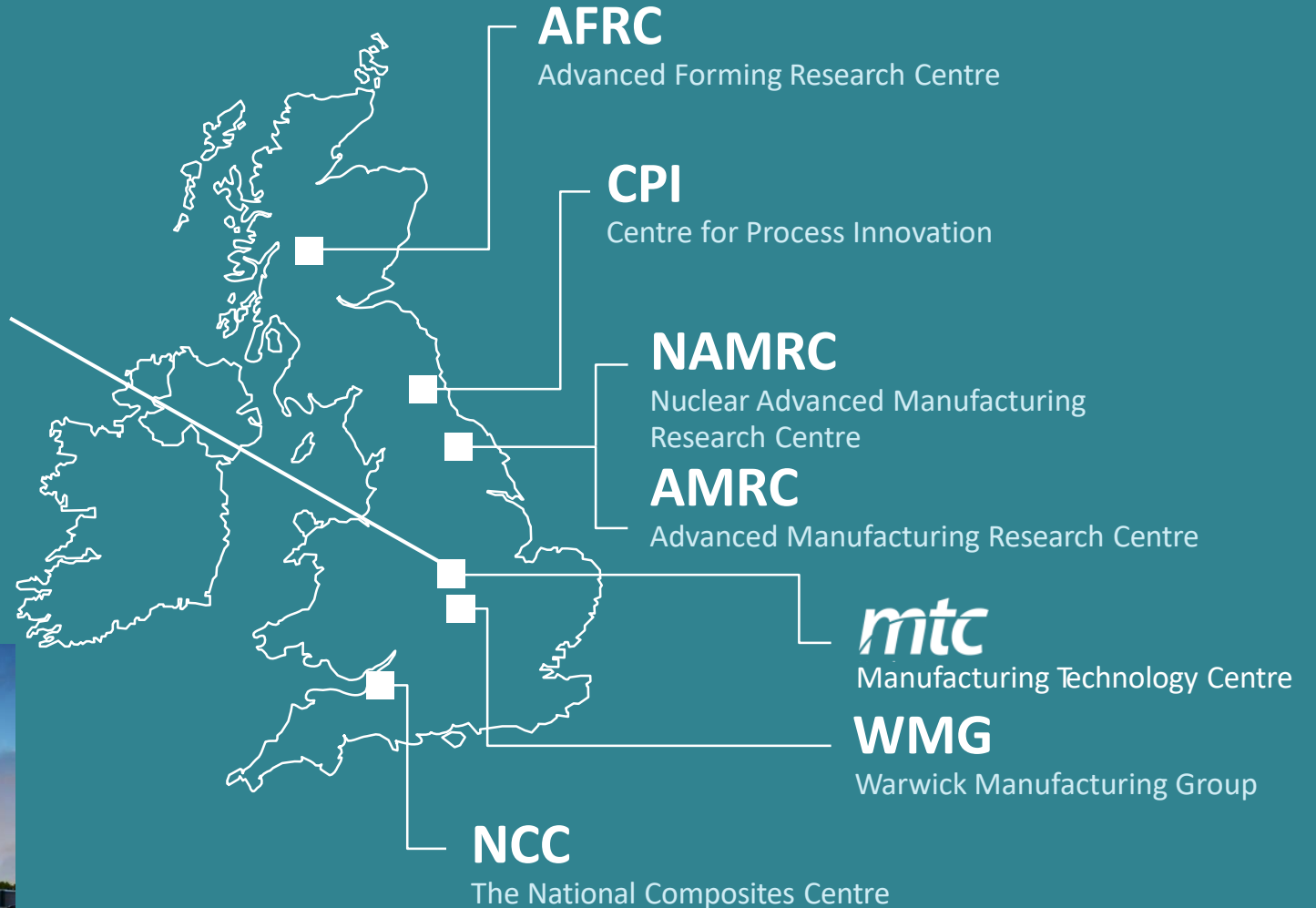
**HOW WE CAN HELP**

# HIGH VALUE MANUFACTURING CATAPULT

## NATIONAL CENTRE ADDITIVE MANUFACTURING

>800 employees

>50 engineers focussed on AM projects



# Additive Manufacturing at the MTC

**NATIONAL  
CENTRE  
ADDITIVE  
MANUFACTURING**

## UK National Centre for AM

since 2014



## European Space Agency (ESA) AM Benchmarking Centre since May 2017



- Access to state-of-the-art capabilities
- Centre for space sector
- European leadership in AM for space



## ASTM Centre of Excellence for AM since April 2018



Strategic partners



- Accelerate
- Global partnerships
- Support education, training, proficiency testing, and certification programs

# **A brief history of AM**

# A brief outline of AM history

Patent  
filed

1951

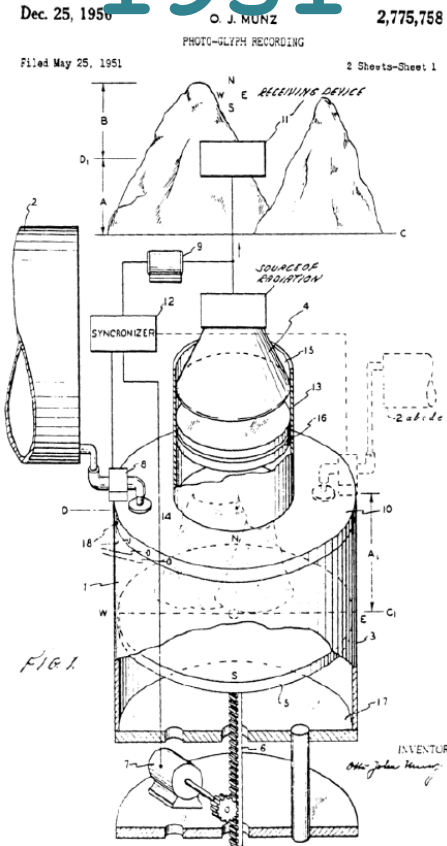


Fig. 7. Photopolymer technique of Munz

Patent  
filed

1981

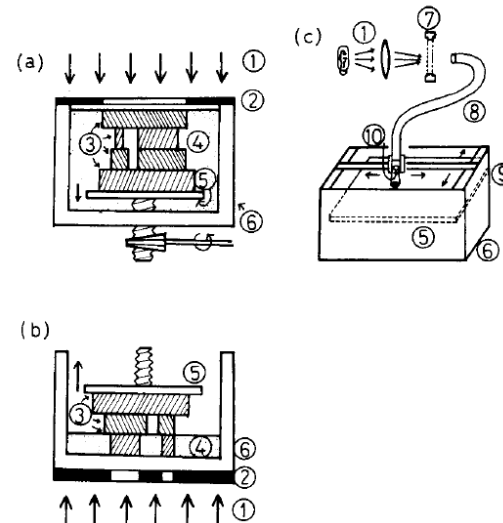
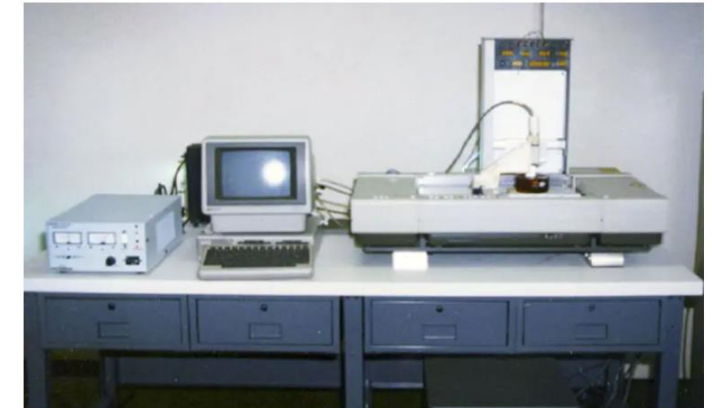


Fig. 11. Stereolithography systems of Kodama

Patent filed

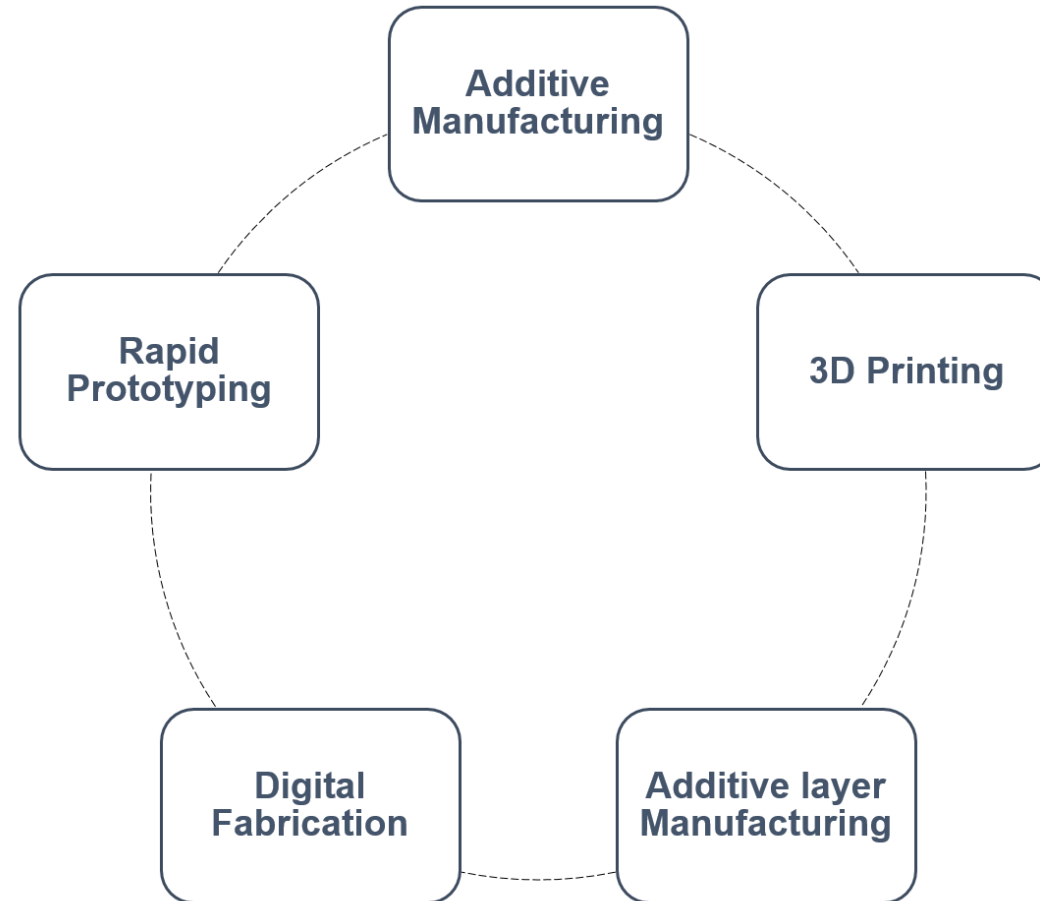
1984



The SLA 1



# What is the correct terminology?



# What is Additive Manufacturing?

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- “A process of joining materials to make objects from 3D model data, usually layer upon layer, as opposed to subtractive manufacturing technologies”.

*American Society for Testing and Materials (ASTM)- ASTM 52900*

- ASTM define seven different processes within AM - which are quite different!
- 3D printing is generally associated with prototyping and low value items

# What is Additive Manufacturing?

- It is recently gaining wider attention across a range of industries and businesses –from food and arts to medicine and aerospace!
- It could be a challenge to choose from the wide ranging technologies and materials
- It is therefore essential to understand these to maximise the benefit in a cost-effective way

## Food



Source: BeeHex

## Aerospace



Source: ge.com

## Medicine



Source: materialise

## Fashion



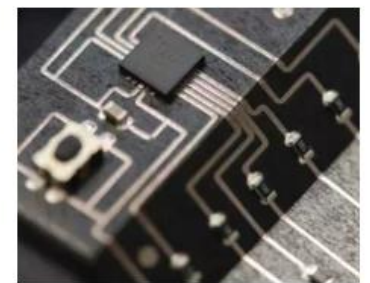
Source: Marvel Studios

## Art



Source: forbes.com

## Electronics



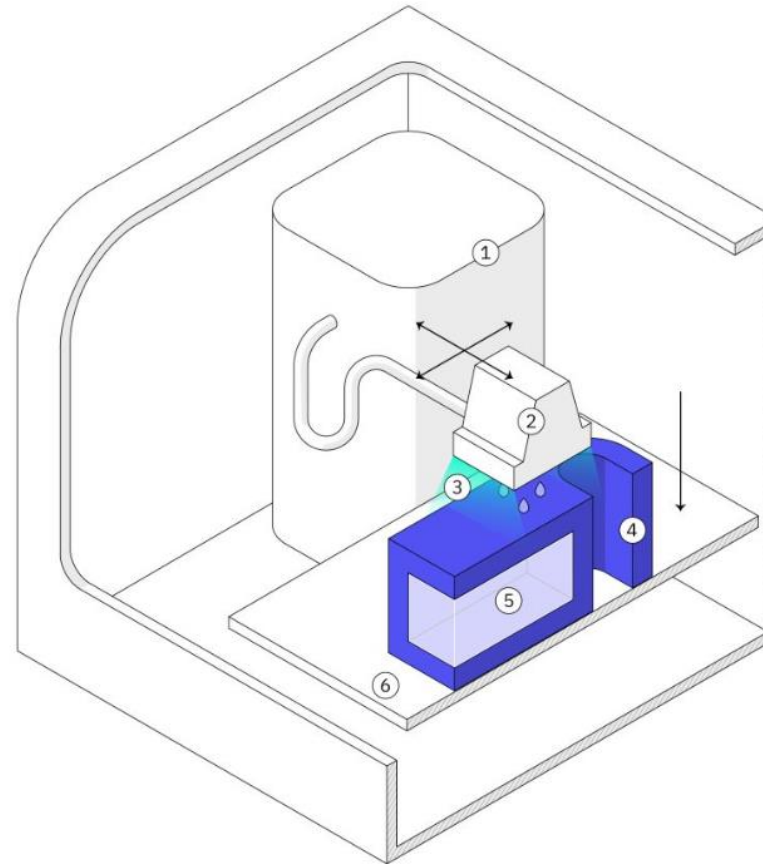
Source: NeoTech

# **Overview of AM processes**

# Additive Manufacturing Processes

1	Vat Photopolymerisation (VPP)	An additive manufacturing process in which liquid photopolymer in a vat is selectively cured by light-activated polymerisation.
2	Binder Jetting (BJT)	An additive manufacturing process in which a liquid bonding agent is selectively deposited to join powder materials.
3	Material Jetting (MJT)	An additive manufacturing process in which droplets of build material are selectively deposited.
4	Material Extrusion (MEX)	An additive manufacturing process in which material is selectively dispensed through a nozzle or orifice.
5	Powder Bed Fusion (PBF)	An additive manufacturing process in which thermal energy selectively fuses regions of a powder bed.
6	Sheet Lamination (SHL)	An additive manufacturing process in which sheets of material are bonded to form an object.
7	Directed Energy Deposition (DED)	An additive manufacturing process in which focused thermal energy is used to fuse materials by melting as they are being deposited.

# Additive Manufacturing Processes



- ① Material container
- ② Inkjet print head
- ③ UV curing light
- ④ Printed part
- ⑤ Support structure
- ⑥ Build platform

# Additive Manufacturing Processes

- 1 Vat Photopolymerisation
- 2 Binder Jetting
- 3 Material Jetting
- 4 Material Extrusion
- 5 Powder Bed Fusion
- 6 Sheet Lamination
- 7 Directed Energy Deposition



Image source: 3D Systems



Image source: Stratasys



Image source: Stratasys



Image source: Stratasys



Image source: Stratasys

# **Design for AM (DfAM) Workflow**



# A REALITY CHECK – IS IT THAT SIMPLE?



Idea



Design



AM Machine



Final product

# 3DP benefits - product supply

## Waste reduction

AM builds components layer by layer to near final geometry resulting in significant material savings.

## Reduced inventory

AM can be used as an 'on demand' service, where parts are produced just ahead of when they are needed. This negates the need to hold extensive (and costly) product stocks.

## Lead time reduction

As tooling isn't required, parts can be manufactured in hours/days. Furthermore, rapid design iterations can be realised without expensive outlay on tooling.

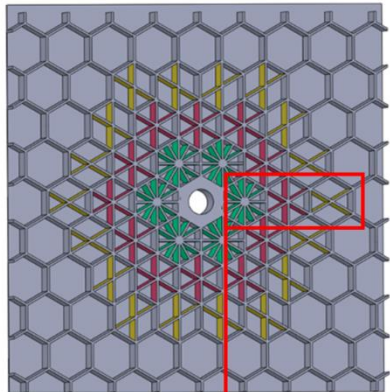
## Decreased cost

AM can offer significant through-life benefits over traditional manufacturing processes for a wide range of products and production volumes.

# Benefits - product function

## Design freedom

Ability to design parts with geometric features that cannot be made any other way; allowing design freedom to create products with enhanced functionality such as air flow.



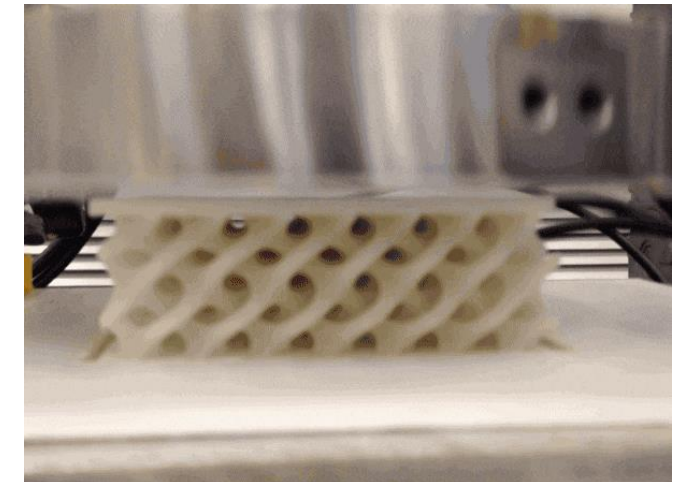
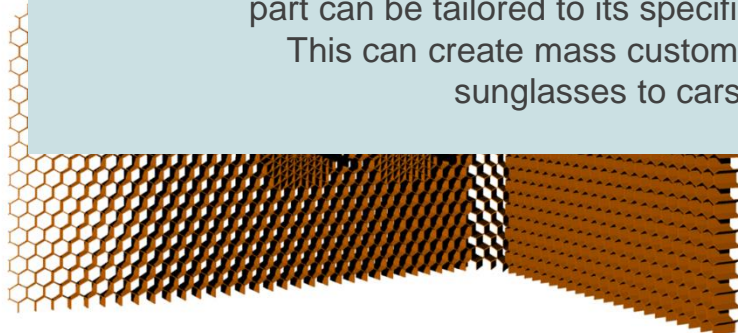
*High Performance Sandwich Structure project*

## Material freedom

As AM matures, materials will be specifically designed for use in these processes, leading to parts with improved material properties such as toughness or wear resistance.

## Mass customisation

As tooling isn't required for AM parts, each part can be tailored to its specific use, or user. This can create mass customisation from sunglasses to cars.



*Source: Autodesk*

# AM Expertise

## METALS

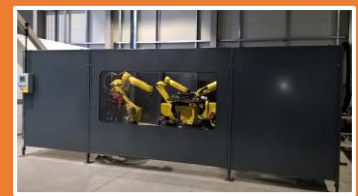
- Powder bed fusion (laser & electron beam) & hybrid-PBF



- Metal binder jetting

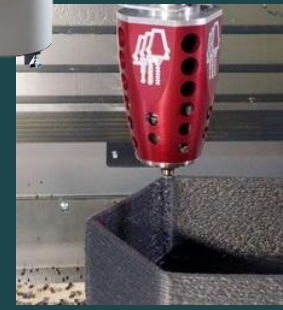
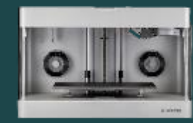
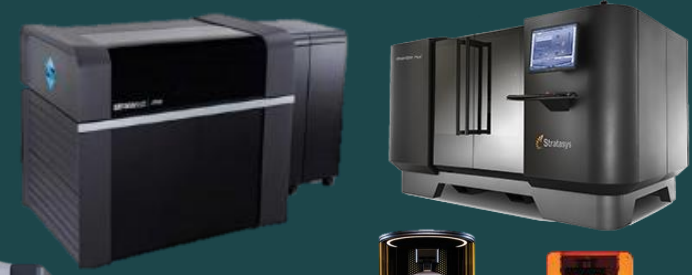


- Directed energy deposition (laser-wire & arc-wire) + hybrid-DED



## POLYMERS

- Material jetting
- Material extrusion
- Vat photopolymerisation
- Powder bed fusion



## CERAMICS

- Ceramic vat photopolymerisation
- Ceramic binder jetting
- Ceramic material jetting



## To Accelerate the Adoption of AM in the UK

### Maximise synergies

- Work collaboratively with the UK AM community
- Build strategic partnerships across academia and industry

### Develop the future workforce

- Upskill and reskill engineers and technicians
- Transfer Knowledge into the supply chain

### Change the way businesses compete

- Raise awareness of AM to help UK companies understand business benefits
- Assist companies develop disruptive business opportunities

### Deliver innovation

- Embed robust AM processes and innovate products into the supply chain
- Developing emerging and disruptive AM technologies/materials

## Technology Adoption Journey

### Network & Events

- Raise awareness of AM
- Showcase UK AM capability
- Provide a platform to build synergies in the UK AM community

### Education

- Advanced apprenticeship programmes
- Short courses
- NCAM Knowledge hub

### AM Support Services

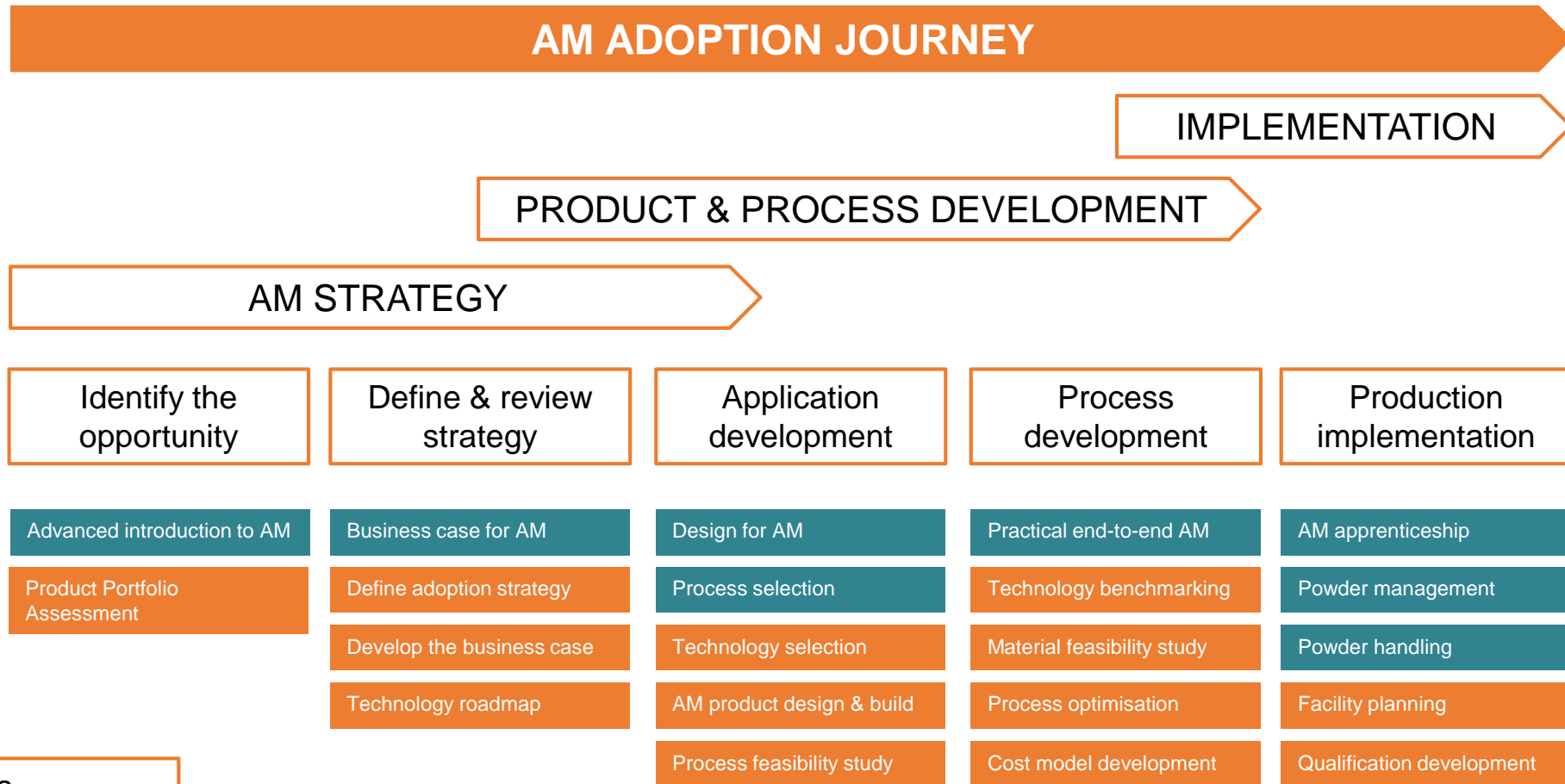
- Assist companies understand the opportunity for AM in their business
- De-risk implementation
- Improve efficiency and productivity

### Technical Solutions

- Develop and demo AM technology
- Provide facilities and knowledge to accelerate the development of AM products and processes.

# Typical Projects

[ncam.the-mtc.org/how-we-can-help](http://ncam.the-mtc.org/how-we-can-help)



**NCAM services**

- Training
- Project

**NATIONAL  
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MANUFACTURING

Dr Farhan Khan  
Senior Research Engineer, Design for AM

+44 2476701633  
Farhan.khan@the-mtc.org

[www.the-mtc.org/NCAM](http://www.the-mtc.org/NCAM)  
[NCAM@the-mtc.org](mailto:NCAM@the-mtc.org)

# Use Case: Acoustic tiles

**Megan Jenkinson-Garner**

Research Physicist  
Precision Acoustics Ltd



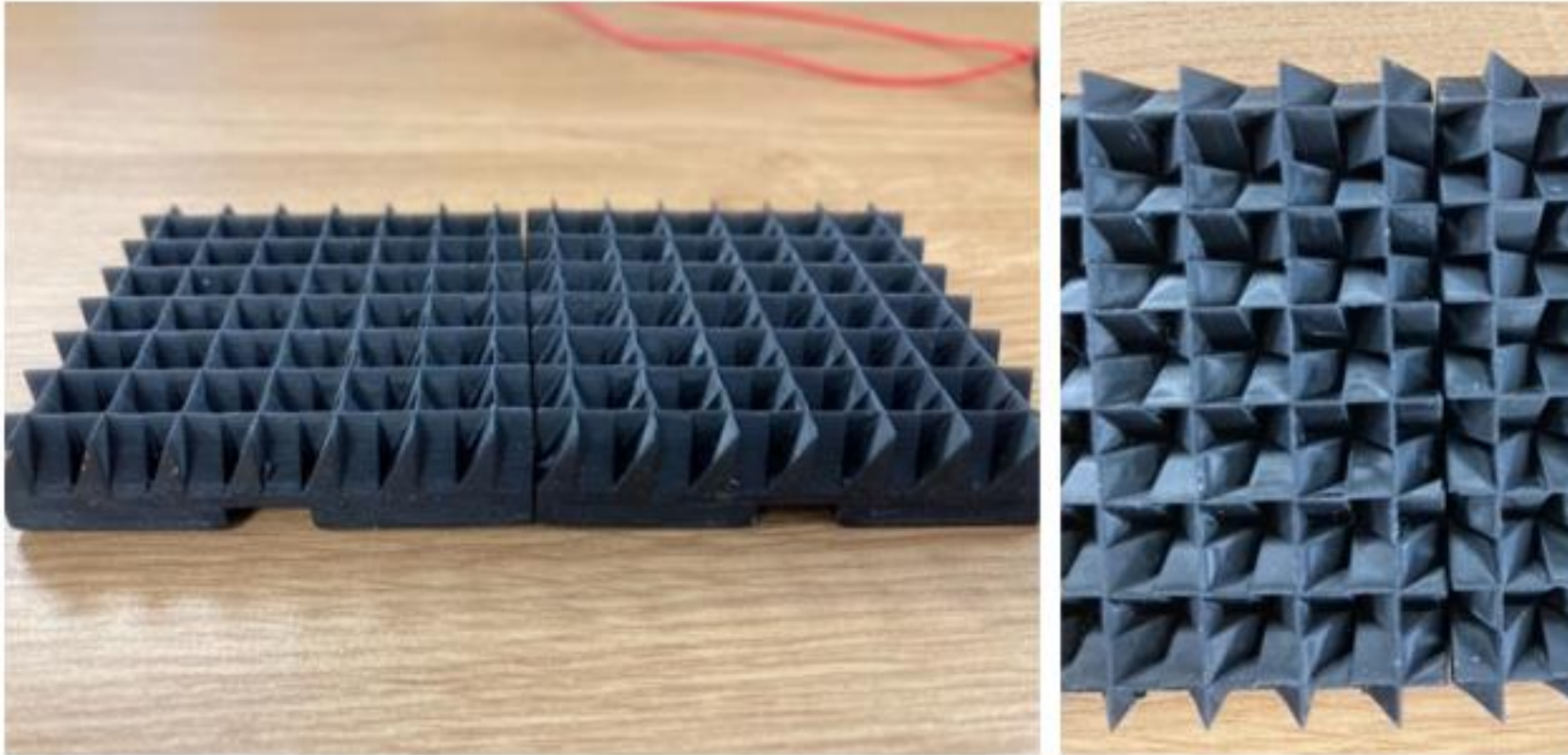
# Precision Acoustics Ltd

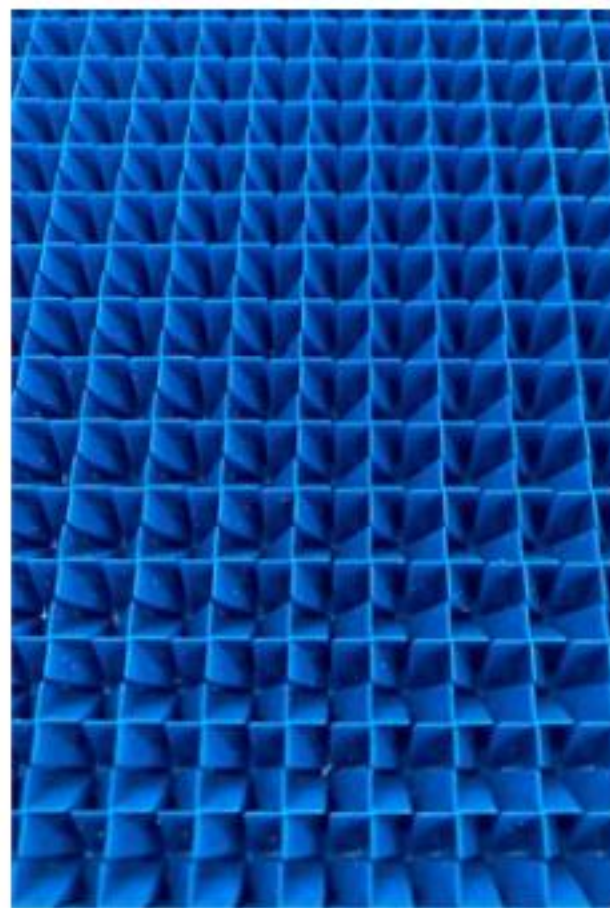
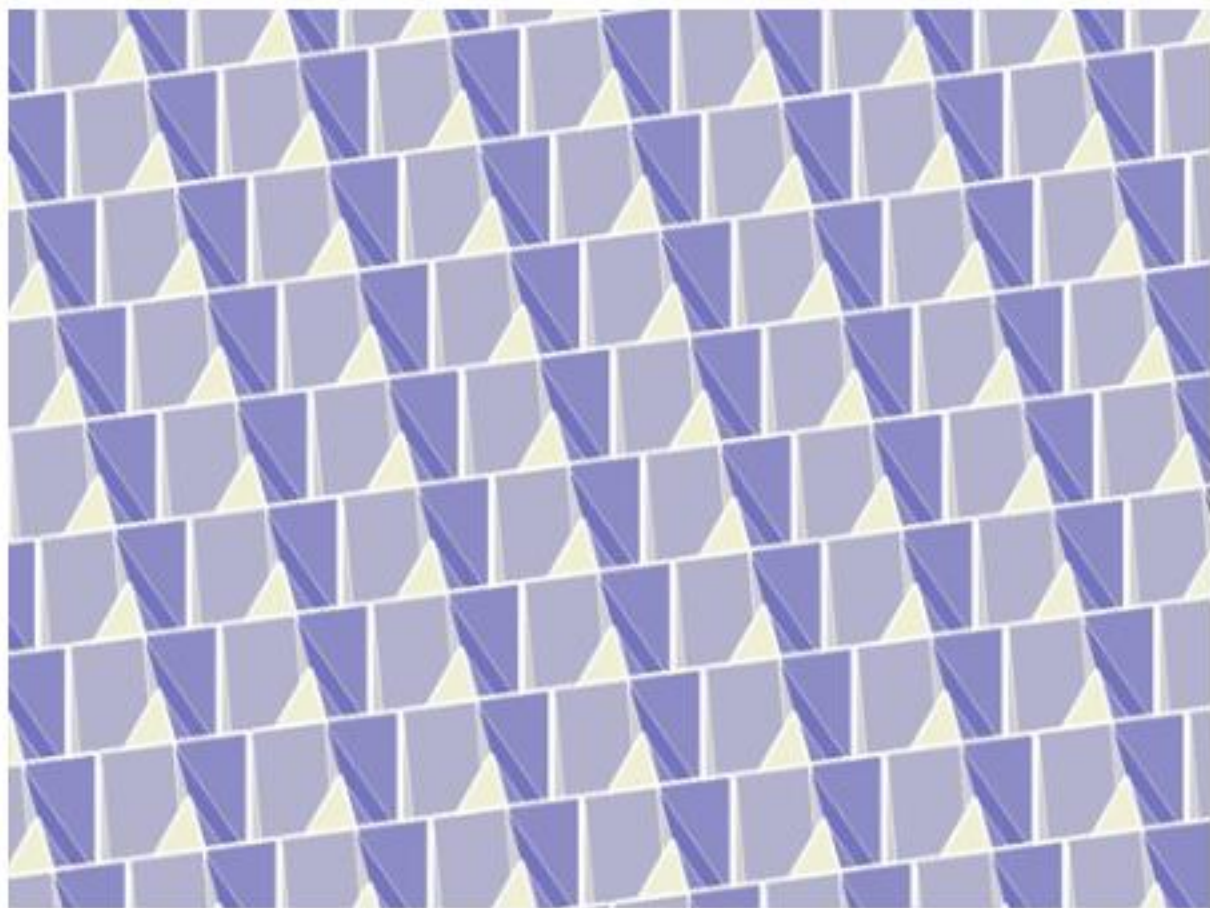
A Global manufacturer of hydrophones, ultrasound transducers, ultrasound test stations and acoustic materials.

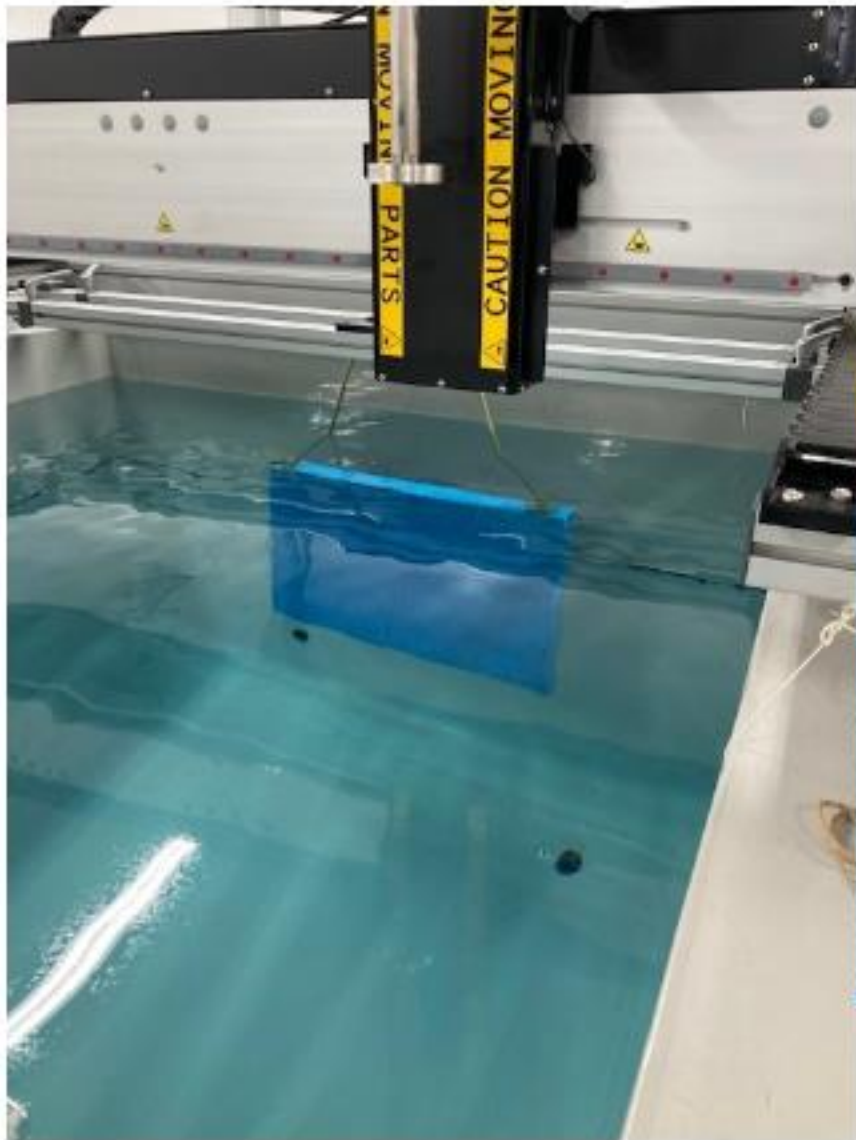


## Collaboration with the MTC

- Development of a new anechoic lining material with the aid of additive manufacturing techniques.







Thank You!



*Set us the challenge!*

T 07866 033218    E [Sylvain.Briand@the-mtc.org](mailto:Sylvain.Briand@the-mtc.org)