

The logo for Manufacturing Technology Centre (MTC) features the lowercase letters 'mtc' in a bold, italicized, white sans-serif font. The letters are set against a teal rectangular background that is part of a larger teal square in the top center of the image. The background of the entire image is a dark blue to black gradient with a complex, glowing network of light blue and white lines, resembling a fiber optic or data network pattern.

*mtc*

Manufacturing  
Technology Centre

# INSPIRING

Great British Manufacturing

The image features a teal-colored background with a complex network of glowing blue lines and dots, resembling a data or manufacturing network. In the upper left, there is a teal square containing the 'mtc' logo and the text 'Manufacturing Technology Centre'. The background also shows a blurred industrial or military scene with a large structure, possibly a ship's superstructure, and a helicopter in the foreground. The overall aesthetic is high-tech and futuristic.

**mtc**

Manufacturing  
Technology Centre

# **IMPROVING** PERFORMANCE AND PRODUCTIVITY FOR **DEFENCE** THROUGH ADVANCED MANUFACTURING **TECHNOLOGIES**

# BACKGROUND



- Opened in 2011
- Independent RTO
- Secure facilities
- Prove innovative manufacturing ideas
- Manufacturing system solutions
- Training

# MTC & HVM CATAPULT

The High Value Manufacturing (HVM) Catapult is the catalyst for the future growth and success of manufacturing in the UK.

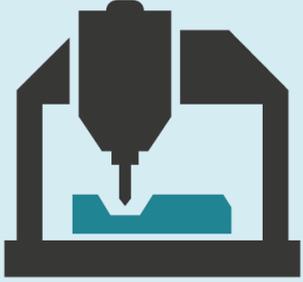
We are developing extensive capability in manufacturing technologies and process expertise to grow the contribution of the manufacturing sector to the UK economy.

The MTC will:

- Identify and implement new technologies
- Undertake research and development
- Complete client or collaborative projects
- Increase operational efficiency
- Support the supply chain
- Provide technical training and employee upskilling



# INDUSTRY CHALLENGES



You want to make something

at a lower cost  
better quality  
quicker  
in higher volume  
you've never made before



You want to assemble something to

minimise reject rate  
improve reliability  
improve consistency  
reduce waste  
reduce errors



You want to use data more effectively for

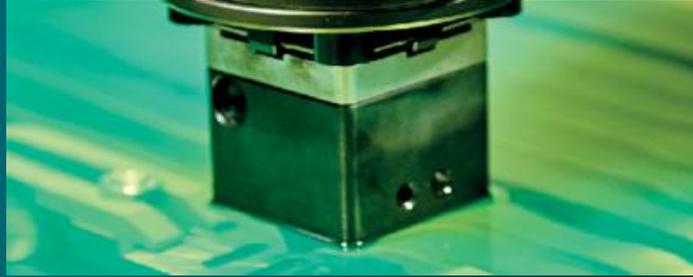
improved design  
better quality  
efficient logistics  
new business models

# MANUFACTURING INNOVATION

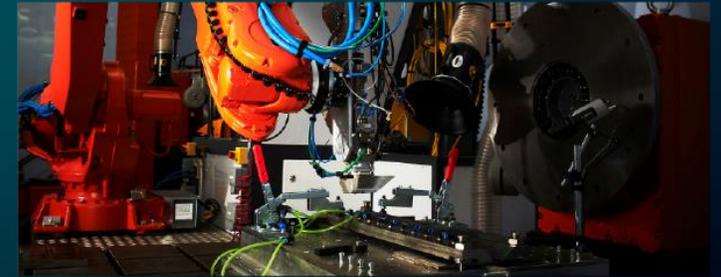
Component  
Manufacturing



Additive Manufacturing



Non-Conventional Machining



High Integrity Fabrication

Assembly  
Systems



Advanced Tooling and Fixturing



Electronics Manufacturing



Intelligent Automation

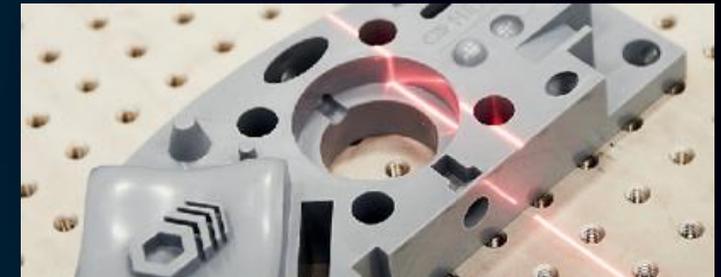
Data Systems



Design and Simulation



Manufacturing Informatics



Metrology and NDT

# FACTORY IN A BOX (FIAB)



## Dr. Hannah Edmonds

- Technical Specialist in Digital Engineering at The Manufacturing Technology Centre and leads:
  - The Thermal Energy Research Accelerator (T-ERA) project for Factory In A Box (FIAB) Manufacture at MTC
  - The MTC's Smart Manufacturing Accelerator (SMA), a service for delivering integrated manufacturing and supply chain solutions enabled by industrial digital technologies

# Factory In A Box:

**A disruptive supply chain solution  
enabled by industrial digital technologies**

**Dr Hannah Edmonds,**

*Technical Specialist / Digital Engineering,*

*The Manufacturing Technology Centre (MTC)*

In partnership with:



**UNIVERSITY OF  
BIRMINGHAM**



**Loughborough  
University**



**IN THE FUTURE...**

**DESIGN AND DEVELOPMENT  
WILL BE DECENTRALISED.**

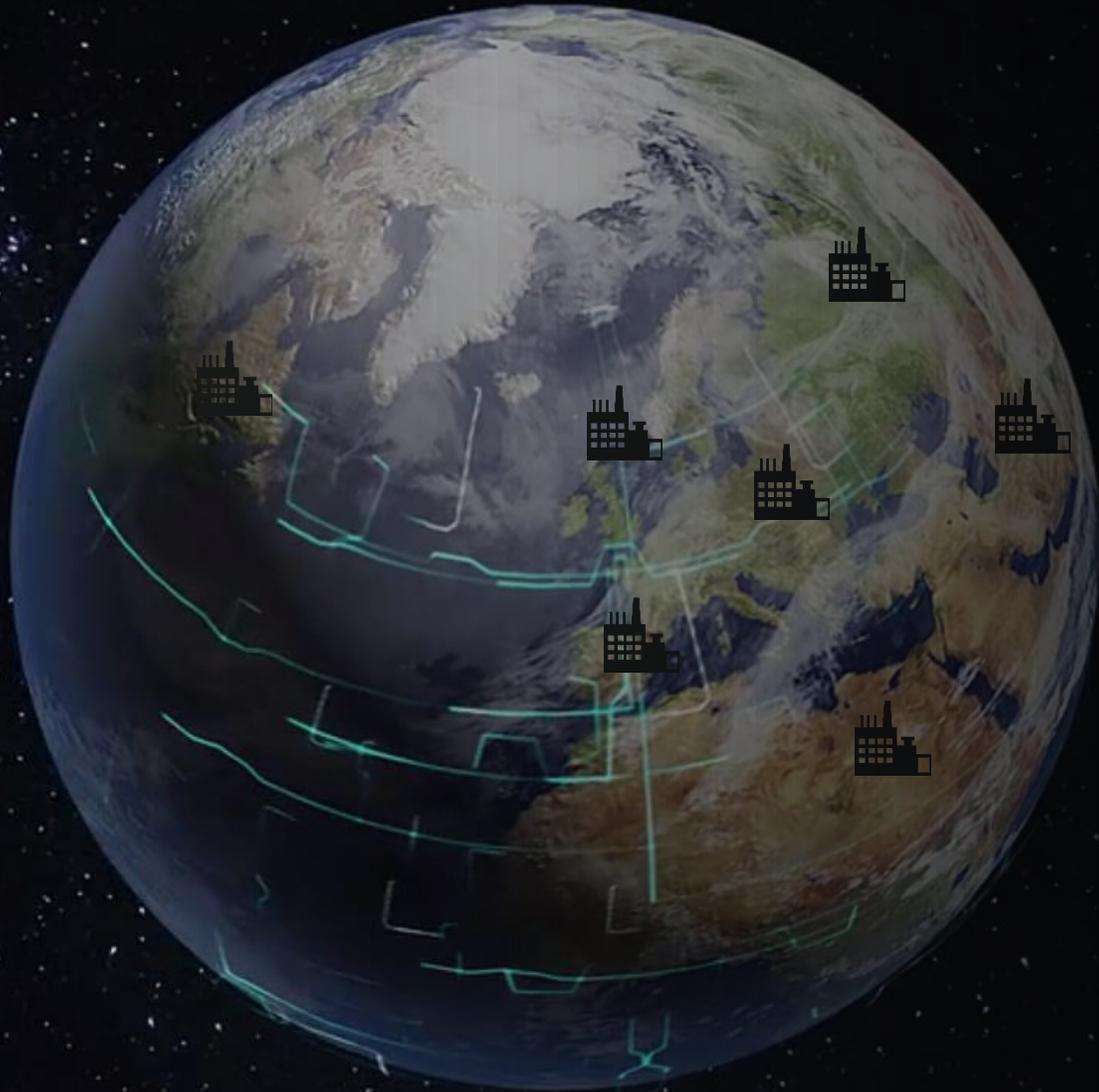
**RISK AND UNCERTAINTY  
WILL BE MINIMISED IN  
VIRTUAL WORLDS THAT  
LEVERAGE LEARNING.**

**IN THE FUTURE...**

**FACTORIES WILL BECOME  
SELF-AWARE,  
HYPER-CONNECTED  
AND SELF-OPTIMISING.**

**AGILITY WILL BE  
SECOND NATURE IN  
MANUFACTURING.**





**IN THE FUTURE...**

**THE WORLD WILL LEARN TO  
DO MANUFACTURING IN A  
DIFFERENT WAY.**

**VALUE WILL SHIFT TO LESS  
TANGIBLE ASSETS AND WILL  
BE REDEFINED.**



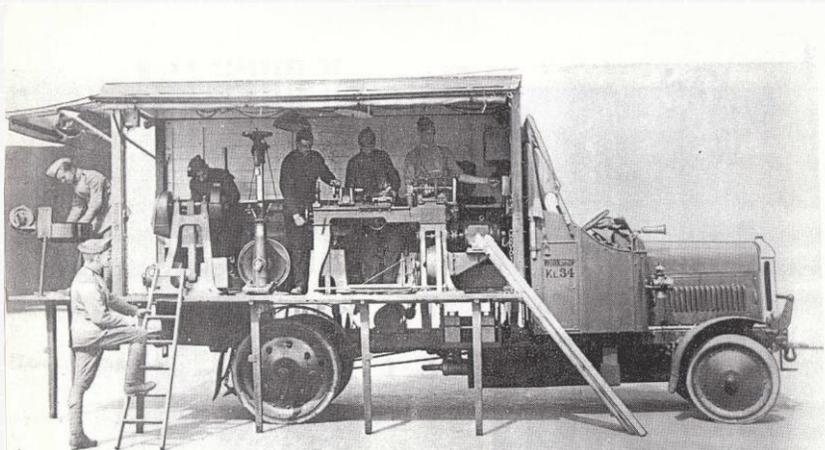
**THE DEMONSTRATOR...**

# What is a Factory In A Box?

## Prior Art...



WW1 RFC Mobile Workshop



**NOMAD** demonstrator  
Norwegian Defence  
Research Establishment



**AMFaD** Technology Demonstrator  
European Defence Agency



**Fablab**  
United States Army's  
Rapid Equipping Force



# Factory In A Box

## Distributed Manufacturing: *A New Business Model*



NETFLIX

Spotify®

amazon

ZARA

UBER

Rapidly deployable,  
Remotely managed,  
Modular,  
Manufacturing supply chain network

Enabled by  
Industrial digital technologies



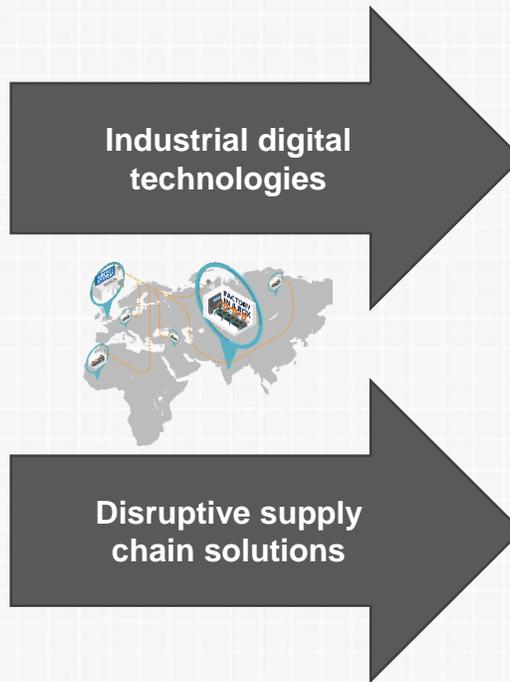
# Why Factory In A Box Manufacture?

## The Value Proposition

### INDUSTRIAL NEEDS

- Local capacity for remote manufacture / repair
- Increased product / process quality and traceability
- Quick to market
- Cyber secure manufacture
- Product variation

### FACTORY IN A BOX (FIAB)



### INDUSTRIAL GAINS

- Shorter / more responsive supply chain
- Product / process digital twin
- Flexibility
- Quality assurance
- Product



# Factory In A Box 1

## Cryogenic Pipe Assembly Fabrication

### Application:

- “Plumbing” for Dearman transport refrigeration unit.
- A range of pipe geometries required to fit different vehicles.



### Manufacturing Challenge:

- Skills shortage.
- Stringent quality & safety requirements.
- Distributed customer base.

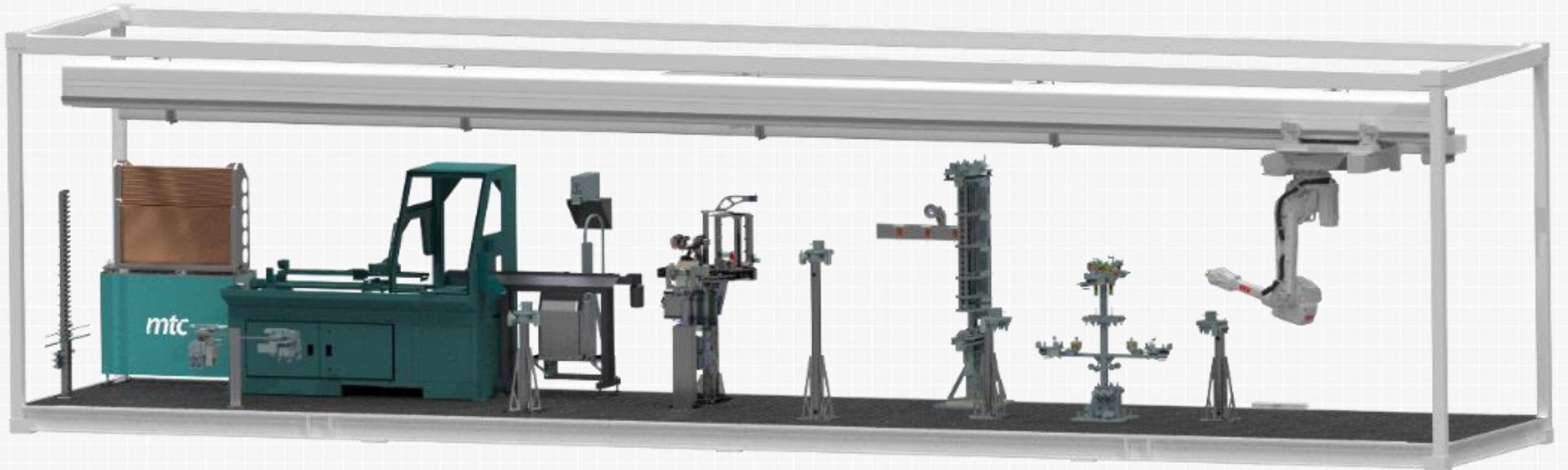
### FIAB Benefits:

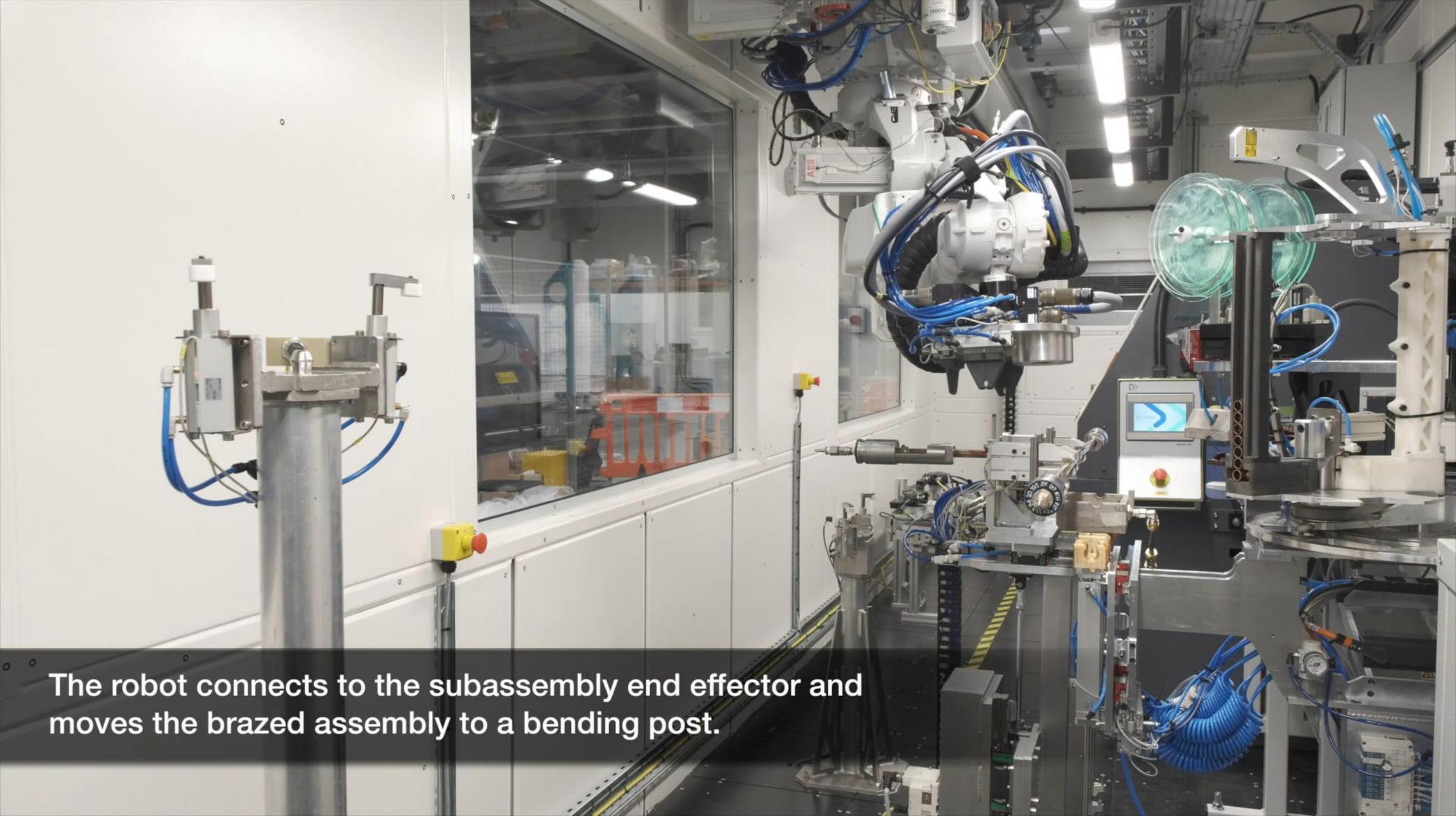
- Increased capacity to meet market requirements.
- Product & process traceability.
- Remote deployment & flexible production.



# Factory In A Box 1

## Cryogenic Pipe Assembly Fabrication

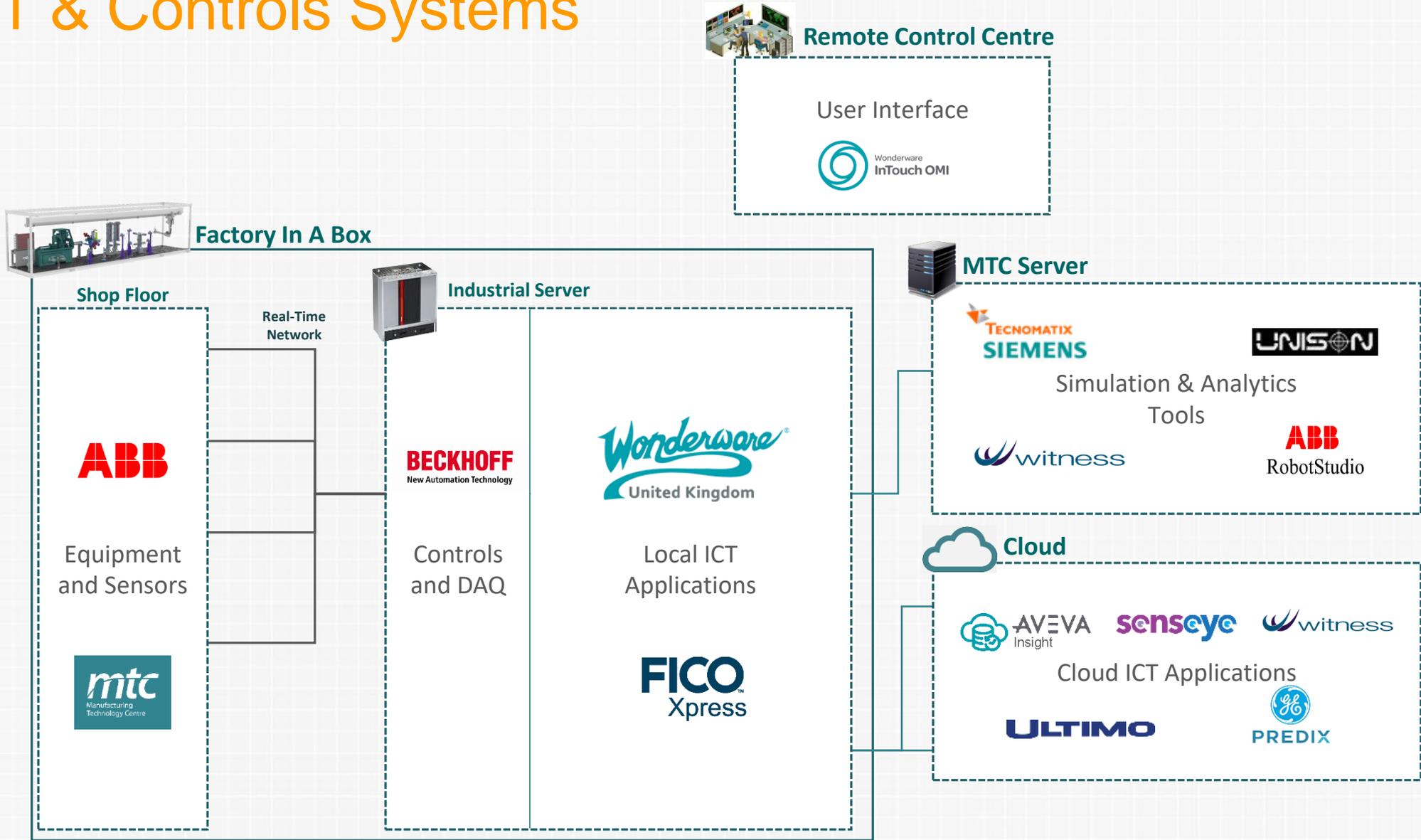




The robot connects to the subassembly end effector and moves the brazed assembly to a bending post.

# Factory In A Box 1

## ICT & Controls Systems



# Factory In A Box 1

## ICT & Controls Systems



"10 steps to Cyber Security"



Cyber Security Framework

IEC 62443

ISO/IEC 27000 Series

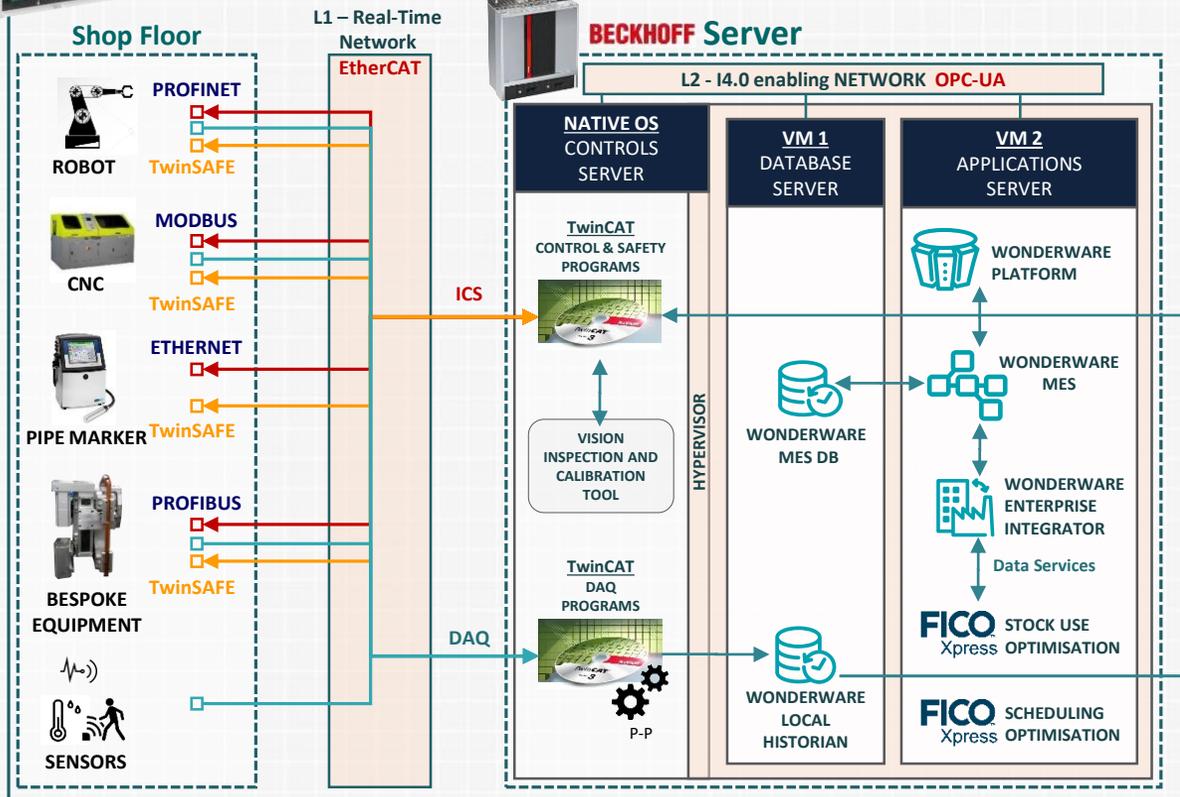
Security Standards



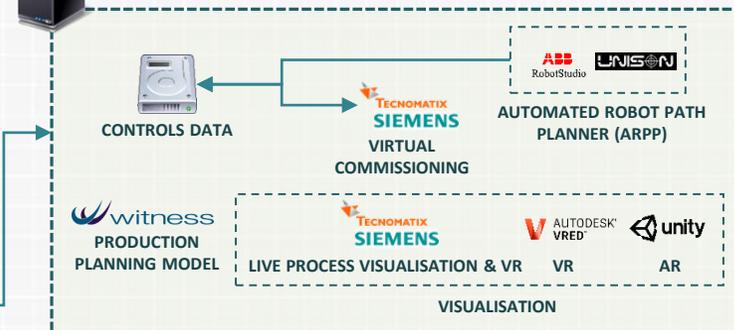
Remote Control Centre



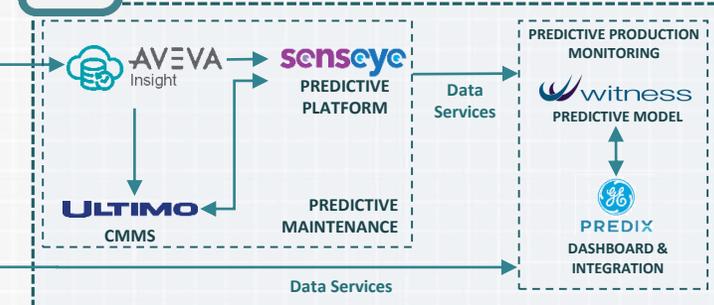
Factory In A Box



MTC Server



Cloud



- ISO 12100
- ISO 13849-1&2
- ISO 13850
- ISO 14119
- ISO 13850
- Safety Standards

# Factory In A Box 1

## Remote Control Centre

### FIAB DASHBOARDS

SELECTED: FIAB 1 - MAIN

#### ORDER MANAGEMENT & OPTIMISATION

- Assembly Catalogue
- Sales Order
- Stock Use Optimisation
- Production Planning Applications

#### REMOTE MONITORING & CONTROL

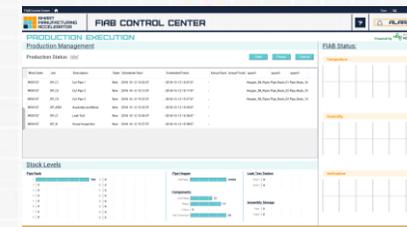
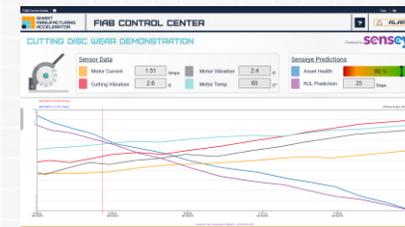
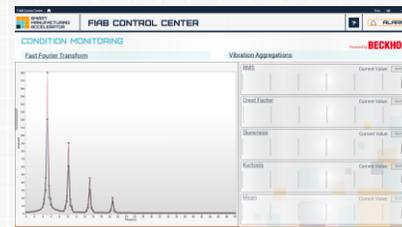
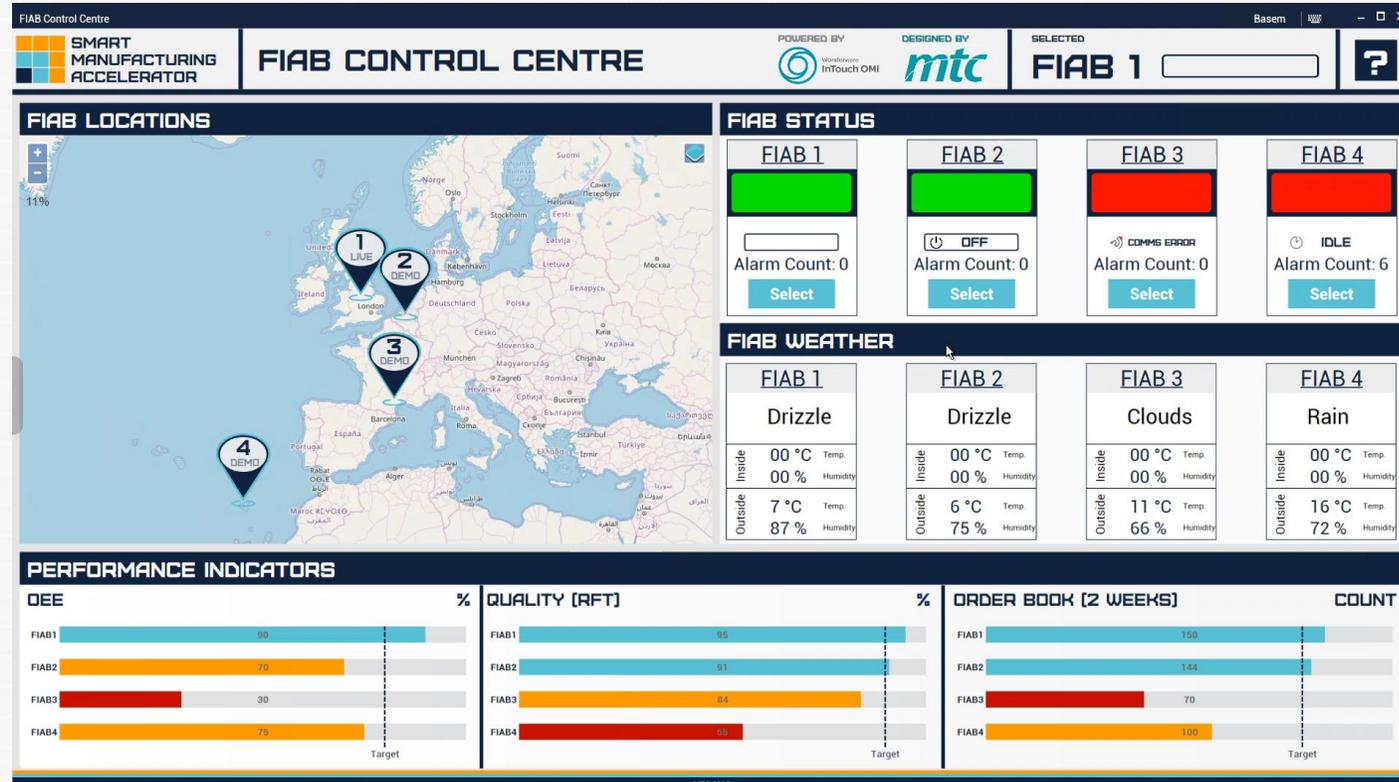
- FIABs Overview
- Machine Monitoring
- Production Execution
- Hardware in Loop
- Stock Management

#### QUALITY MANAGEMENT

- Assembly Quality
- FIAB Overall Quality

#### MAINTENANCE MANAGEMENT

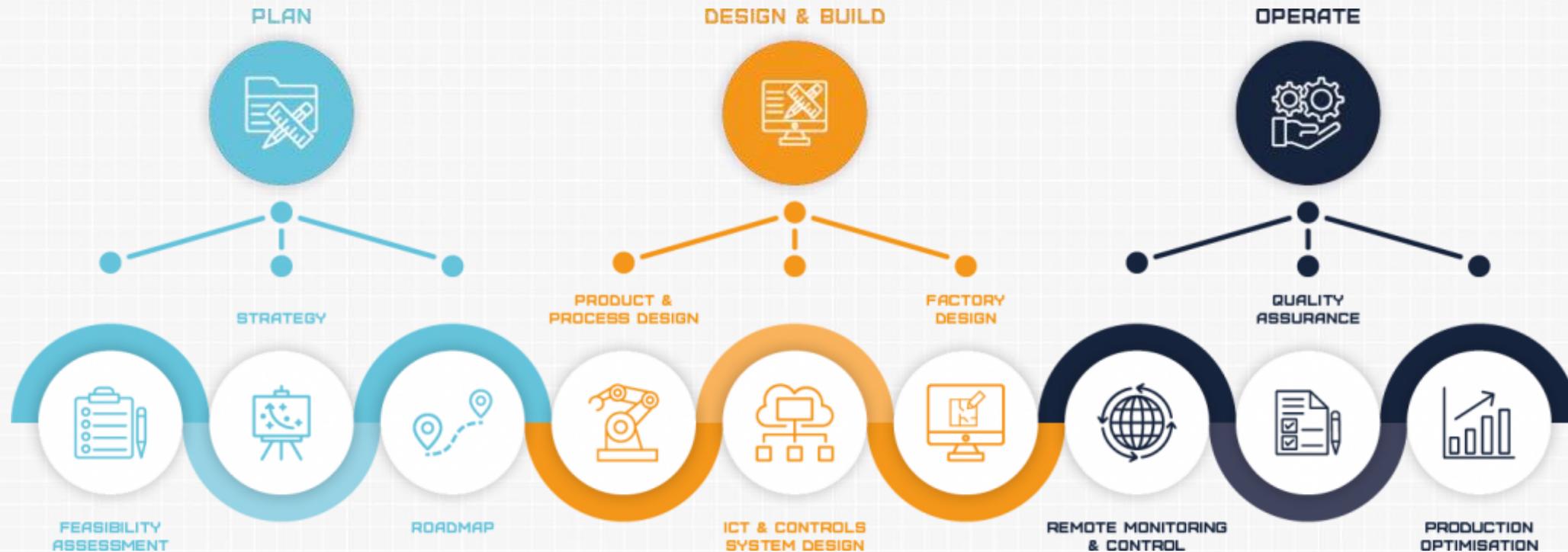
- Maintenance Assessment
- Predictive Maintenance
- Automated Maintenance Order
- AR for Maintenance



# The Smart Manufacturing Accelerator

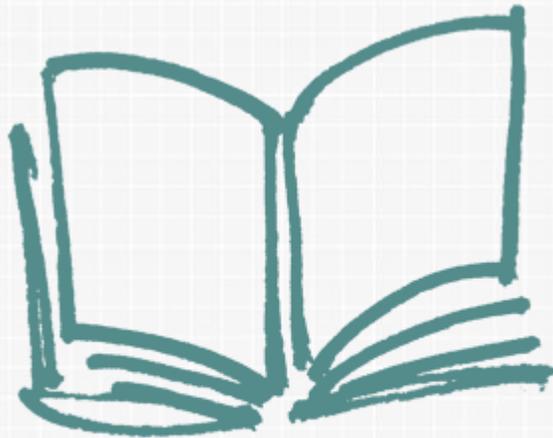


A framework for innovative manufacturing and supply chain solutions.






**SMART  
MANUFACTURING  
ACCELERATOR**



- Mechanical system design & build.
- Factory design & layout validation.
  - Process design validation (3D Kinematic Modelling).
  - Virtual Reality based design review.
- Automation system design.
  - Controls architecture design.
  - Virtual commissioning of controls.
- ICT architecture & infrastructure design.
  - Systems down selection.
  - System architectures (cloud-based architecture).
- What if analysis using a virtual factory model.

- Flexible manufacturing
  - Automated robot path planning.
- Autonomous system management.
  - Cyber security.
- Operations real time visualisation.
  - Remote control centre.
  - Process simulation (3D kinematic model) .
- Production Optimisation.
  - Schedule optimisation.
  - Stock use optimisation.
- Predictive maintenance.
  - Condition monitoring.
  - Computerised maintenance management system.
- Performance visualisation.
  - Process digital twin.
- Quality Assurance.
  - Operations data for traceability.
  - Production of certified products.
- Advanced visualisation
  - Remote process visualisation (Virtual Reality).
  - Maintenance support (Augmented Reality).

# Factory In A Box Project Delivery Team



**ABB**

**Dearman.**

solutions<sup>pt</sup>  
Industrial IT Solutions

**ULTIMO**  
SOFTWARE SOLUTIONS

**SIEMENS**

**LANNER**  
Future. Proof.

**UNISON**  
INTELLIGENT TUBE TECHNOLOGY

**mtc**  
Manufacturing  
Technology Centre



**FICO**

**AUTODESK**

**senseye**



**BECKHOFF** New Automation Technology

**ERA** ENERGY  
RESEARCH  
ACCELERATOR

**Innovate UK**



**UNIVERSITY OF  
BIRMINGHAM**



**Loughborough  
University**



# #MakingDigitalaReality

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