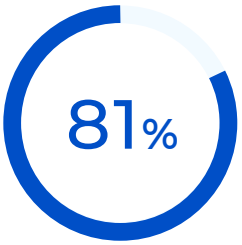
# The Connected Factory

July 2020

How Digital Catapult worked to develop and demonstrate in-factory internet of things solutions for Special Metals Wiggin and Dyer Engineering - the learnings and outputs of the project.

# Asset tracking within factory settings




**81% of factory owners say that they are ready to invest in new digital technologies to boost productivity.**

- Hennik Research Annual Manufacturing Report 2019

Internet of things (IoT) solutions applied within manufacturing and factory environments have the potential to unlock productivity, streamline processes, improve yield and increase quality control - ultimately driving improvements throughout the manufacturing process. However, transformational real-world technology success stories are rare - most of the existing examples are from larger corporates instead of the medium-sized businesses that make up the majority of the UK's manufacturing sector. Further to this there is a misconception that a large scale factory refit is required to adopt this technology, and to benefit from the opportunities a connected factory brings.

Being able to identify a part and its location, as and when it is needed, is a simple enough expectation of any business. Having parts unavailable at the point they are needed wastes man hours and risks orders not being completed on time. Losing a part means it needs to be remade, risking quality issues if processes are hurried in order to satisfy a commitment, in addition to the wasted time and resources.

IoT and asset tracking, particularly within the manufacturing sector, enables a product that would otherwise have no way of sharing information about itself, its environment or its location, to be monitored and share information electronically.

A part or batch of parts, say one or more cut sheets of metal, is such a product. It has no way of communicating anything about itself except for being visible. By introducing a small, low cost, low power device, these parts can be made smart or connected. They can provide a continuous stream of information that enables workers to precisely locate and even provide information about the environment - including the temperature or air moisture.

In response to both of these opportunities and challenges, Digital Catapult initiated an industry-first trial, funded by Innovate UK, with two well established UK manufacturers. This paper explores the outputs and learnings from these connected factory trials undertaken with UK manufacturers Special Metals Wiggin and Dyer Engineering. This project and paper demonstrates how the application of IoT technologies can be applied to legacy factories to boost productivity.

# An introduction to the trial factories

## Special Metals Wiggin:

### Asset tracking indoors and outdoors across 190,000 square metres

Special Metals Wiggin, based in Hereford, is a leading supplier of specialist alloys to the marine, automotive and nuclear industries. Over the past decades it has refined and optimised its production processes which, coupled with expertise in the field of metallurgy, makes the company a global player.

Special Metals Wiggin required assets to be tracked across the entire manufacturing facility (approximately 190,000 square metres) in both indoor and outdoor environments. The team at Special Metals Wiggin had identified and recognised the need for a connected factory, however it had not yet embarked on its IoT adoption journey due to the lack of accessible, relevant case studies to take learnings from.

Hereford based market leader in the production of specialist Nickel based alloys for the automotive, aerospace, marine and nuclear industries.

Its product is cutting-edge and used by companies across the globe including Airbus, ABB, Westinghouse, Fiat, Rolls Royce and SNECMA. The facility is vast, with legacy equipment and incredibly difficult to update to industry 4.0 standards.

£180m

£180 million turnover

400+

400+ employees

1800's

Established in 1800's

190K m²

190,000 square metre site

## Dyer Engineering:

### Indoor asset across multiple sites with a footprint of 8,361 square metres

Dyer Engineering, based in County Durham, specialise in fabrication and machining with wide-ranging capabilities to manufacture metal components and structures. It manufactures for key markets including rail, oil & gas and marine.

Dyer Engineering required assets to be tracked around multiple warehouses over two sites with a total combined footprint of 8,361 square metres. Tracking was only required indoors, with no GPS signal available inside the warehouses.

Dyer Engineering specialises in the fabrication and machining businesses with wide-ranging capabilities to manufacture metal components and structures.

£12m

£12 million turnover

150+

150+ employees

1977

Established in 1977

8K m²

Multi-site requirement with 8,361 square metres

1K

Processing over 1,000 orders at any time

5K

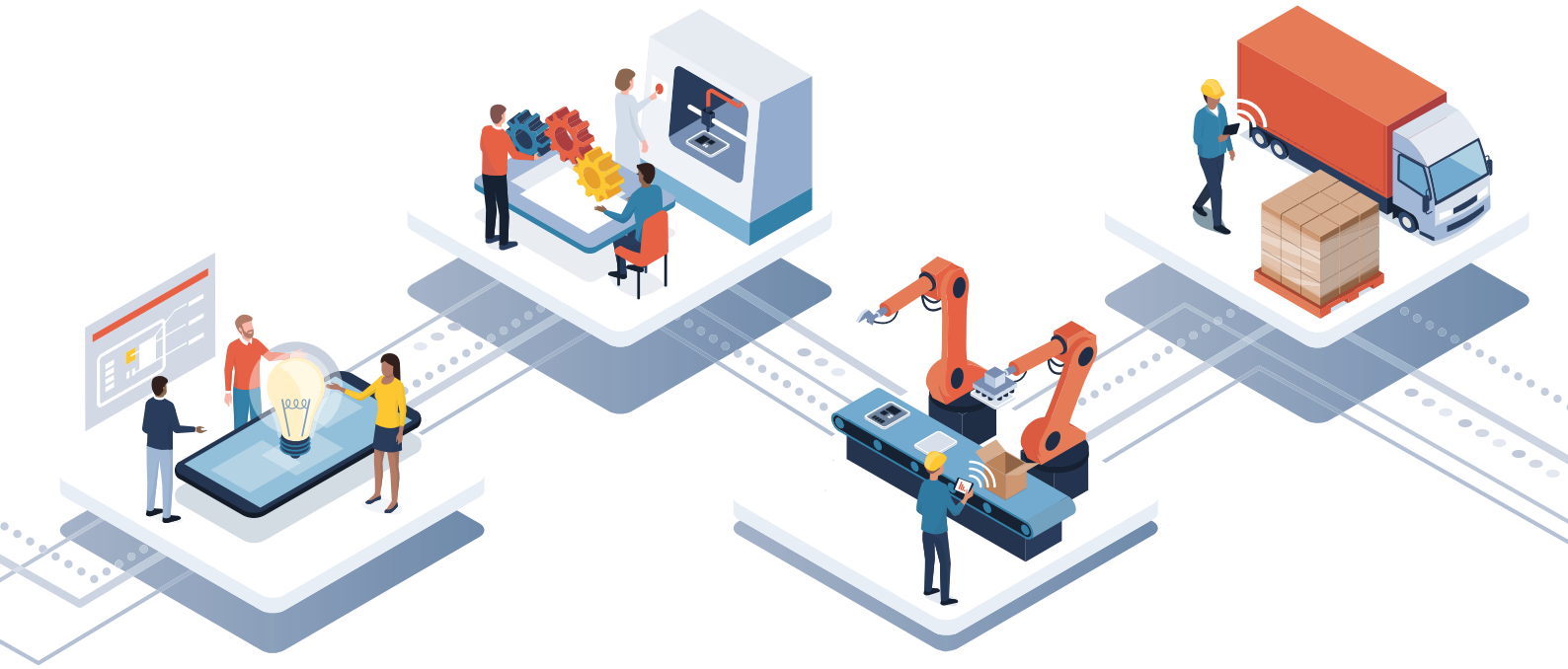
5,000 parts (assets in circulation)

# Challenge led solutions

Across both trial partner sites, due to the sheer scale and complexity of the operations, there was the potential for hundreds of component parts to be moving around the sites at any given time. While orders can easily be tracked through established systems, the tracking of actual parts was a highly manual process that still relied on people. However, a manual process, especially across sizable sites, can often lead to missing and mislaid parts and result in costly production delays.

The aim of the trials was to create a physical connected manufacturing demonstrator, to solve these business challenges - which are commonly seen across the industry. Utilising emerging industrial IoT technologies, Digital Catapult wanted to de-risk the deployment for factory partners by proving that a particular use case in a real factory is both viable to set up and brings a return on investment.

In collaboration with the factory operations managers and end users, together we refined the partner requirements, set the relevant challenges and launched an open call to find solutions from Digital Catapult's leading innovation community of IoT startups. The proposed solutions utilised a wide range of low powered networking technologies including Bluetooth, ultra-wide band and low powered wide area networks (LPWAN). Leveraging Digital Catapult's in-depth knowledge of these technologies allowed the pitching and development of solutions that would best suit the use cases identified.



# Developing solutions to fit factory settings

For deployments of IoT solutions, factory environments are by their very nature harsh in terms of radio interference and complexity of layout. Due to the nature of the two partner settings this was particularly the case for both sites. Such environments require robust hardware that can withstand both physical shock as well as high temperatures. Tracking sensors need to be able to operate for months or even years without the need to change batteries. In addition the sensors need to be able to be paired and unpaired with physical assets in a seamless and rapid way. The tracking equipment deployed around the factory needed to be integrated with the existing networking infrastructure without the requirement to upgrade switches or even install new network components. For the full benefits to be realised the tracking solution required integration with the enterprise resource planning (ERP) systems that the factories use for their day-to-day order processing. For any solution to be truly effective it needs to work for the end user factory workers without adding unnecessary burden to their work and operations – and for that reason the factory teams were engaged with the project from the outset.

These factories cover a significant footprint so understanding the precise location of components is essential. It was identified early on in the project that an accuracy of one metre was required. Both factories had outdoor storage areas and therefore both the sensors and the beacons needed to be able to withstand the diverse British weather.

Following a detailed evaluation of the technologies proposed as well as a business case analysis of the solutions the relevant and individual solutions were identified.

The selected vendor, Thinkinside, specialises in location intelligence for indoor spaces. It measures, monitors and analyses in real-time how people and assets move inside a physical space. It provides analytics and KPIs to decision-makers on how to optimise business processes through advanced real-time indoor location-based services. The company's origins date back to 2010 when the team of four founders were working in a research centre in the development of new solutions for indoor localisation. Since then, Thinkinside has been designing, developing and deploying indoor location-based solutions with customers in different market sectors including smart manufacturing, retail, fairs and exhibitions, smart buildings and healthcare.

The Thinkinside platform is specifically designed to easily and rapidly support the deployment of indoor location based services, supporting different kind of real time locating systems (RTLS) technologies (Quuppa, WiFi, BLE beacons), and providing all the necessary supporting services (monitoring, maintenance, asset life-cycle management, analytics, APIs for third-party integration).

Following site visits to both factories Thinkinside developed the deployment and integration plan which included a radio survey of the sites to identify how many beacons would be needed and where they should be located. Unlike many other tracking solutions that require multiple beacons to locate through triangulation, the Thinkinside solution uses an array of antennas within the beacon to measure angle of arrival and received signal strength and thus derive the position from which the signal originated (the location of the asset). In essence, any tracker located within the cone beneath the beacon can be found. This solution is ideal in metallic environments where radio reflections are likely to occur. Additional tracking coverage is obtained by deploying more beacons. Specific hotspots can be added as required.

Working closely with the IT and engineering teams at both factories, an integration architecture was designed. A key aspect of the project was to make the solution accessible to the end users who operate the facilities on a day to day basis. As such, the teams were provided with digital display dashboards, scanning devices and the necessary training to ensure that they could seamlessly integrate the new tracking solution into their day to day activities. Over the following four weeks, the antennas were delivered and installed, and the 1,000+ tracking devices arrived on site.The form factor of the selected tracking devices was carefully selected to ensure that they would be compatible with the assets being tracked at the two sites. Both partner factories represented relatively hostile environments for electronic equipment due to the use of heavy machinery, high temperatures and significant electrical noise. This resulted in the need for robust tracker casings.

# Demonstrating the benefit of asset tracking for factory environments

In both cases, the solution was integrated with the factories' ERP order management systems. As orders arrived and initiated, trackers were paired with the order paperwork as well as the physical items. In the case of Special Metals Wiggin, this starts as a metal ingot and in the case of Dyer Engineering, these are machine metals parts which go on to become a finished assembly. This immediately allows any tracked object to be located in real time on the factory floor. A key feature of the system is the ability to show the tracker's location against the actual factory floor plan. The system also maintains and shows a complete journey profile for each tracked object which allows for workflow and factory layout design to be optimised. Items left for long periods or in areas that represent a health and safety risk can be quickly identified therefore reducing the risk of accidents.

Within days of the solutions going online, both factories reported immediate benefits in terms of time saved in locating items. Skilled staff can focus on their tasks rather than spending time searching for mis-placed assets. The production cycle throughput increased productivity leading to improved profitability, and reduced lead times have resulted in an overall better customer experience.

To ensure effective operation Special Metals Wiggin performs regular stock checks, with production stopped during these times. These checks are completed four times a year. Further to this, any misplaced items or parts may require remanufacture in order to meet required delivery schedules.

£2m

Special Metals Wiggin estimated that a tracking solution would alleviate this and thus save them £2 million per year. For a company with an annual turnover of £180 million this represents a significant cost saving.

5%

Dyer Engineering has an annual turnover of £12 million with over 150 employees. It estimated that a five percent improvement in productivity overall would be realised through more efficient asset tracking. The savings are equivalent to eight people.

Following the successful implementation and six month trial, Dyer Engineering decided to expand the deployment across its entire site. Special Metals Wiggin is seen by its parent company PCC as being an exemplar site for IoT innovation.

## Demonstrating the benefit

As part of the trials, Digital Catapult identified a number of clear benefits for companies in similar environments when activating an asset tracking IoT solution:

- **Savings in employee wages:** The time taken for staff to locate parts
- **Downtime saved:** The lost order capacity when machines and operators are not in use whilst staff locate and/or reprioritise jobs
- **Remakes avoided:** The cost of remaking assets or parts over locating parts, or because products have become unusable due to the way they had been stored
- **Cancelled orders avoided:** The cost of orders lost due to delays in production
- **Penalties and fines avoided:** The cost of late deliveries, or sub-standard quality as a result of missing parts, unsuitable storage of parts, or timing of locating parts
- **Increased order capacity:** The ability to process more orders due to increased productivity
- **Reduced order completion time:** The ability to save time for processing orders with parts being more easily located
- **Employee wellbeing:** The improved wellbeing of staff no longer frustrated by locating missing parts, having to cut corners to make up time, or having to work overtime to complete orders

> "We are thrilled to have been able to provide Special Metals Wiggin and Dyer Engineering with the opportunity to implement cutting edge IoT indoor tracking technology. This has allowed both factories to enhance their production business and operations and has allowed them to accelerate their IoT journey and benefit from the opportunities this presents"
>
> **Peter Karney**
> Head of Product Innovation at Digital Catapult

# The Connected Factory

### Hand held scanning device

Associates the tags with the items being tracked

**Benefit:**
Tag association can be built into the existing workflow

### Beacons

Beacons installed around the factory receive radio signals from the tags to allow their location to be calculated

**Benefit:**
Simple to install across an entire manufacturing environment

### Location lookup screens

Providing a complete overview of all parts via screens on the factory floor

**Benefit:**
Easy access to the location of assets

### Tracking tags

Sensors that get attached to the items being tracked

**Benefit:**
Time saved searching for parts - item locations can be found instantly

### Location resolver

Uses the data from the beacons to identify where the items are currently located

**Benefit:**
Reduced downtime and more efficient workforce as parts are in the right place at the right time

### Back office computer

Providing a complete overview of all tracked parts on the factory floor

**Benefit:**
Optimising factory throughput

### Process optimisation system

Uses historical location data to model enhancements to the factory layout

**Benefit:**
Factory layout can be optimised to maximise production throughput

### Sales order

Integrates with the sales order system

**Benefit:**
Faster production times leading to increased customer satisfaction

# Digital Catapult's work in factories and asset tracking

To find out how asset tracking solutions can benefit your facility, Digital Catapult has developed a simple online tool to calculate how much a solution could benefit your business. For further information, please visit the Connected Factory project page at:

www.digicatapult.org.uk/for-large-businesses/commercial-solutions/connected-factory

Digital Catapult has also recently launched it's IoT Discovery Programme enabling businesses working in the industries that can benefit from internet of things (IoT) adoption to make informed technology choices that will have a positive impact on their business. Visit:

www.digicatapult.org.uk/for-large-businesses/commercial-solutions/iot-discovery-programme

## Digital Catapult is the UK's leading advanced digital technology innovation centre, driving early adoption of technologies to make UK businesses more competitive and productive and grow the country's economy.

We connect large established companies, startup and scaleup businesses and researchers to discover new ways to solve big challenges in the manufacturing and creative industries. Through this collaboration businesses are supported to develop the right technologies to solve problems, increase productivity and open up new markets faster.

Digital Catapult provides physical and digital facilities for experimentation and testing that would otherwise not be accessible for smaller companies.

As well as breaking down barriers to technology adoption for startups and scaleups, our work de-risks innovation for large enterprises and uncovers new commercial applications in immersive, future networks, and artificial intelligence technologies.

For more info please visit: www.digicatapult.org.uk

To keep up to date with Digital Catapult's latest work please subscribe to the newsletter here