UNIVERSITY OF CAMBRIDGE
Department of Engineering

IfM MANAGEMENT TECHNOLOGY POLICY

How stuff gets made 2022

The IfM colouring book

Welcome

Take a look around you at all the things that have been made – your chair, your pen, your clothes, the food you ate for your last meal, and hundreds of other ordinary things you use or see every day.

How are they made? Who made them, and where?
What are they made from?
Could there be a better way to make them?

Manufacturing is all about how stuff gets made. At the Institute for Manufacturing we work on helping people to make things in better ways. This can be from thinking about how the tiniest things (so small you can't see them) fit together at nanoscale, right up to how we move things around the world. It can be about how people work together, how they come up with new ideas, or how we make things in a way that is better for the planet.

We hope you enjoy colouring the pictures in this book and finding out a little bit more about how stuff gets made.

Contents

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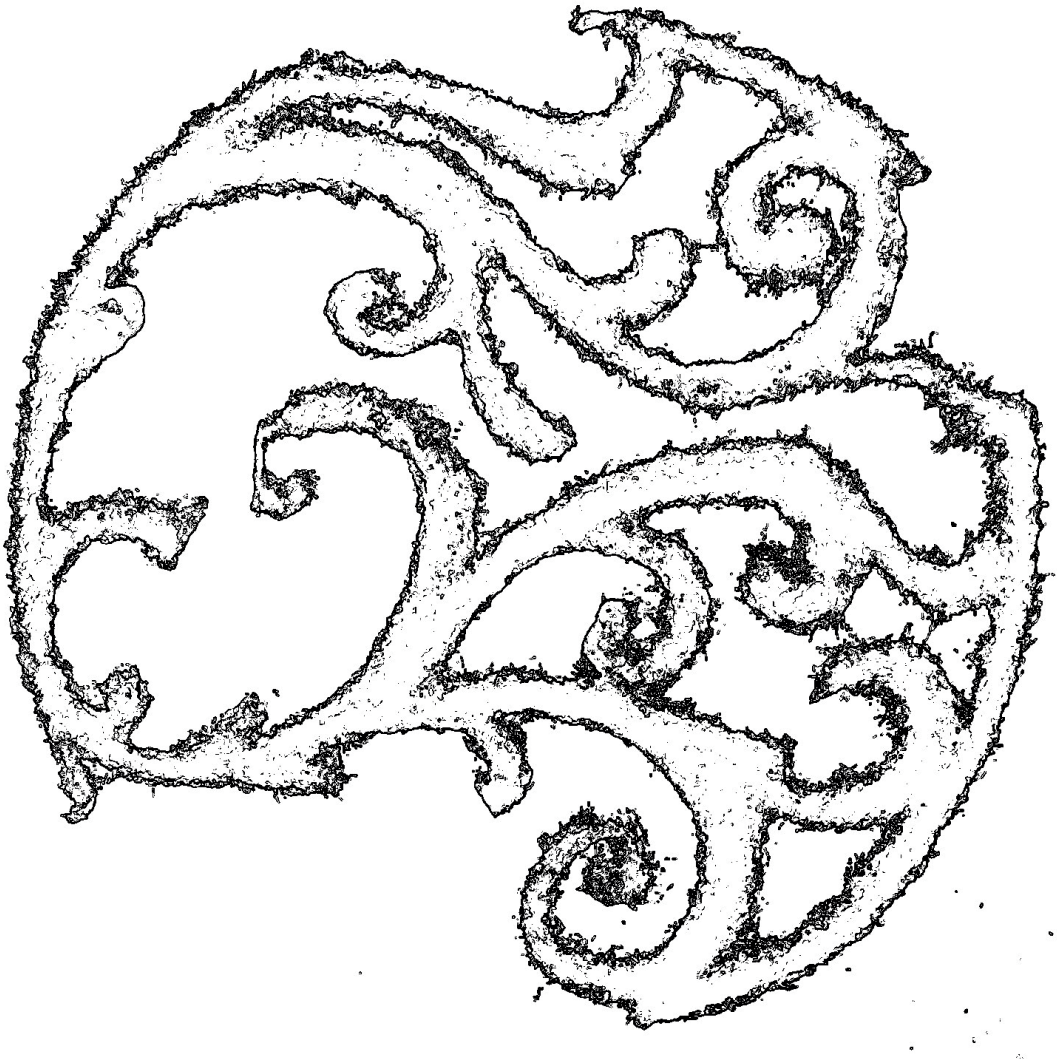
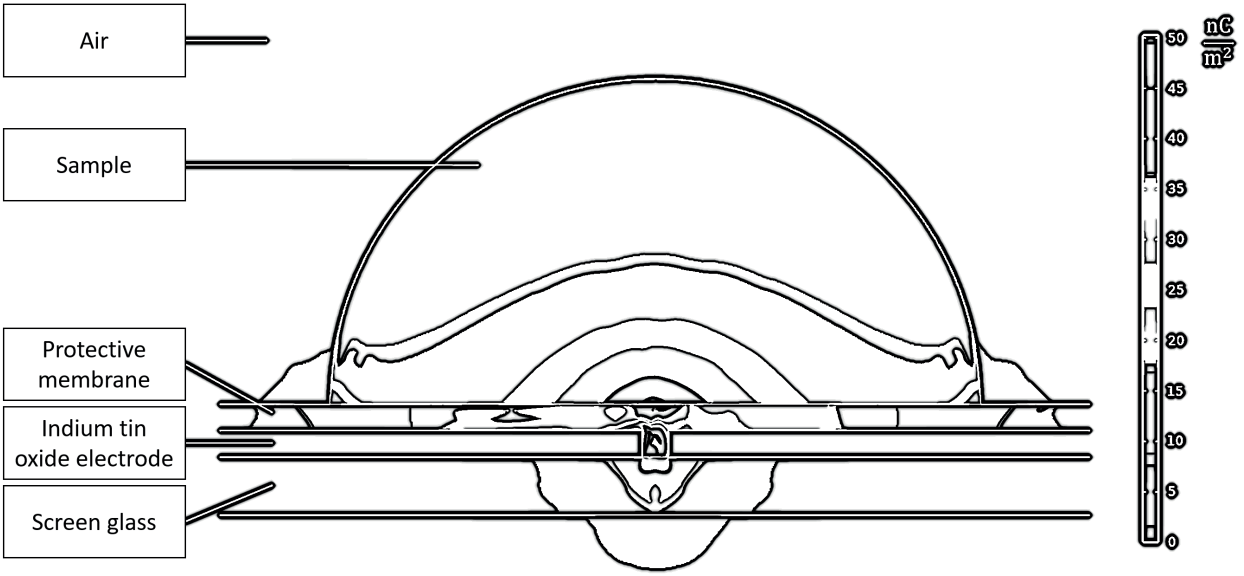
Activity pages

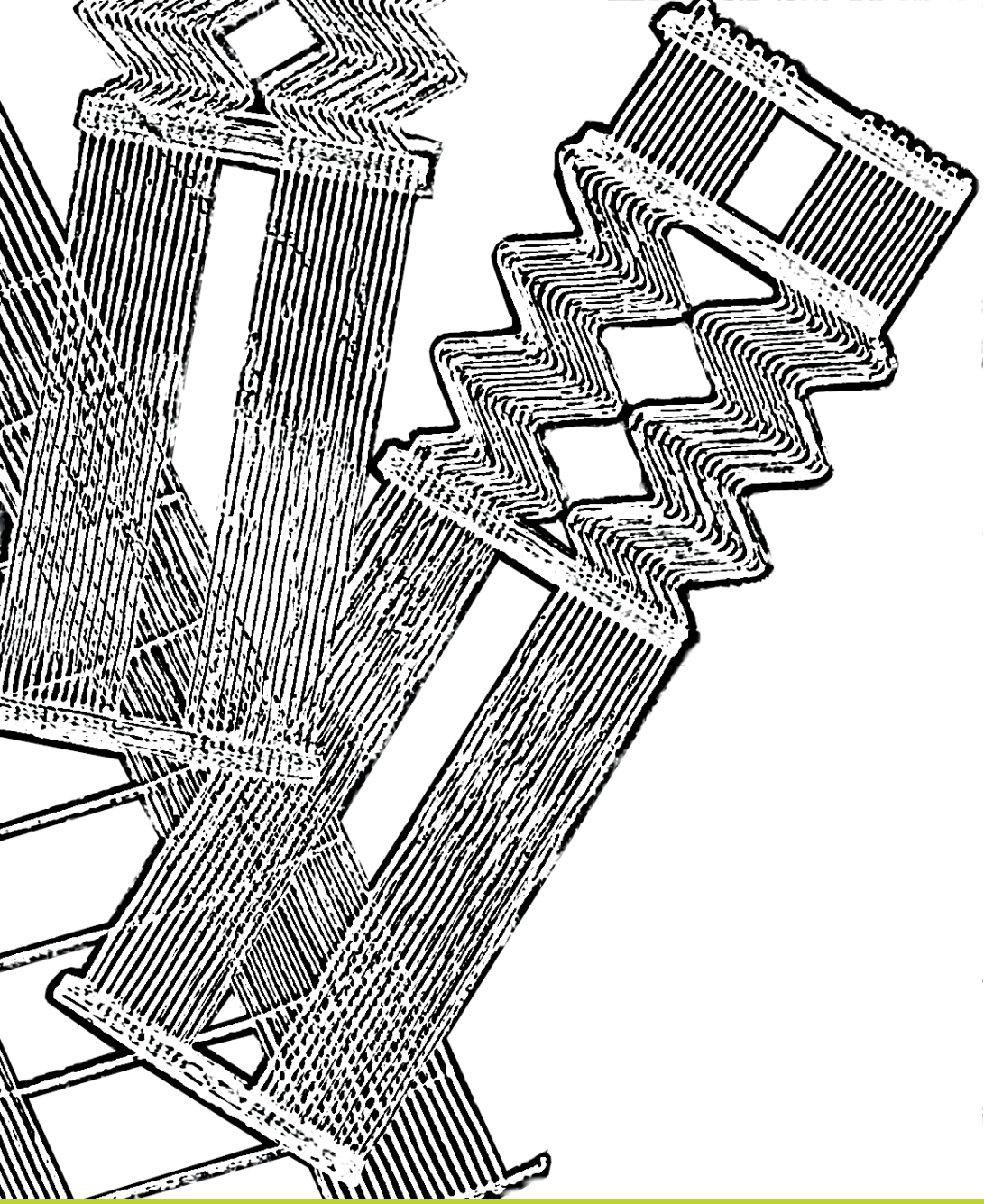


The IfM is researching how to print our own paper. The drawing shows a paper pattern that was printed from a computer image.

We can turn our smartphones into sensors by altering their touchscreens. We use computers to predict how the modified touchscreen will sense droplets with different types of salts, similar to those found in energy drinks.

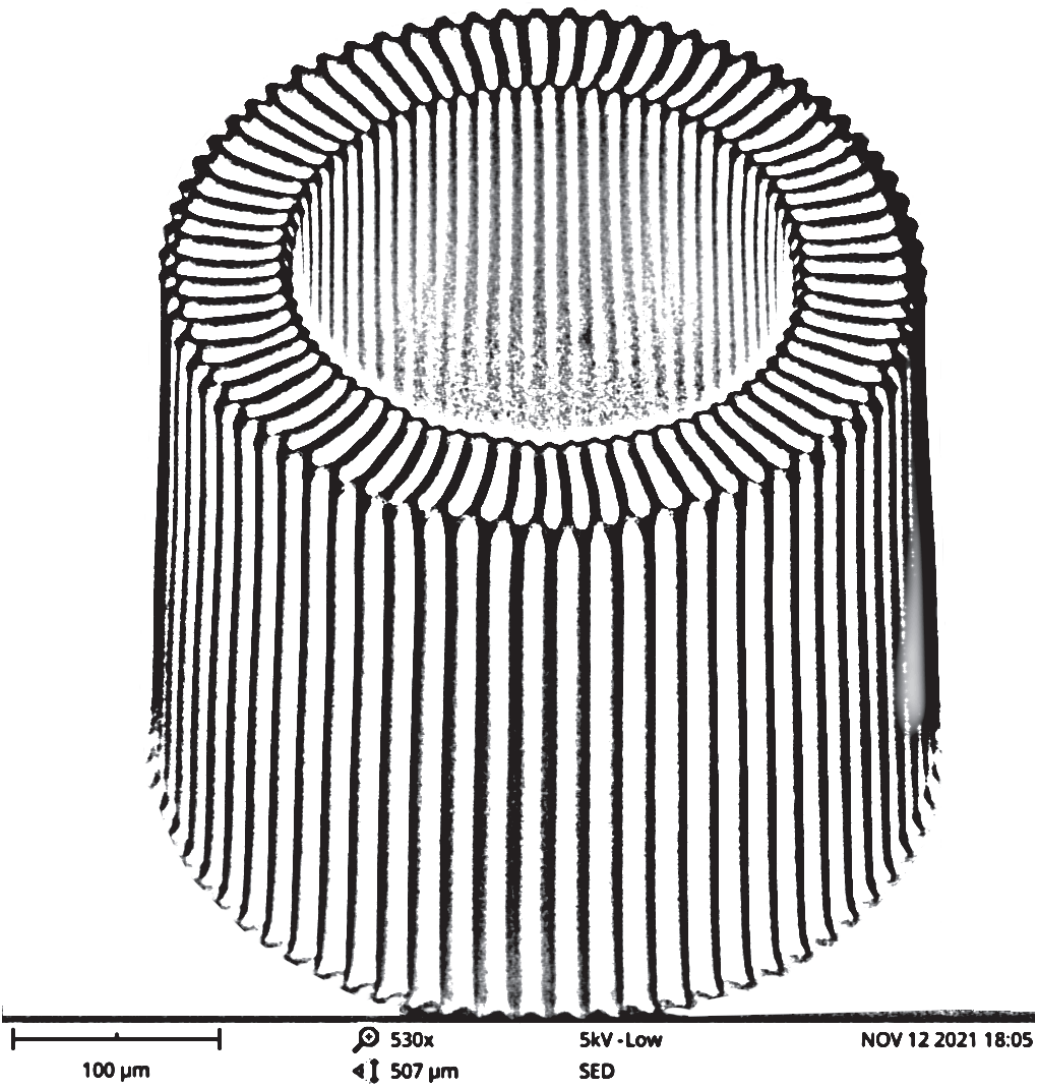
The electric displacement field while measuring a sample drop on a capacitive touchscreen sensor



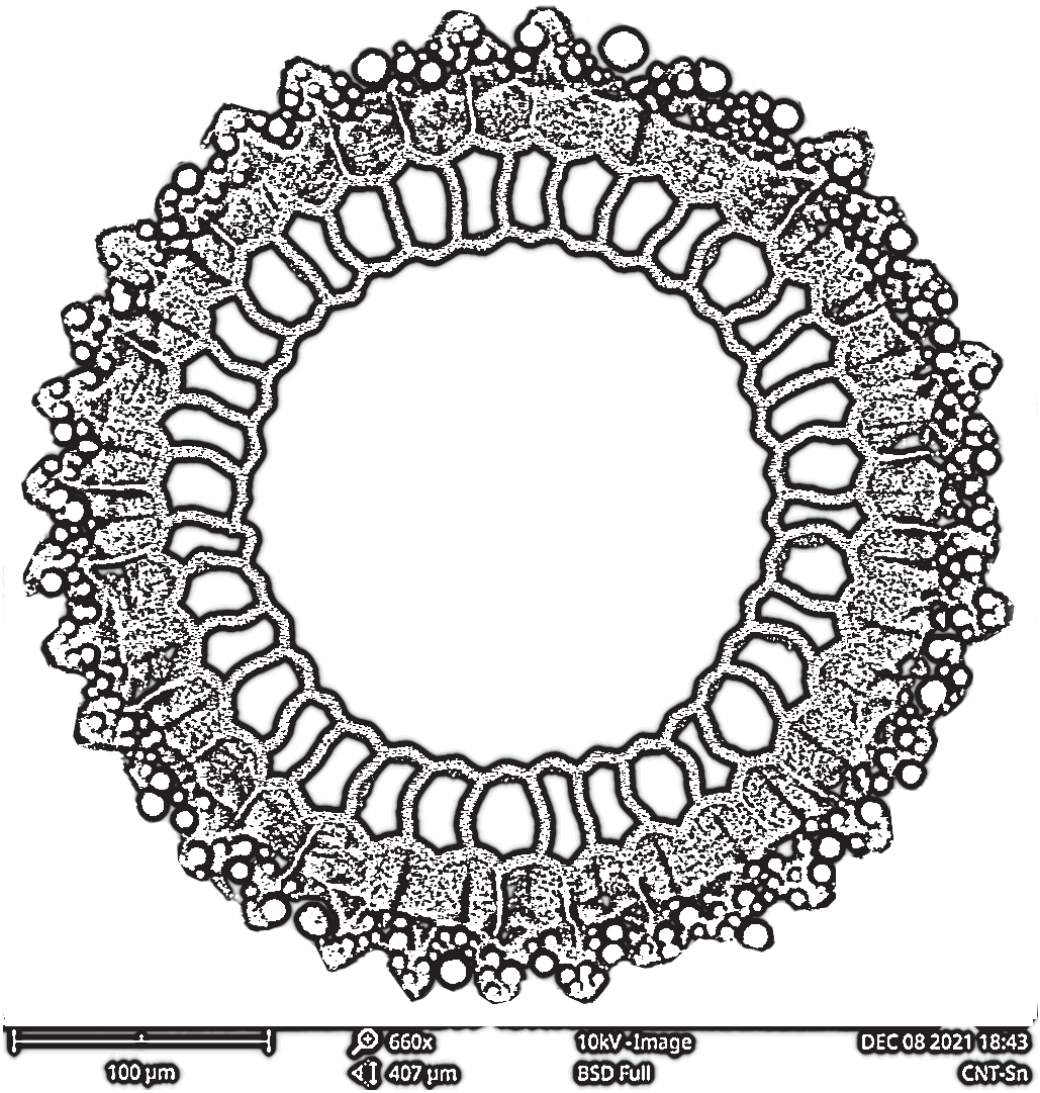


We can also print our own structures using 3D printers. This mesh can be used to make braces for things like broken joints. They are comfortable while still being protective.

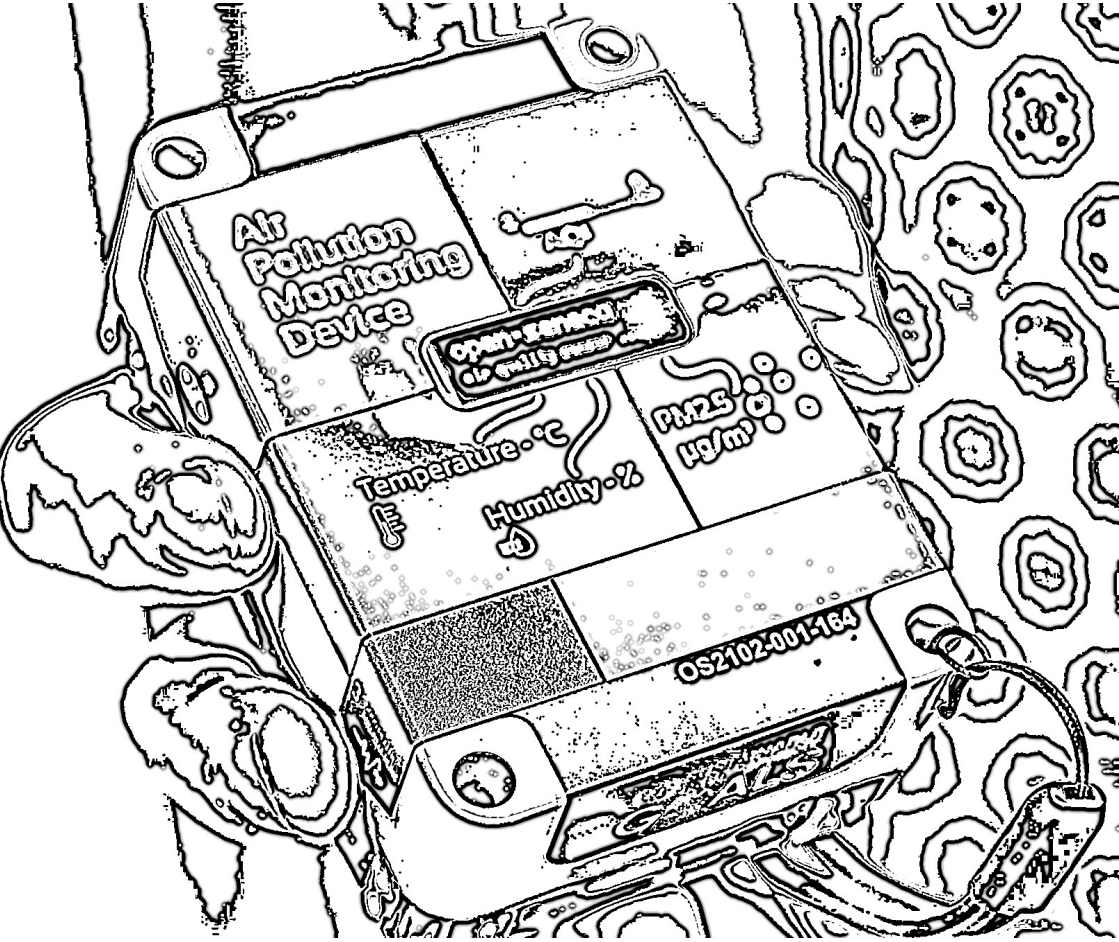
At the IfM we use computer programs to analyse images to detect errors that occur during 3D printing and use this to improve the printing process.



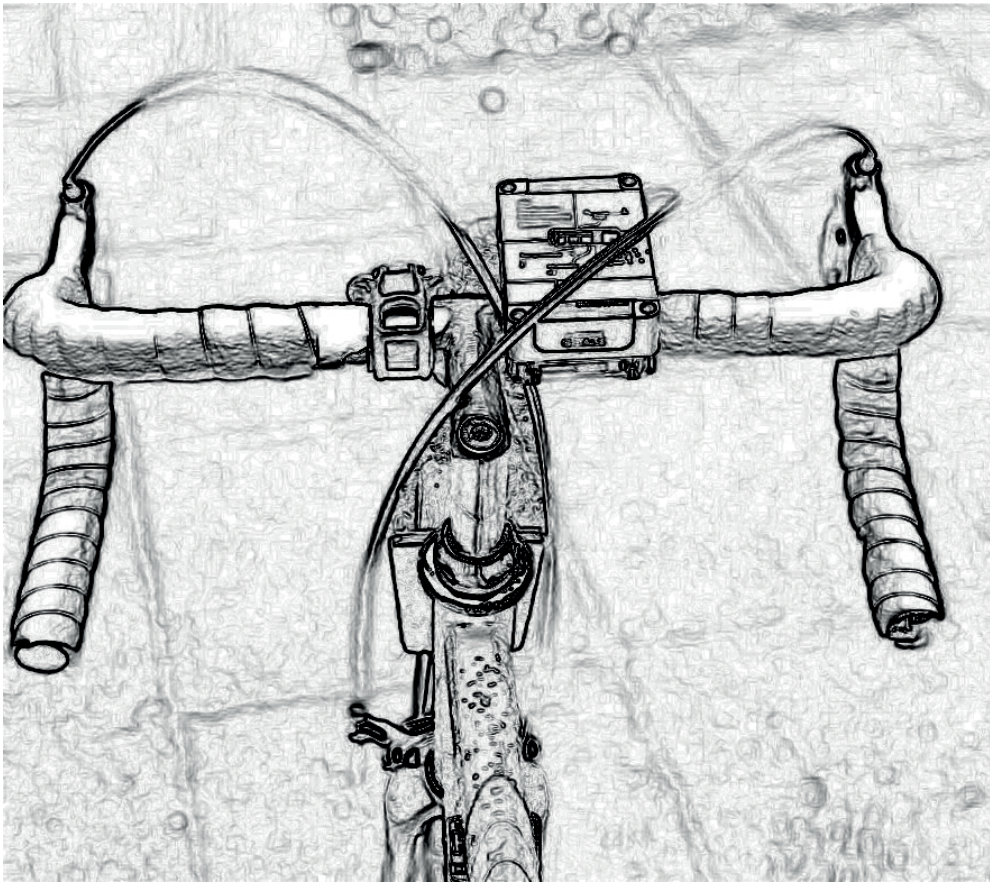
Fun with electrochemically active micro-structures! Thousands of carbon nanotubes are grown closely together to form a cone that can be opened and closed using an electrical charge.



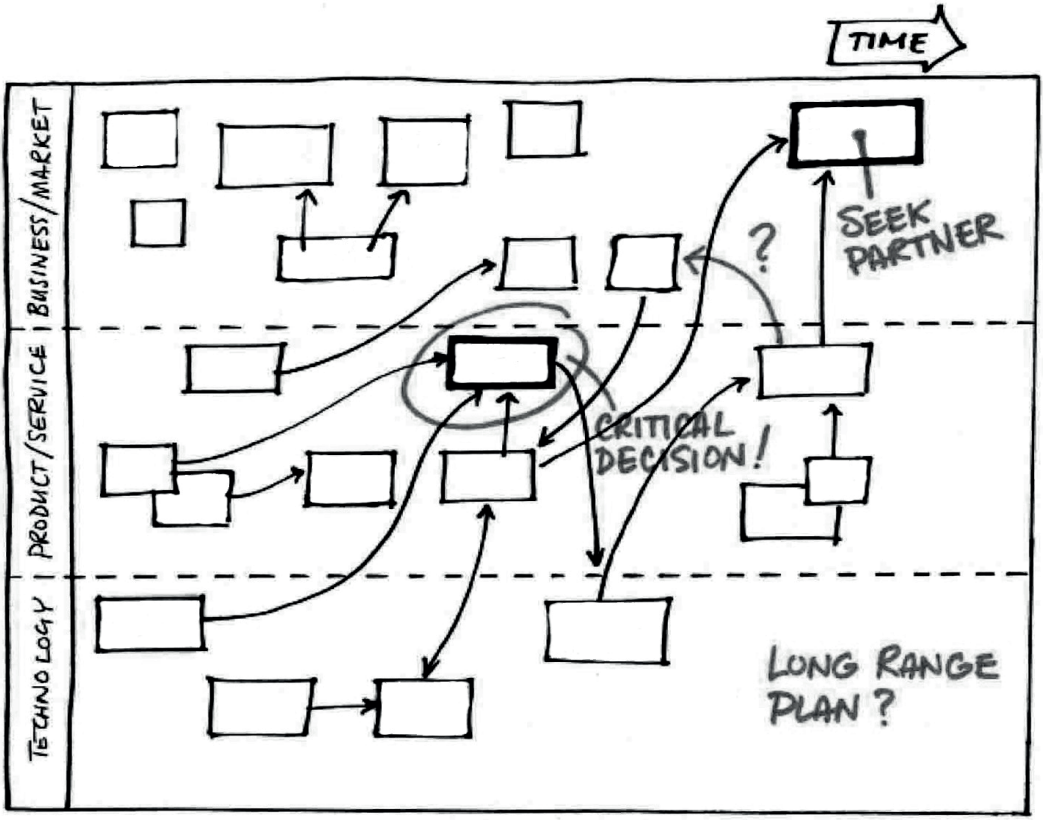
Changing the pattern the nanotubes are grown in changes the cone structure and how it behaves inside new batteries.



This portable device that allows you to check the quality of the air you breathe everywhere you go! It measures the levels of particles in the air that are harmful to your lungs (particulate matter, PM2.5). The open-seneca initiative maps air pollution in cities using these devices and the help of volunteering citizens.

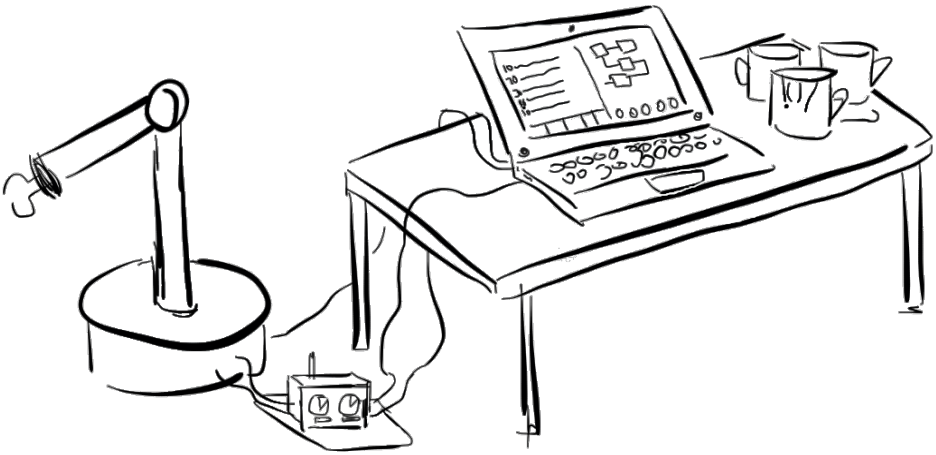


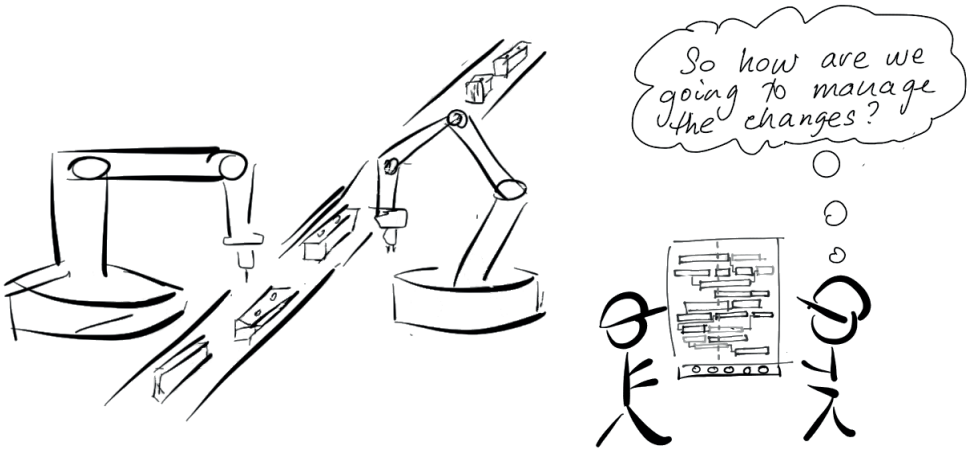
The open-seneca sensor in action! Mount it on your bike, scooter, motorbike, anywhere, and start monitoring the air around you in your daily journeys.



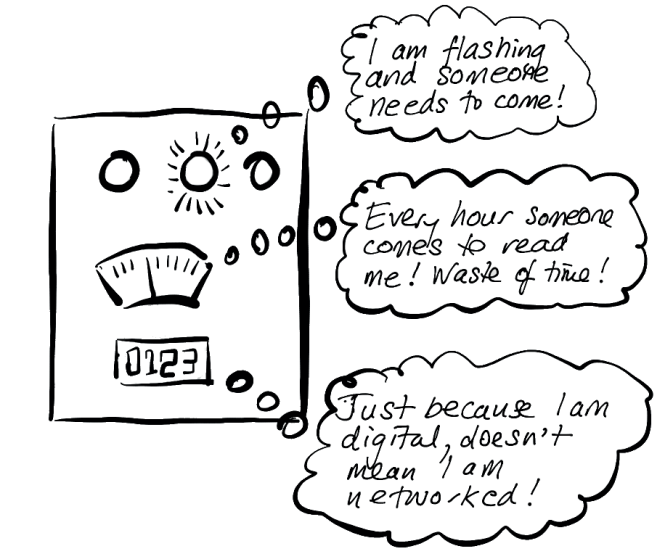
How do you get where you want to go? And how do you know where you want to be? The IfM uses a method called roadmapping to help people plan their strategy and then put their plans into action.

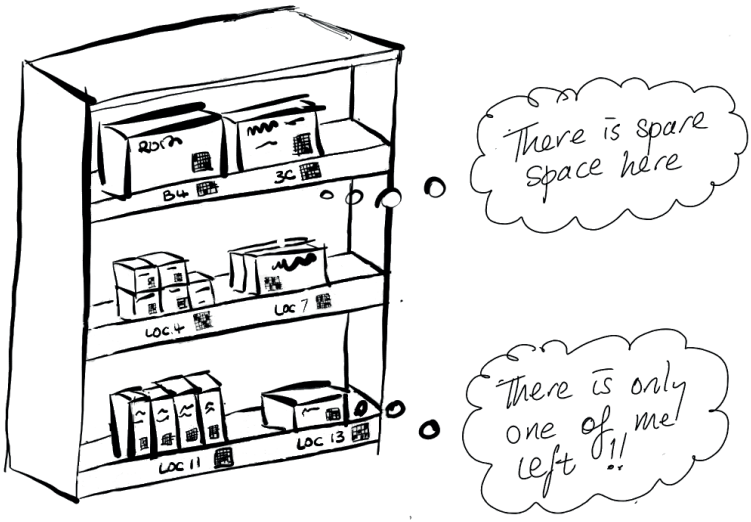
Making sure everyone's views are included is a key part of roadmapping. Roadmapping uses sticky notes and wall charts to bring together people's ideas and plans. Writing and drawing together makes things clearer and helps people from different kinds of jobs understand each other's point of view. This is very useful when you want to make new cars or planes, for example, or want to work together on something complex, such as how to reduce global warming or save animal habitats.





Making manufacturing smarter without breaking the bank – Digital Manufacturing on a Shoestring.

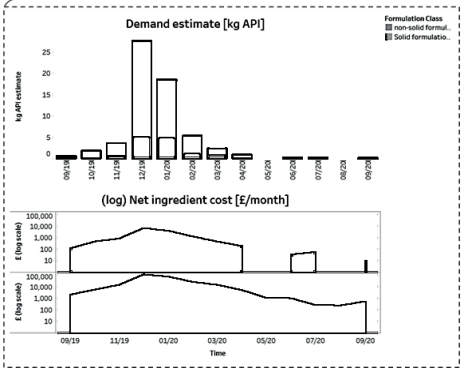


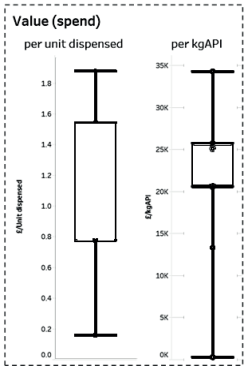


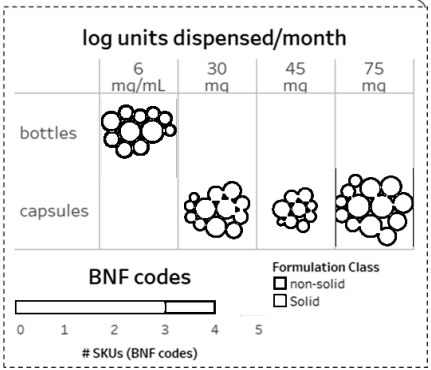
Shoestring helps companies try out new technologies cheaply – like helping to get their different devices to talk to one another.

	Demand uncertainty	Product value	SKU flexibility	Supply uncertainty	Manufacturing asset cost
Antivirals	H	H	M	M	H
Analgesics	L	L	H	L	L
Anti-malarial	L	M	H	H	M
Anti-diabetes (Type2)	L	L	L*	L	L

e.g. oseltamvir



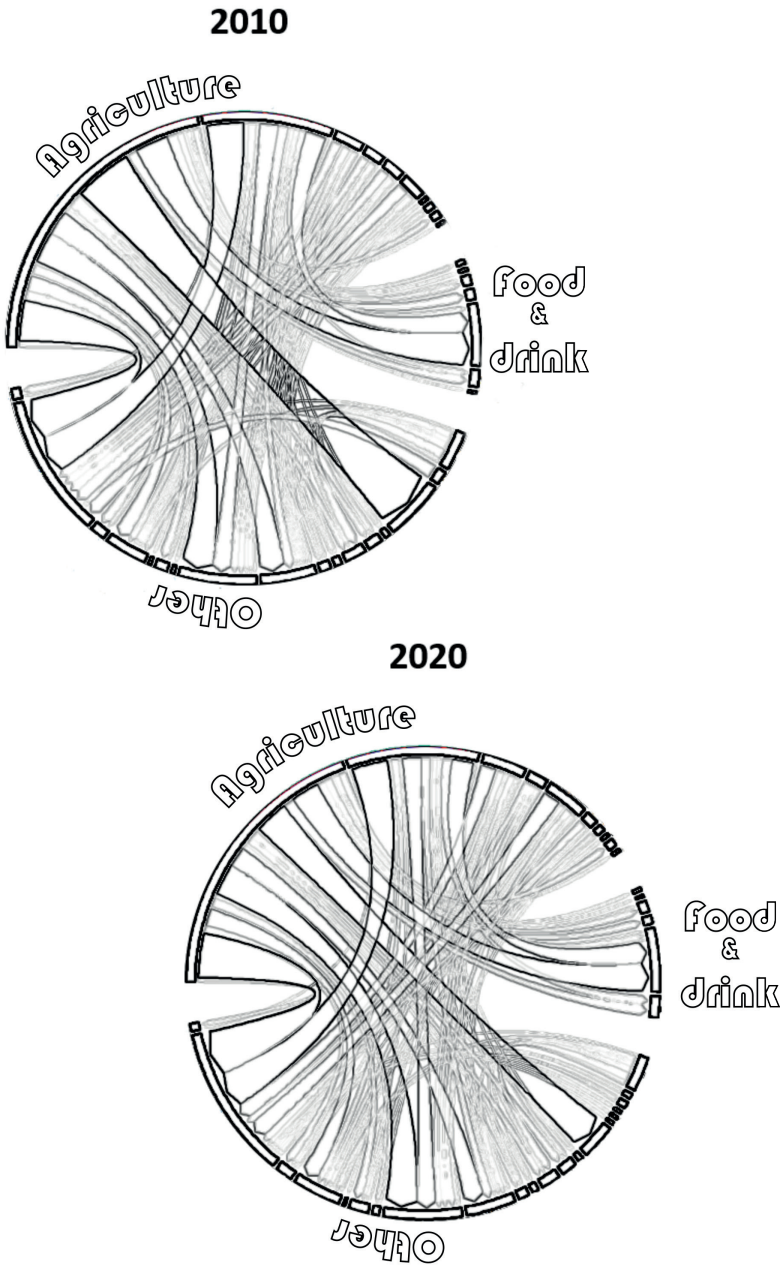




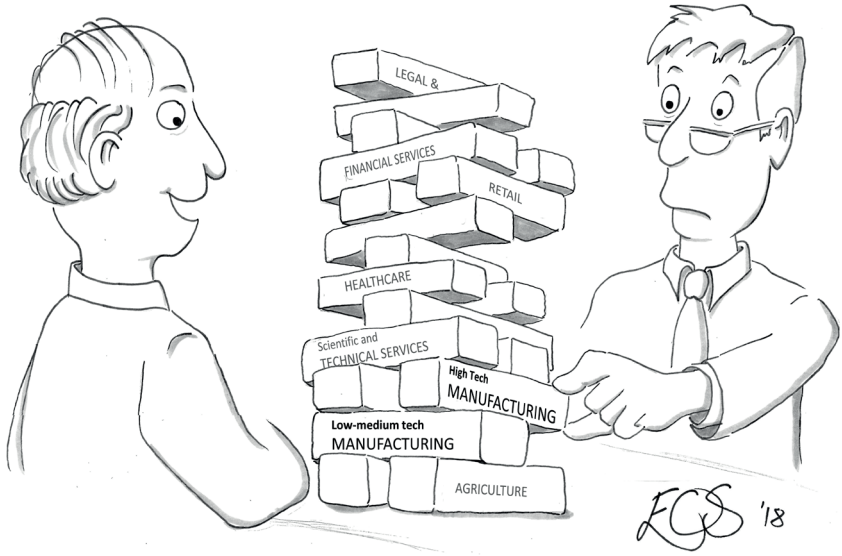
Summarising prescription data for technology selection

These graphs show one year of raw data from NHS England on prescriptions for an antiviral drug. The data was used to help experts understand the opportunities for manufacturing specific drug ingredients in the UK rather than abroad using novel technologies.

CMAC FUTURE MANUFACTURING RESEARCH HUB



The diagrams above show the quantity and direction of trade between the UK and India for different parts of the economy as measured in the 'water cost', or the amount of water required in the processing and trading. Water cost measured is a similar concept to the 'carbon cost' of other types of production.



"Go on… Manufacturing is only 10% of the economy…"

When policy officials meet academics.

Manufacturing Word Search

C O M M E R C I A L I S A T I O N G
P D I S T R I B U T I O N Q K R R I
A D D I T I V E Z O D I G I T A L N
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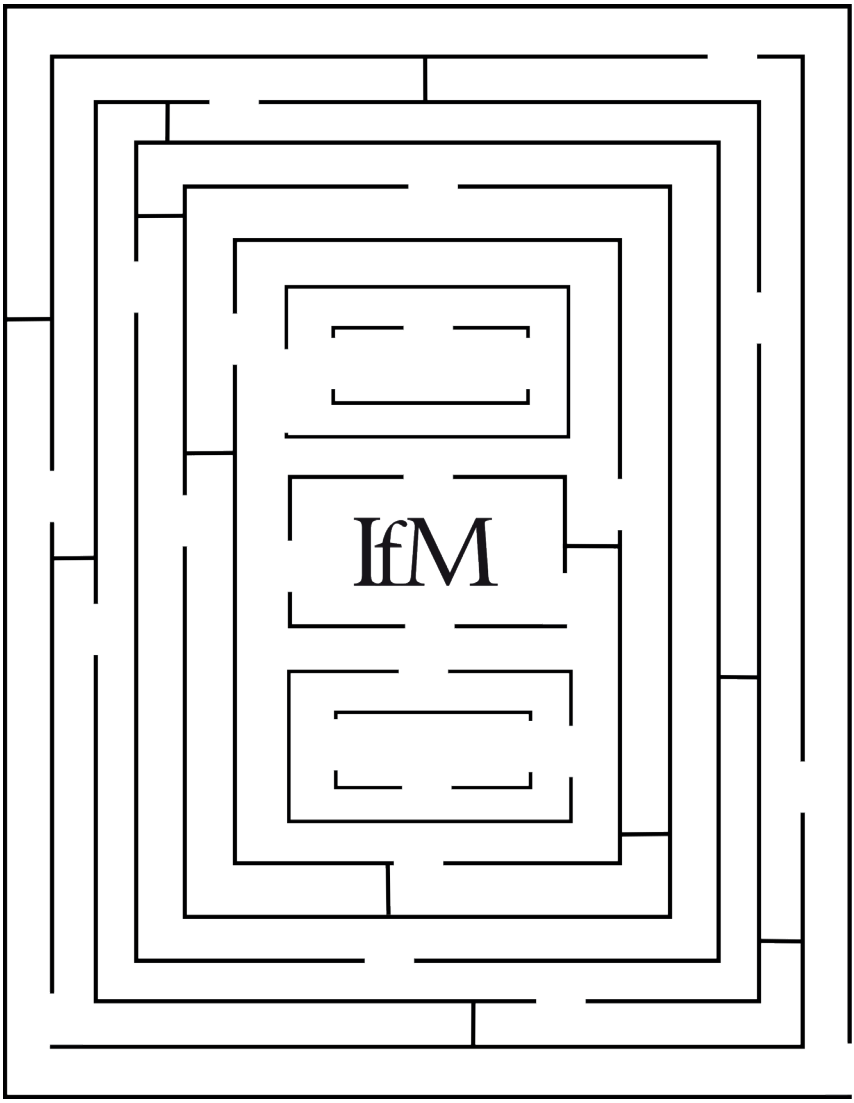
V C G B A U T O M A T I O N I O R I
H H S U P P L Y C H A I N W U W Y O
A J M A N U F A C T U R I N G J G N
D E S I G N T E C H N O L O G Y A R

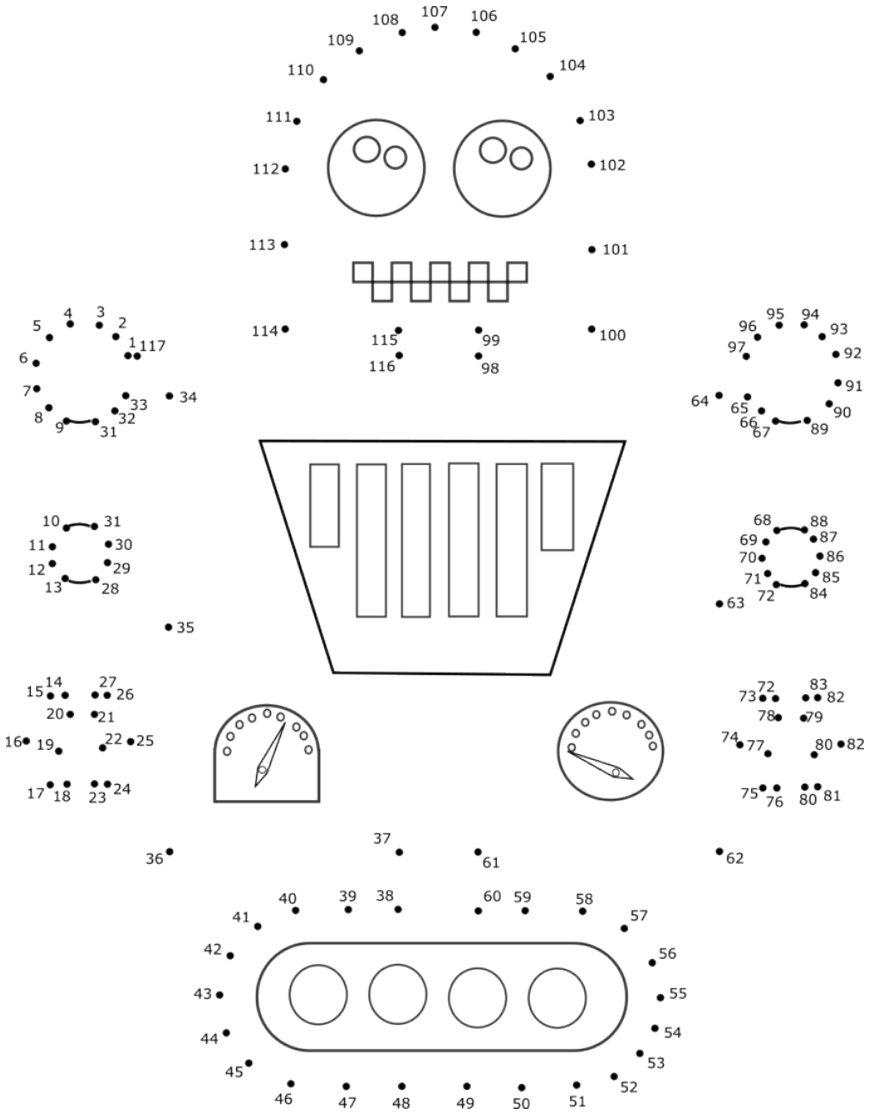
Find the following words in the puzzle.
Words are hidden → ↓ and ↘ .

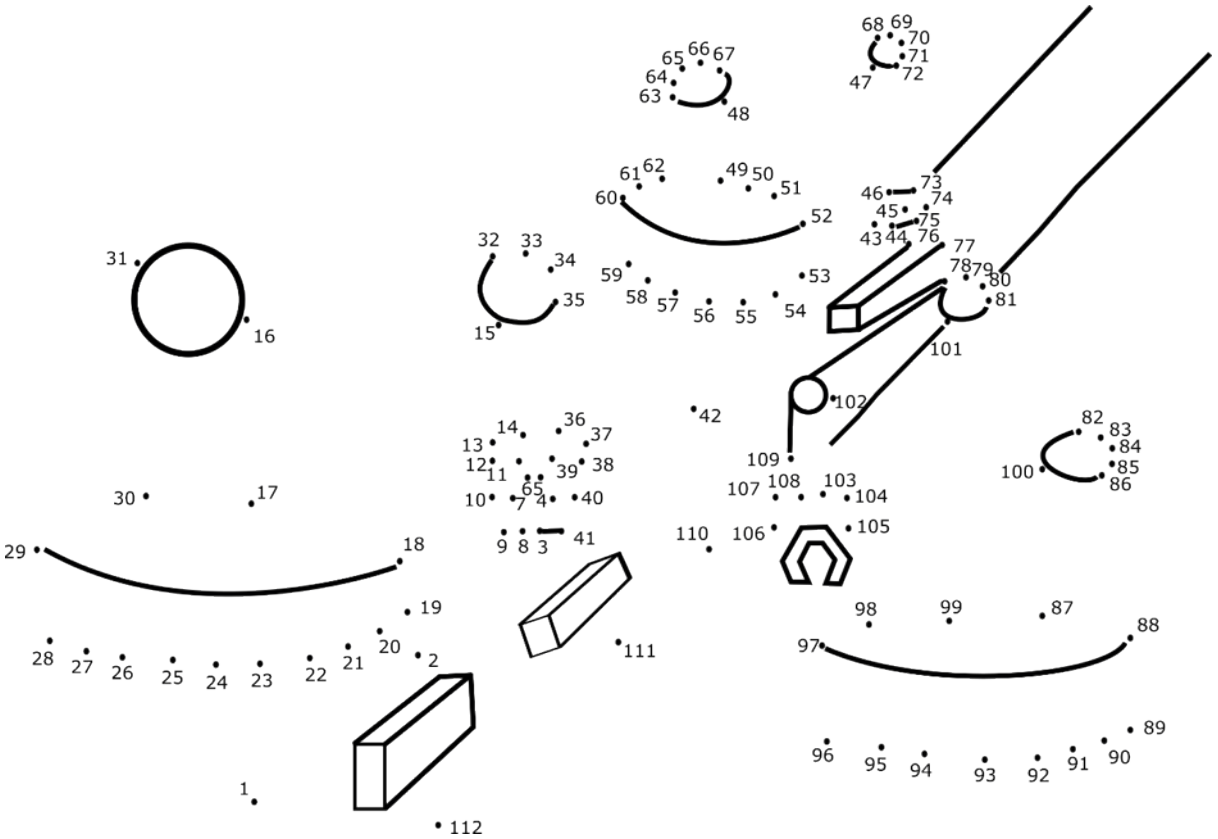
ADDITIVE
AUTOMATION
COMMERCIALISATION
DESIGN
DIGITAL
DISTRIBUTION
ENTERPRISE
INDUSTRY
INNOVATION
MANAGEMENT
MANUFACTURING
RESILIENCE
SUPPLY CHAIN
SUSTAINABILITY
TECHNOLOGY

IfM maze



Join the dots

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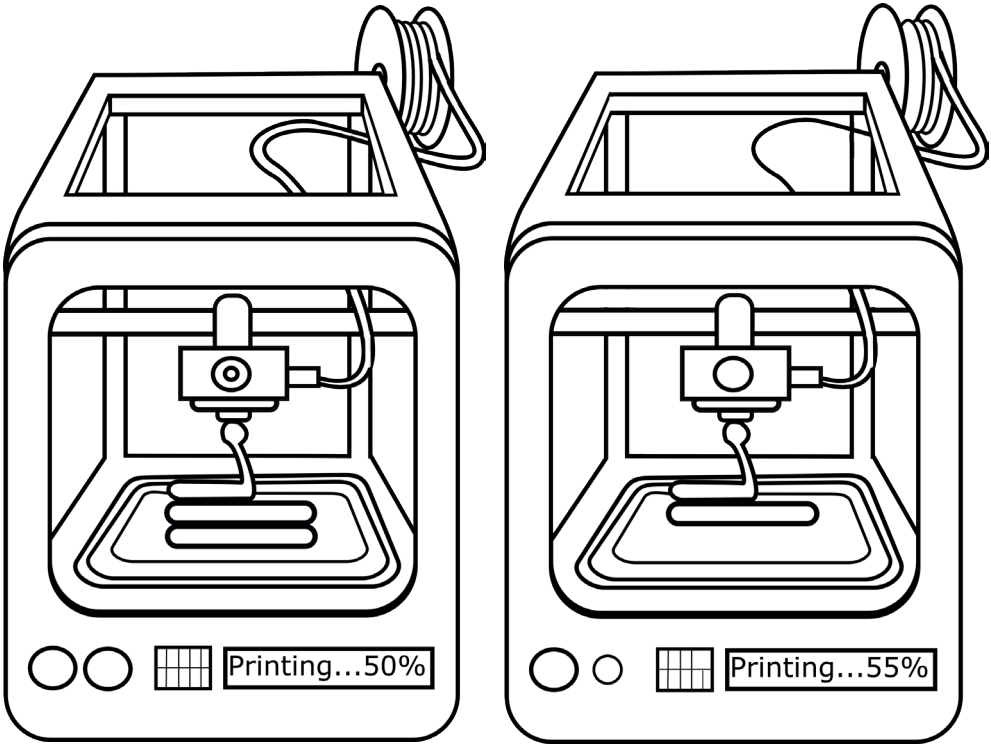
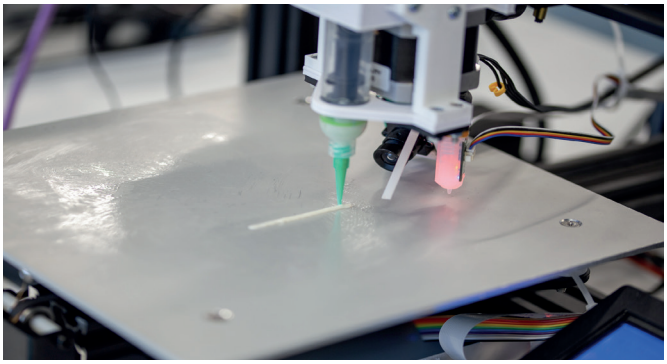
Spot the difference



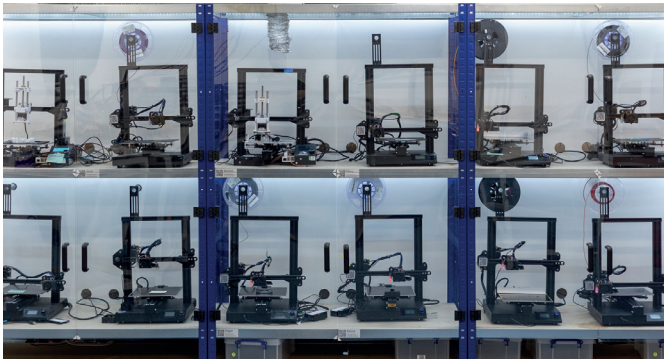
Spot the difference

Real life images of the IfM

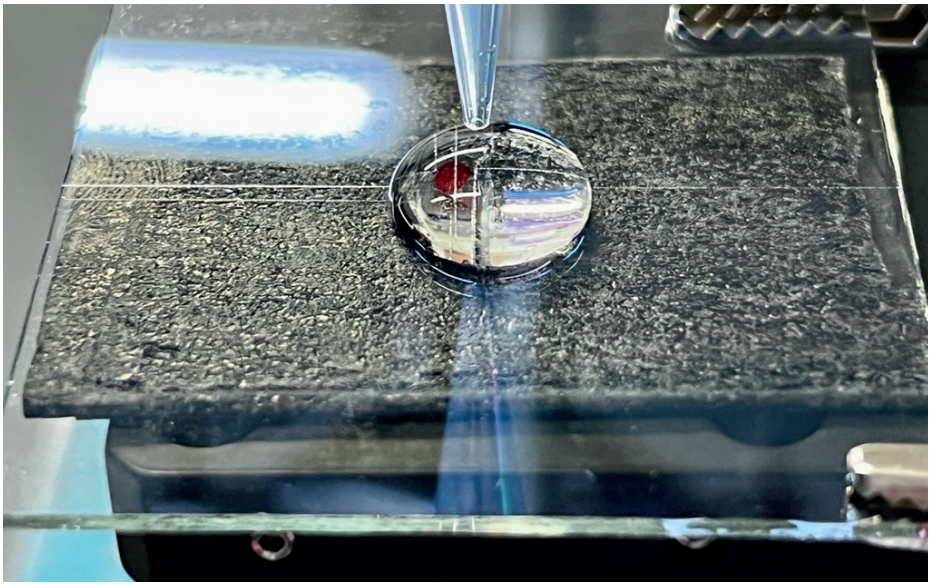


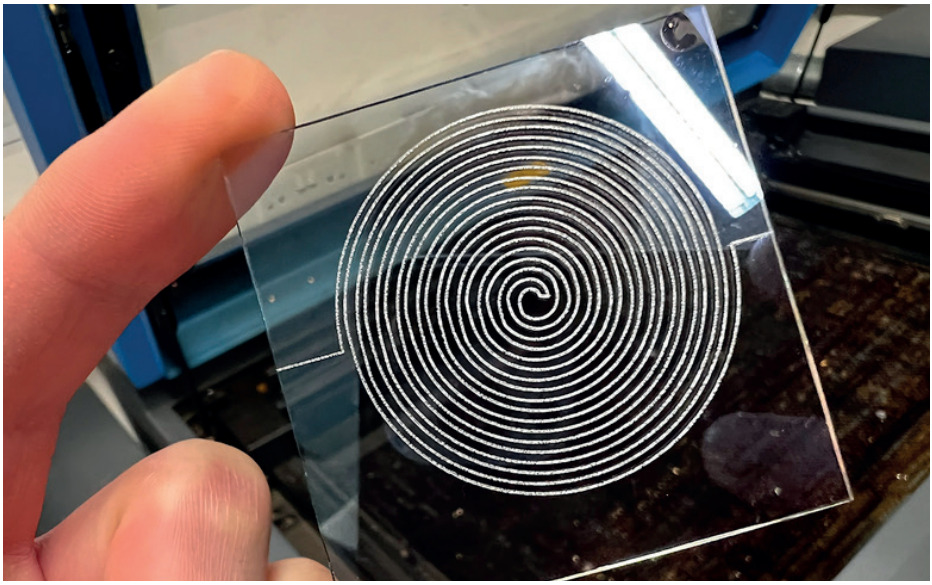
This 3D printer uses AI and computer vision to learn how to print mayonnaise – by itself! Yum!

At the IfM, students learn to programme state of the art industrial robots.

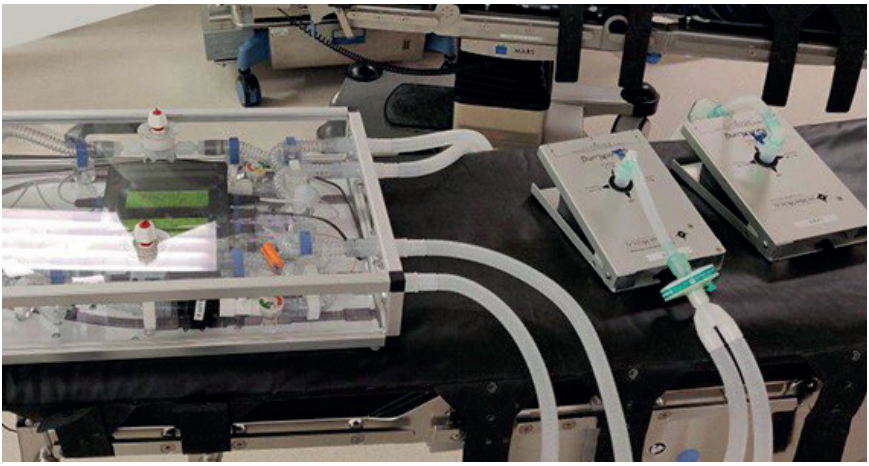


The Fellowship of Printers! Networked 3D printers work together to collect lots of information and learn how to print better!





Structures patterned into touchscreen glass increases their sensitivity as sensors. The spiral pattern is excellent for measuring droplets.

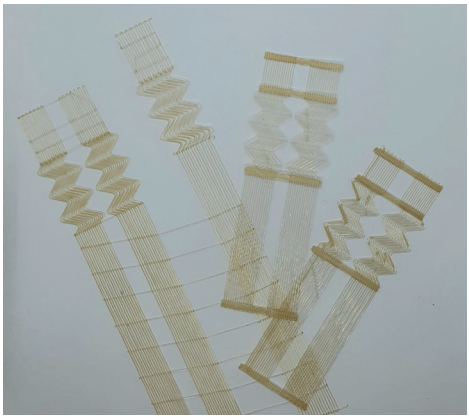


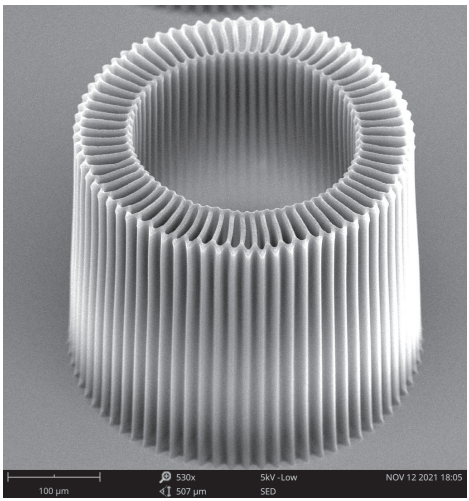
During the COVID-19 pandemic, IfM volunteers worked with the Royal Papworth Hospital to develop a device to double the capacity of ventilators so more patients could be treated in an emergency.

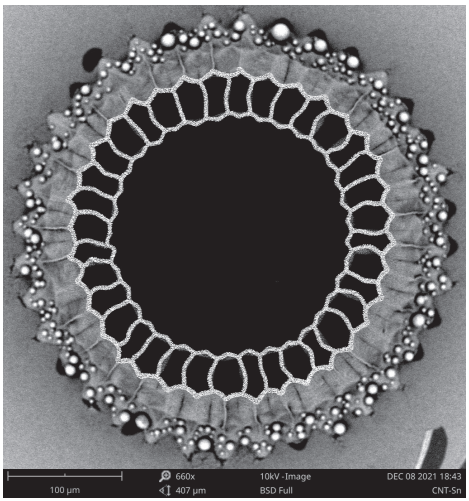
Volunteers from the IfM also helped to set up a temporary warehouse to deliver donated PPE items to Addenbrookes Hospital.

The IfM also helped to run the University's testing programme, delivering over 2,500 tests per week.

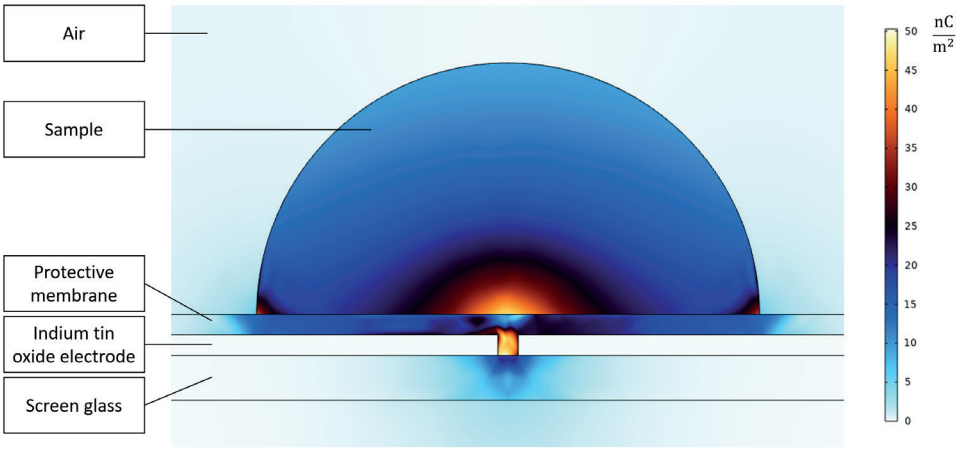
The original images

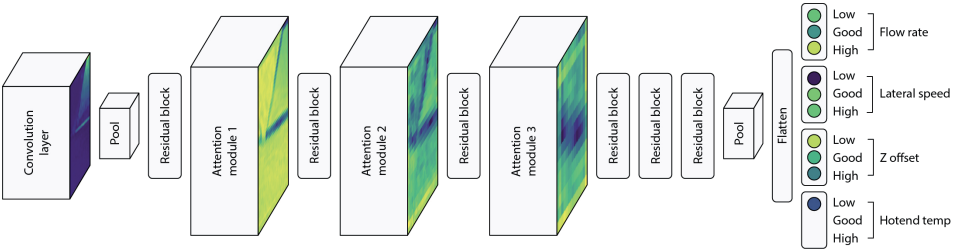






The electric displacement field while measuring a sample drop on a capacitive touchscreen sensor




Convolution layer
Pool
Residual block
Attention module 1
Residual block
Attention module 2
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Attention module 3
Residual block
Residual block
Residual block
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Good
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Flow rate
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Good
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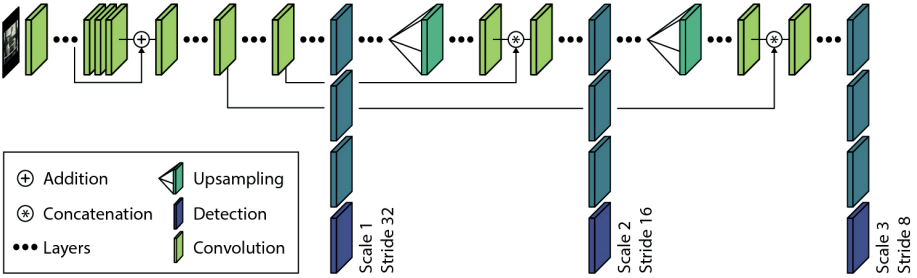
Lateral speed
Low
Good
High
Z offset
Low
Good
High
Hotend temp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Concatenation
Layers
Upsampling
Detection
Convolution
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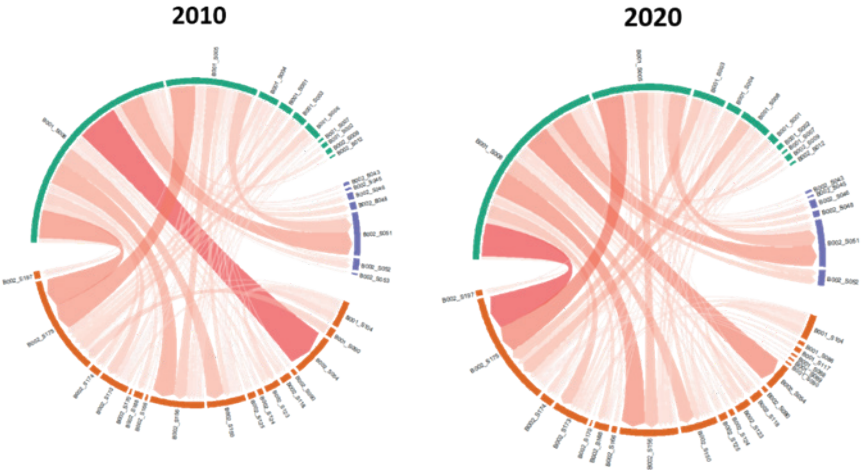
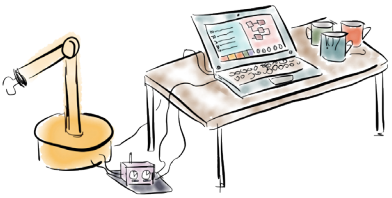
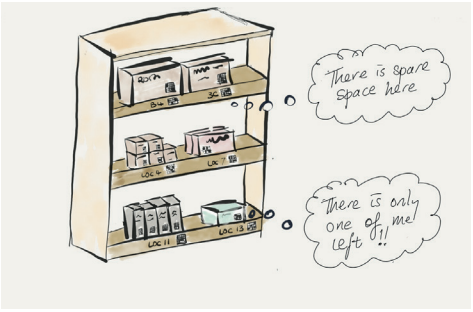
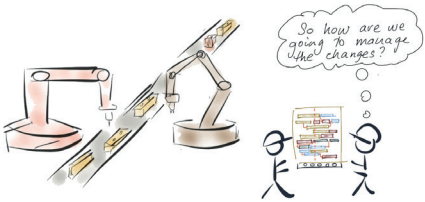
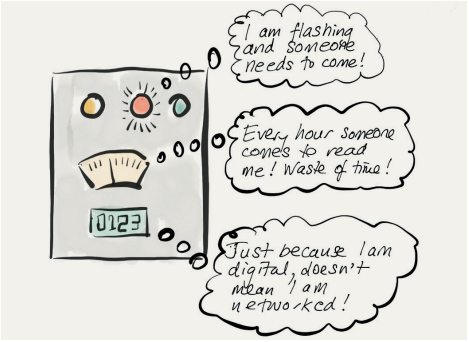
Stride 32
Scale 2
Stride 16
Scale 3
Stride 8


2010
2020



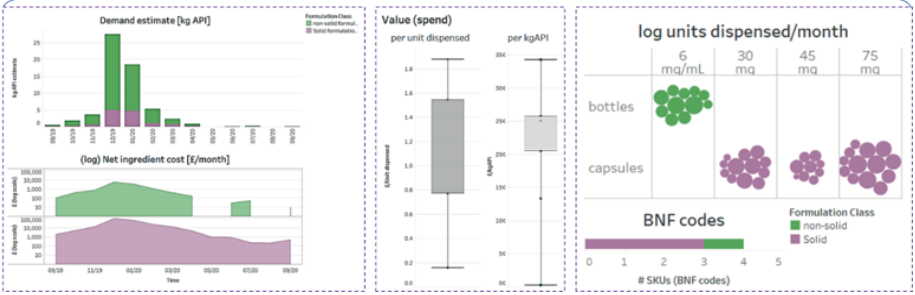




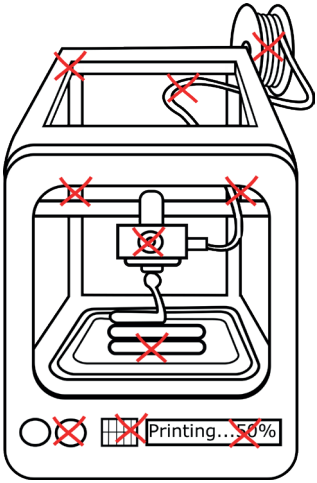


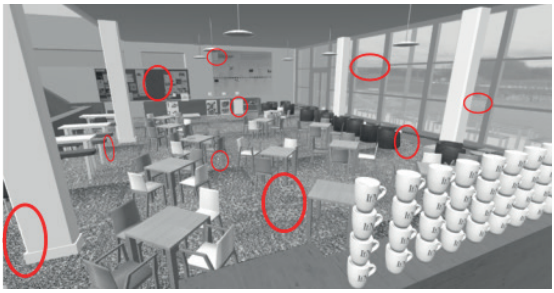
	Demand uncertainty	Product value	SKU flexibility	Supply uncertainty	Manufacturing asset cost
Antivirals	H	H	M	M	H
Analgesics	L	L	H	L	L
Anti-malarial	L	M	H	H	M
Anti-diabetes (Type2)	L	L	L*	L	L

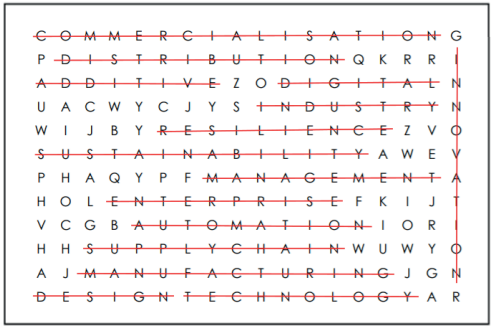
e.g. oseltamvir

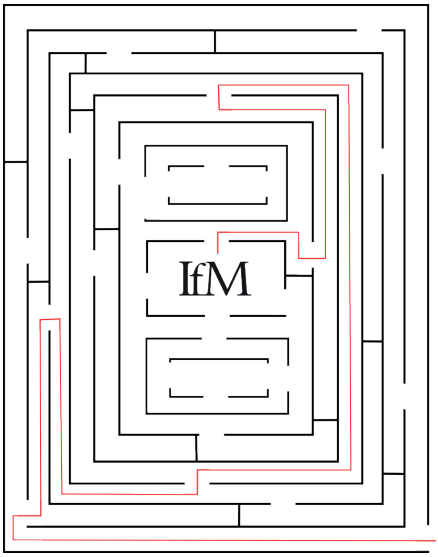


Activity solutions









Contributors

Colour in images

Pages 2-3 Lorena Gordillo-Dagallier and Sebastian Horstmann, Fluids in Advanced Manufacturing

Pages 4-5 Cassi Henderson and Douglas Brion, Complex Additive Materials

Pages 6-7 Mahdi Hamidi, NanoManufacturing

Pages 8-9 Lorena Gordillo-Dagallier, open-seneca

Pages 10-11 Clare Farruk and Rob Phaal, Centre for Technology Management

Pages 12-13 Duncan McFarlane, Distributed Information and Automation Laboratory

Pages 14-15 Ettore Settanni, International Manufacturing

Pages 16-17 Eoin O'Sullivan, Centre for Science, Technology and Innovation Policy

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Page 24 Douglas Brion

Page 25 Sebastian Horstmann

Page 26 Ronan Daly

Page 27 Rob Glew

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Activity pages designed by Niamh Fox.

Designed by Lisa Barnett

UNIVERSITY OF CAMBRIDGE
Department of Engineering

IfM MANAGEMENT TECHNOLOGY POLICY

Institute for Manufacturing
www.ifm.eng.cam.ac.uk

We can arrange visits into local schools through our 'How stuff gets made' programme, introducing manufacturing concepts to children with fun hands-on activities.
To find out more, please contact us: ifm-enquiries@eng.cam.ac.uk.

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