CONNECTING MANUFACTURING TO **THE INTERNET OF THINGS**

WHAT IS THE
INTERNET OF THINGS?

The Internet of Things (IoT) connects the physical world with the digital world.

With IoT, devices are linked by a wireless connection to the internet so that data can be shared. By connecting these devices to the internet, instant, accurate information can be collected, analysed and then used to improve productivity and efficiency.

For manufacturers, data generated by IoT devices provide real-time information which can help them to plan more effectively and build products faster. IoT can hold the key to unlocking increased visibility, security and a better customer experience.

"IoT brings many opportunities for manufacturers. There are solutions that will help even small companies step into the digital space."

Professor Duncan McFarlane, Institute for Manufacturing, University of Cambridge
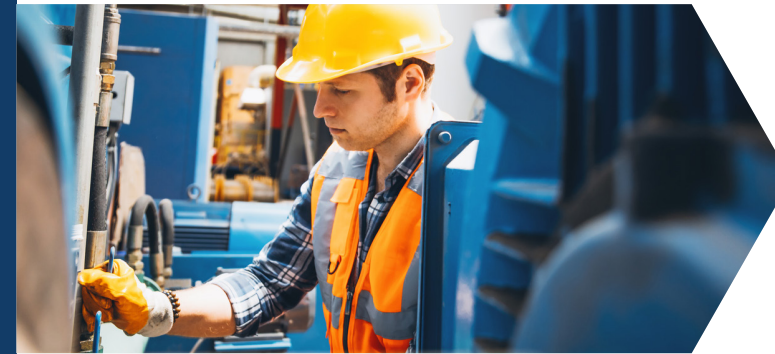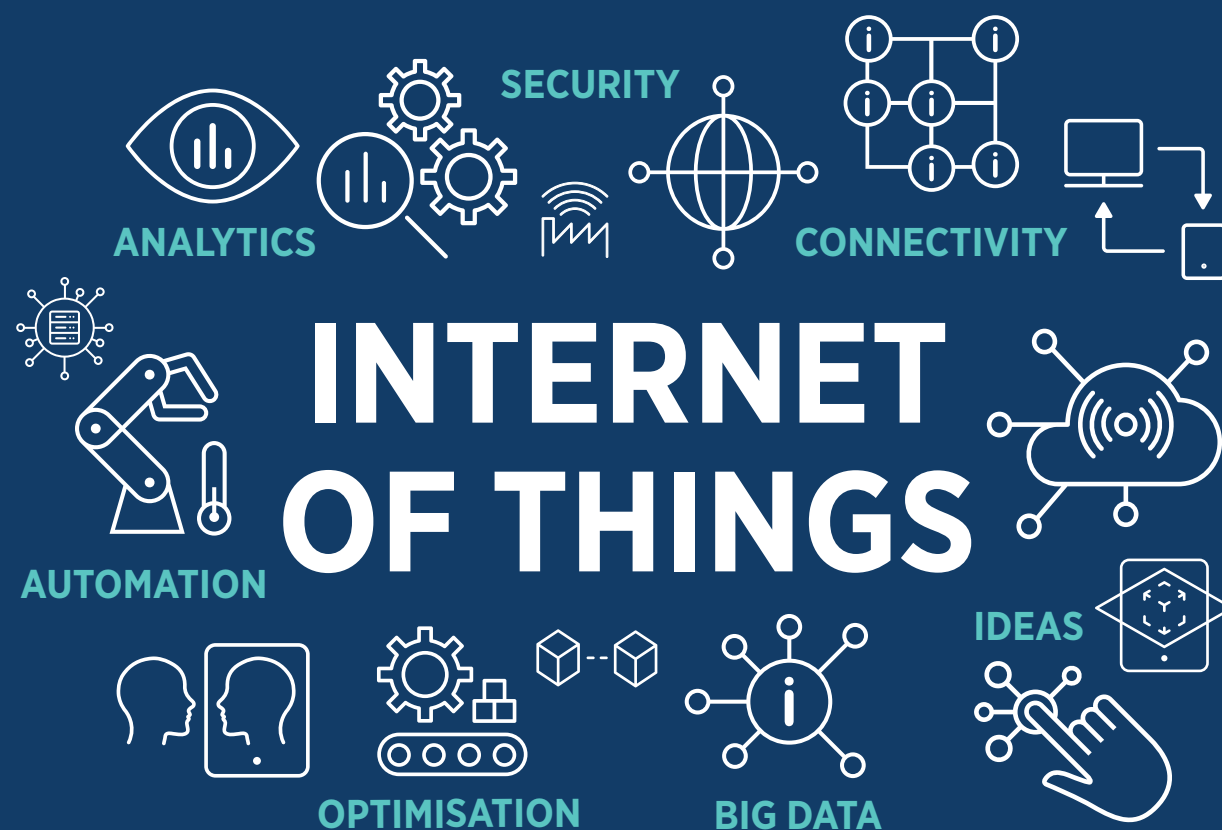
BENEFITS OF IOT IN MANUFACTURING

Digital transformation represents a priority for manufacturers across the UK.

Through digitalisation, manufacturers have the potential to achieve greater productivity, delivery and customer service.

Thanks to IoT, manufacturers can collect additional data and then act on what that data reveals. This means they have increased visibility and control over their processes and can make improvements quickly. In turn, this means companies can build products faster and more effectively.

SECURITY

ANALYTICS

CONNECTIVITY

INTERNET OF THINGS

AUTOMATION

IDEAS

OPTIMISATION

BIG DATA

EFFICIENCY ON THE FACTORY FLOOR

IoT solutions help monitor and predict machine breakdowns, so manufacturers can schedule maintenance in advance and avoid unexpected problems. Digital work instructions can help workers find and fix issues more effectively, improving workforce productivity.

PRODUCT DESIGN

Another benefit of IoT in manufacturing is that customer feedback and product-usage monitoring can be more easily incorporated into the design process. This results in better products and improved customer satisfaction.
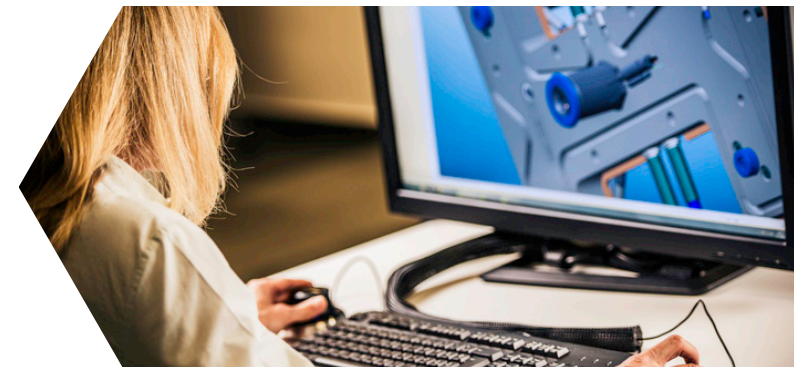
EFFICIENCY IN LOGISTICS AND SUPPLY CHAINS

IoT solutions can help transform supply chains, resulting in more seamless and coordinated operations. Sensors provide multiple real-time information points, for example when used to track a truck's location and the humidity and temperature levels inside its storage area. Combining IoT data can help handle uncertainty across the supply chain.

PRODUCT QUALITY

Using sensors to monitor production processes can provide insights into how fine-grained processing conditions relate to product quality. With IoT enabled technology, the quality of a product can be predicted with more confidence, reducing the need for costly manual inspections.

SUCCESSFUL INNOVATION IN MANUFACTURING USING **THE INTERNET OF THINGS**

This brochure showcases a number of projects led by researchers based at the **Institute for Manufacturing (IfM), University of Cambridge**, that are working to help the manufacturing industry connect with IoT.

Thanks to funding from **Pitch-In**, and through collaboration with industry, these projects have sought to help a range of manufacturing companies overcome the barriers to IoT adoption, offering practical and applicable routes for manufacturers of all sizes.

Typical barriers to adopting IoT include a lack of knowledge on how to deploy low-cost IoT systems, a lack of understanding of the variety of possible IoT solutions available and uncertainty as to how IoT can generate value. Pitch-In projects also looked at ways of overcoming connectivity barriers, such as lack of knowledge of various stakeholder skills and interests, as well as resource access barriers which included how to overcome IP, legal, security and business model difficulties to encourage data sharing.

By working in collaboration with industry partners such as the UK Warehousing Association, Fetch.ai, Schlumberger and Federal Mogul, the research has focused on solving real-world industry problems, offering up solutions which fit business needs, improve efficiencies and modernise industrial processes, whether on the factory floor or via supply chains.

REMOTE MANUFACTURING

By connecting manufacturing devices to the internet using IoT, employees can monitor operational equipment and environments and initiate local activity remotely. This research project demonstrates how to improve manufacturing quality control with IoT:

Manufacturing quality control with IoT

Showing how IoT-enabled sensors placed on a manufacturing process can provide significant improvements to statistical process control.

SEE RESOURCES ON **PAGES 10/11**

LOW-COST **AUTOMATION**

For many organisations, moving towards digital manufacturing can seem expensive, risky and out of reach. The perception of digital solutions is that they require significant initial investment and ongoing operating costs. These research projects demonstrate how low-cost and off-the-shelf technology are a critical component which open up the ability to drive business transformation through custom software applications:

Digital manufacturing on a shoestring

Using off-the-shelf, low-cost and open source IoT technologies to help develop digital solutions for manufacturing SMEs.

Digitalising non-critical healthcare support in hospitals

Demonstrating how low-cost digital technologies can support healthcare professionals in non life-critical situations, such as stock control, equipment usage and temperature monitoring of storage environments.

Customising large surfaces with sensors

Finding low-cost ways to customise large engineered, curved surfaces with sensors, and showing how, using using standard factory robots to print sensors onto these surfaces, parts can be customised at a late stage in the production process and costs kept low.
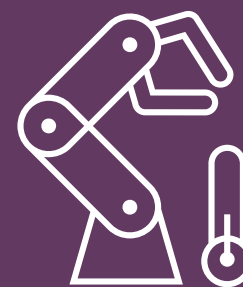
NEW
BUSINESS MODELS

Technology is continuously developing and many companies are keen to explore how new business models can help them maintain their competitive advantage. These research projects demonstrate how IoT can inform the kind of new business models that could have a big impact on manufacturing in the future:

Using smart licenses to restore trust in IP Licensing

Showing how smart contracts can digitally record and validate transactions for accountable, enforceable, transparent and trusted licensing agreements.
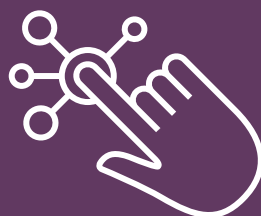
IoT-driven mass customisation

A theoretical tool to measure consumers' perception of the value of products customised using IoT data.

DIGITAL **STRATEGY**

Digital transformation involves the integration of digital technology into all areas of a business. The outcomes of these projects are designed to support companies to engage with IoT no matter where they are on their digitalisation journey:

Executive education courses to help companies engage with IoT

Executive education materials for non-technical managers to improve understanding of how IoT can be used to generate value and support new business models.

Creating a digitalisation strategy that works

A digital transformation strategy blueprint for manufacturers which shows what a successful IoT digitalisation strategy looks like.

SUPPLY **CHAINS**

Covid-19 has presented some significant challenges for supply chains. Thanks to the availability of real-time data, manufacturers can transform their supply chain operations, enabling up-to-date, informed decisions to be made.

Transforming supply chains with digital twins

Demonstrating how to gain competitive advantage by using IoT-based live models ('digital twins') to conduct 'what-if' scenario planning.

Using IoT to create autonomous, decentralised operations in supply chains

Mapping the technical feasibility of automating routine tasks of supply chain monitoring in real-life scenarios.

Integrating IoT and static data from multiple supply chain companies

Demonstrating the benefits of combining real-time data (from IoT) with static operational data in an integrated platform, enabling up-to-date, informed decisions to be made.

UNLOCKING IOT: **HELPFUL RESOURCES**

"IfM is here to help companies with inspiration and practical guidance on how to adopt IoT and innovate."

**Dr Alexandra Brintrup, Institute for Manufacturing, University of Cambridge**

The IfM has a number of resources to help manufacturers take advantage of the potential IoT has to offer.

CASE STUDIES

These case studies demonstrate in more detail how IfM research is encouraging the adoption of IoT in manufacturing.

- **Using Smart Licenses to Restore Trust in IP Licensing**
- **Using Executive Education Programmes to Help Organisations Engage with IoT**
- **Transforming Manufacturing Supply Chains with Digital Twins**
- **Demonstrating the Feasibility of Autonomous Supply Chains**
- **Creating a Digitalisation Strategy that Works**
- **Using Low-Cost Technologies to Help SMEs Move Towards Digital Manufacturing**

SCAN TO FIND ALL THESE RESOURCES AND MORE OR VISIT OUR WEBSITE **HERE**.
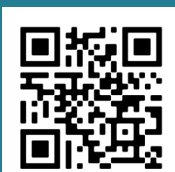
COURSES AT IFM ENGAGE

IfM Engage partners with organisations across industry, government and academia to support them in solving complex challenges, using approaches and knowledge developed at the Institute for Manufacturing (IfM). IfM Engage offerings are grounded in exceptional research, combined with a breadth of industrial expertise. There are a number of courses which can help you engage with IoT technologies.

Find out more: **www.engage.ifm.eng.cam.ac.uk**

COURSE: THE INTERNET OF THINGS – AN INTRODUCTION TO IOT STRATEGY AND TECHNOLOGY

This course provides an introduction to the strategy and adoption of Internet of Things technology. Participants are taken on a journey from how sensors work to how the use of the data generated could transform their organisational ecosystem. The course is designed for management- and executive-level employees in organisations from all sectors. Participants are not required to have any education in engineering or computer science, nor a technical background.

To register and find out more: **www.engage.ifm.eng. cam.ac.uk/project/the-internet-of-things/**

DIGITAL MANUFACTURING ON A SHOESTRING

Digital Manufacturing on a Shoestring offers an alternative approach that shows how it is possible for small- and medium-sized companies with small budgets to capitalise on advances in technology and implement low-risk digital solutions. Visit the website to see how your company can get involved.

Find out more: **www.digitalshoestring.net**

SHOESTRING CONSTRUCTION

Led by the **Construction Innovation Hub**, Digital Manufacturing on a Shoestring brings the opportunity for small- and medium-sized enterprises and other construction organisations to work with academic experts from the **Institute for Manufacturing**, **Centre for Digital Built Britain** and **Centre for Smart Infrastructure and Construction** to identify specific low-cost digital solution priorities. Organisations are helped to identify practical pathways for developing and deploying simple, low-cost digital solutions.

Find out more: **www.digitalshoestring.net/about/ affiliated-projects/**
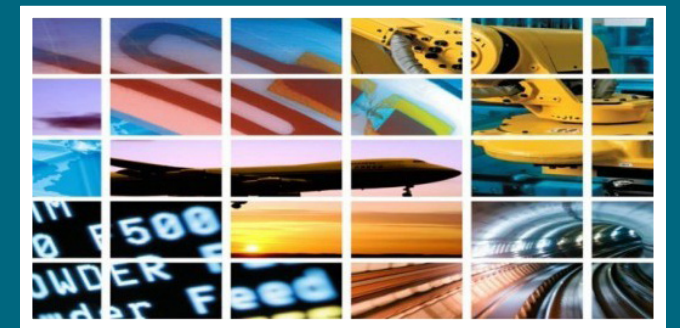
DISTRIBUTED INFORMATION AND AUTOMATION LABORATORY (DIAL)

The Distributed Information and Automation Laboratory (DIAL) based at the Institute for Manufacturing helps companies develop distributed automated solutions for manufacturing and logistics. There are a range of available tools designed to help companies overcome some key operational challenges.

Find out more: **www.ifm.eng.cam.ac.uk/research/dial/**

THE MANUFACTURING ANALYTICS GROUP (MAG)

The Manufacturing Analytics Group (MAG), part of the Distributed Information and Automation Lab (DIAL), studies emerging artificial intelligence technology, and nature-inspired and agent-based computing techniques to develop novel tools and methods for understanding and handling emergent outcomes in industrial systems. Focus areas include artificial intelligence in supply chains, smart factories and self-organising industrial systems.

Find out more: **www.ifm.eng.cam.ac.uk/research/ manufacturing-analytics/**

THE CENTRE FOR DIGITAL BUILT BRITAIN

The Centre for Digital Built Britain (CDBB) is a partnership between the Department for Business, Energy and Industrial Strategy and the University of Cambridge to understand how the construction and infrastructure sectors could use a digital approach to better design, build, operate and integrate the built environment. CDBB provides helpful case studies, tools and guidance for industry.

Find out more: **www.cdbb.cam.ac.uk**

Pitch-In, a collaborative project led by the Universities of Sheffield, Cambridge, Newcastle and Oxford, together with industrial and commercial partners, was established to show how to overcome some of the barriers to innovation in IoT within the manufacturing, energy, cities and health and wellbeing sectors.

Funded by Research England's **Connecting Capability Fund** since 2018, the project has trialled and developed a number of solutions in the form of 67 mini-projects to address the barriers to exploiting IoT opportunities.

CONTACT US

If you would like to find out how your organisation could benefit from IoT, get in touch to receive updates on the latest research and developments on IoT in manufacturing.

Distributed Information and Automation Laboratory (DIAL)
Institute for Manufacturing
17 Charles Babbage Road
Cambridge CB3 0FS

+44 (0)1223 766141
dial-admin@eng.cam.ac.uk

UNIVERSITY OF CAMBRIDGE
Department of Engineering

IfM MANAGEMENT TECHNOLOGY POLICY

Pitch-In

UKRI UK Research and Innovation