





Potential of 3D Printing and Opportunities

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Brunel University London

- ✓ Founded in 1966
 - 54 years (relatively young university)
- ✓ Located in Uxbridge, West London
- ✓ ~14,000 students and 2,500 staff
- ✓ Top 400 universities in the world
 - QS World University Rankings 2021
 - Times Higher Education World University Rankings 2021
- ✓ 9^{th} for Research Intensity in the UK
 - University League Table 2021











Digital fabrication laboratory at Brunel University

- ✓ 3D Printers
- ✓ 3D Scanners
- ✓ Turn computer-aided design
 - (CAD) models into working
 - prototypes or finished products





Source: https://www.brunel.ac.uk/virtualtour/?filter=academic&content=10&frompin=10)







Outline

- ✓ What is 3D Printing and Why ?
- ✓ Potential of 3D Printing
- Opportunities







What is 3D Printing and Why ?







What is 3D printing

- ✓ 3D Printing (also called Additive Manufacturing (AM) *often used interchangeably*)
 - Design a 3D Model of an object with a CAD software
 - Convert the model into a format (called an STL file) that the 3D printer understands
 - Build the object by adding (not subtracting) materials layer by layer with a 3D printer



Source: giphy (2020)







3D Printing process









Why 3D Printing

- ✓ Less waste
 - ◆ Use the right amount of amount of material with little or no material wasted
- ✓ Customisation
 - Each design can be different, and suited to what you want

✓ Complex geometries

- ✤ 3D Printing can help create complex designs compared to traditional types of manufacturing
- ✓ Fast production
 - ✤ 3D Printing can make objects within a minutes or hours (depending on the complexity)
 - You need the 3D Model and a 3D Printer



Source: 3D Printing industry (2020)







Put into context



Source: How 3D printing is enabling the '4th Industrial Revolution' | Dr. Tim Minshall | TEDxOxBridge <u>https://youtu.be/IsJLZ1UYxGc</u> and <u>https://openclipart.org/</u>







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Potential of 3D Printing







Potential of 3D Printing

Cells, tissues, biomaterials



Source: 3Dnatives (2020)



Source: 3Dnatives (2019)







Potential of 3D Printing



Source: Fabbaloo (2018)

Food



Source: Fabbaloo (2019)







Potential of 3D Printing

Concrete



Source: de zeen (2018)



Source: m-tec (2020)







Potential of 3D Printing

Concrete



Source: The Guardian (2018) - <u>https://www.theguardian.com/artanddesign/2018/jun/06/netherlands-to-build-worlds-first-habitable-3d-printed-houses</u>







Potential of 3D Printing

Concrete

Source: The Guardian (2018) - <u>https://www.theguardian.com/artanddesign/2018/jun/06/netherlands-to-build-worlds-first-habitable-3d-printed-houses</u>







Potential of 3D Printing



Source: AMFG.ai (2019)

Metals



Source: AMFG.ai (2019)







Potential of 3D Printing

3D printed cast



Prosthetic hand



Source: pixabay (2020)







Potential of 3D Printing

Miniature human heart model

3D printed denture



Source: The Week (2019)



Source: Shutterstock (2020)

- ✓ Visualisation and training aid for abstract concepts
- ✓ Demonstrate complex human anatomy using accurate models







Case Study

3D Printing and covid-19







Issues due to covid-19 pandemic

- ✓ Increased number of cases and infections
- ✓ Panic buying of items
- ✓ Shortage of personal protection equipment (PPE) and medical devices
- ✓ Disruptions in supply chains
 - Logistical challenges
 - Transport restrictions







How 3D Printing is helping

- Decentralised manufacturing
 - Competitive advantage in unexpected situations
- ✓ Co-location of 3D Printing factories at hospitals
 - Remote accessibility and adaptability
- Students, researchers, manufacturers, designers, engineers, industries, universities and charities used 3D Printing to make PPE and medical devices to meet high demands
 - Face shields and masks
 - Test swabs
 - Part for ventilators

Brunel volunteers 3D-printing face shields for Guy's and St Thomas' medics

By Press Office 22 Apr 2020



Source: Brunel University - <u>https://www.brunel.ac.uk/news-and-</u> events/news/articles/Brunel-volunteers-3D-printing-face-shields-for-Guy%27s-and-St-Thomas%27-medics







3D models and open-source files (and modify/upload new files and designs) to support covid-19

✓ Thingiverse

www.thingiverse.com

✓ PRUSA PRO Face Shield (*Downloaded over 100,000 times in March 2020*)

https://www.prusaprinters.org/prints/32714-prusa-pro-face-shield/files

✓ 3D Systems

https://www.3dsystems.com/covid-19-response

✓ Farsoon Technologies

http://en.farsoon.com/yl_detail/productId=98.html









- ✓ 3D printed covid-19 test swabs
 - Efficient manufacturing option to keep up with the demand for test swabs





Source: 3Dprintingindsutry (2020) Photo via Formlabs







- ✓ Personalised 3D printed face masks for covid-19
 - Mass customisation
 - Ergonomic fit (using 3D scanning)





Source: 3D Printing Media Network (2020) Davide Sher https://www.3dprintingmedia.network/personalized-ppe-mask/







✓ 3D printed visors for covid-19



Work by Giselle Loh – PhD researcher at Brunel University







3D printed ventilator valves



Photo via CRP Technology. Source: 3Dprintingindsutry (2020) Source: AMFG (2020) - https://amfg.ai/







3D printed quarantine booths in China by Winsun Ltd



Photo by Winsun. Source: 3Dnatives (2020) - <u>https://www.3dnatives.com/en/winsun-coronavirus-260220205/#</u>!







Opportunities







3D Printing and Industry 4.0

✓ Industry 4.0

- ✓ New phase of Industrial Revolution
- ✓ Digital transformation of manufacturing
- ✓ Interconnectivity and automation
- ✓ Increased productivity and efficiency











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- ✓ AM Designer
- ✓ AM Process Engineer
- ✓ AM Inspector
- ✓ AM Supervisor
- ✓ AM Coordinator
- AM Operator and Technician
- ✓ AM Researcher and Scientist and more.....



Source: 3D Printing industry (2020)

*List is not exhaustive









- What is 3D Printing and Why?
- Potential of 3D Printing
- Opportunities







Any Questions ???