Automated Deployment of Manufacturing Use-Cases through OpenStack HPC

Ben Rixon – Senior Research Engineer

Neil Martin – Research Engineer

- Opened in 2011
- Independent RTO
- To bridge the valley of death
- Prove innovative manufacturing ideas
- Manufacturing system solutions
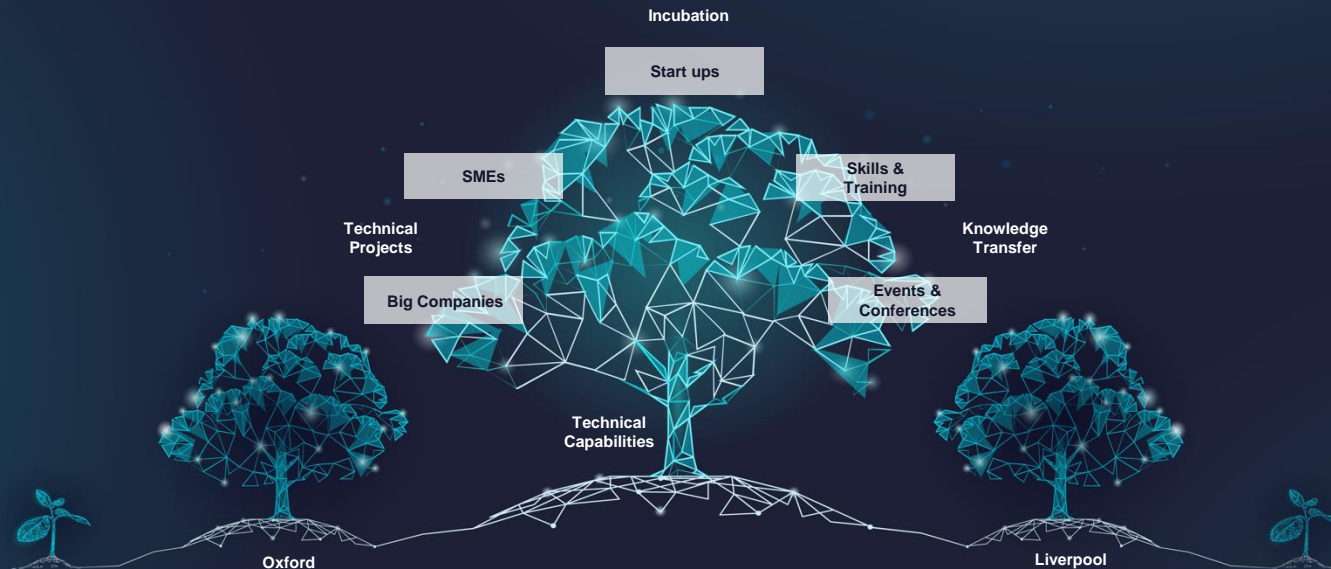- Training & Skills

UNIVERSITY OF BIRMINGHAM

Loughborough University

The University of Nottingham

Incubation

Start ups

SMEs

Skills & Training

Technical Projects

Knowledge Transfer

Big Companies

Events & Conferences

Technical Capabilities

Oxford

Liverpool

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

Loughborough University

UNIVERSITY OF BIRMINGHAM

Academic Roots
Midlands

Utilising key technologies

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TRANSFORMATION TEAM	DIGITAL ENGINEERING	ADVANCED PRODUCTION SYSTEMS	COMPONENT MANUFACTURING TECHNOLOGY	FUTURE SKILLS
BUSINESS TRANSFORMATION	MODELLING & SIMULATION	AUTOMATION, MECHATRONICS AND ELECTRONICS MANUFACTURING	ADDITIVE MANUFACTURING	
DIGITAL TRANSFORMATION	METROLOGY & NDT	DESIGN & BUILD	LASER PROCESSING	
TECHNOLOGY TRANSFORMATION	INFORMATICS		ADVANCED MATERIALS PROCESSING	

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What we had

What we needed

Isolated Project Infrastructure

Secure Multi-Tenant Project Environment

Long Software Deployment Times

Flexible Digital Sandpit

Re-deployable Manufacturing Software

Lack of Engineer Autonomy

Reconfigurable Digitally Enabled Shop-Floor

Microsoft Hyper-V 2016

Modern cloud-based technologies

The Digital Manufacturing Accelerator Programme Overview

£17m
Investment in the assets

LCRA
Funding

MTC's
Technical Specialists

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Capabilities & Assets which allow manufacturers to experience the advantages of **Industry 4.0**, IoT, smart manufacturing, robotics, and automation in a **risk-free environment** with accurate **financial and operational projections** to **enable the deployment and rapid scale-up of technological capabilities.**

DMA

Digital Factory Environment

A **digital sandpit** which provides a **digital infrastructure** & **catalogue of pre-configured solutions** to develop and demonstrate new digital manufacturing solutions and technologies.
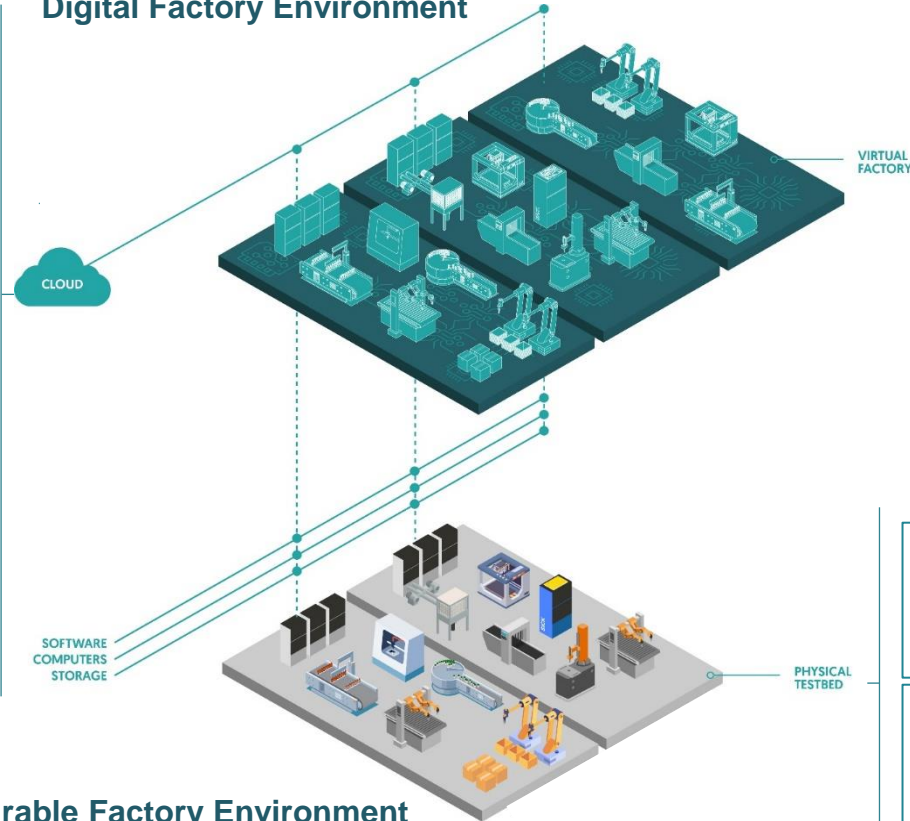
DFE

RRFE

Rapidly-Reconfigurable Factory Environment

- A **physical test-bed facility** which provides the **space, utilities and reconfigurable production lines** for developing and demonstrating new manufacturing solutions and technologies.

DMA Supply Chain
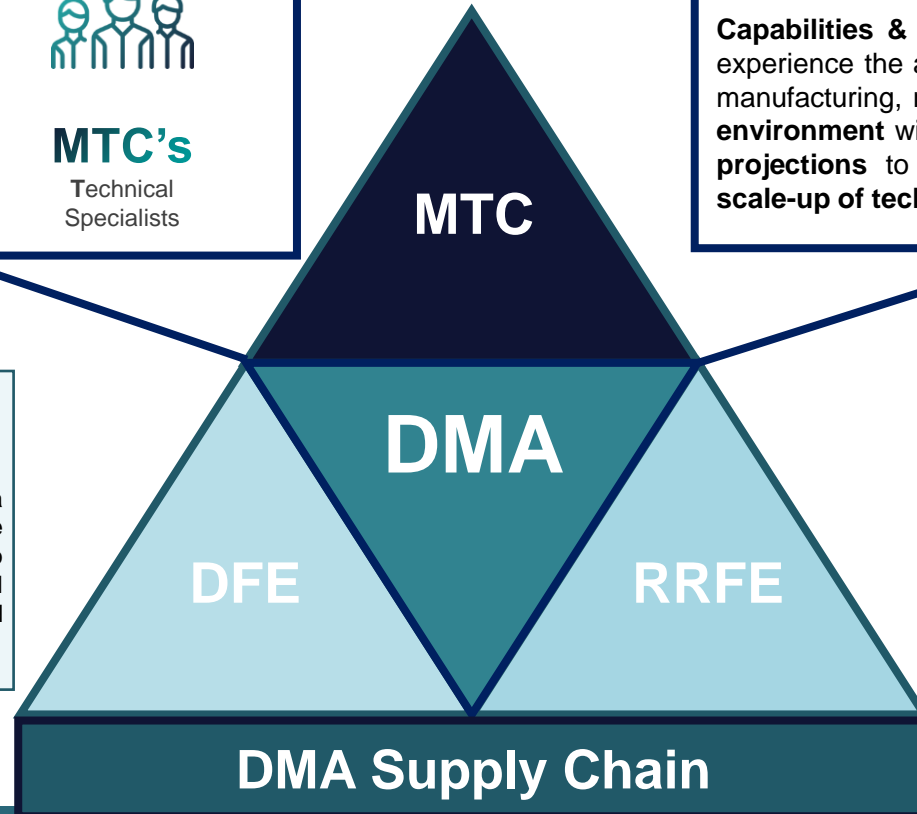
The Digital Manufacturing Accelerator Infrastructure

Digital Factory Environment

Data and Computing Power on Demand

Control and data acquisition modules enabling testing of different digital integration configurations.

A digital infrastructure which can be quickly configured and deployed for client projects in a safe unconstrained environment.
(You can mess about without messing up!)

Client portal providing a single interface to project data and manufacturing systems.

Library of manufacturing ICT systems and simulations from a range of vendors which can be quickly configured and deployed.

CLOUD

SOFTWARE COMPUTERS STORAGE

VIRTUAL FACTORY

PHYSICAL TESTBED

Virtual factory technologies allowing simulation of processes, assets and architectures before deploying physical manufacturing systems, leading to a digital twin.
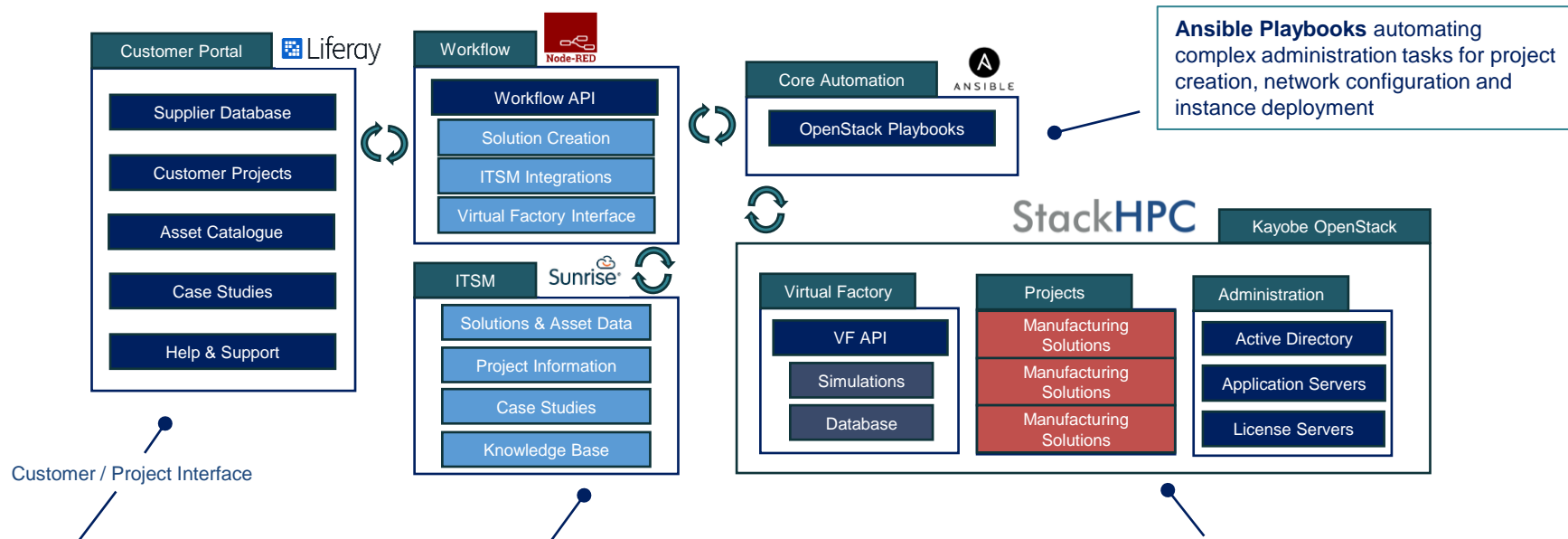
"Smart factory" control, Digital twinning, monitoring and optimisation of the physical and digital environments ...

Factory space with flexible services and utilities allowing multiple manufacturing systems to be deployed at any one time.

Standardised process interfaces allowing modular reconfiguration of manufacturing systems.

Rapidly-Reconfigurable Factory Environment

How does the deployment look?

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Customer Portal — Liferay
- Supplier Database
- Customer Projects
- Asset Catalogue
- Case Studies
- Help & Support

Workflow — Node-RED
- Workflow API
  - Solution Creation
  - ITSM Integrations
  - Virtual Factory Interface

ITSM — Sunrise
- Solutions & Asset Data
- Project Information
- Case Studies
- Knowledge Base

Core Automation — ANSIBLE
- OpenStack Playbooks

Ansible Playbooks automating complex administration tasks for project creation, network configuration and instance deployment

StackHPC — Kayobe OpenStack

Virtual Factory
- VF API
  - Simulations
  - Database

Projects
- Manufacturing Solutions
- Manufacturing Solutions
- Manufacturing Solutions

Administration
- Active Directory
- Application Servers
- License Servers

Customer / Project Interface

Portal providing information on previous projects, associated **case studies** and **suppliers**

Ability to view and provision **manufacturing software assets** within the Digital Factory Environment

Node-RED API interfacing with OpenStack through Ansible, **Virtual Factory** applications and the ITSM Platform

Information contained in ITSM is queried from the customer portal via the **Workflow API**

Pre-configured manufacturing applications packaged as solutions to be re-deployed when required, reducing installation and configuration time for complex platforms.

Virtual Factory API hosting simulations and modelling applications to be redeployed across projects

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- Workflow driven **modelling & simulation platform** combining multiple software platforms to generate analysis results.

- Can be redeployed across multiple projects, **to minimise reconfiguration time** for complicated software required to perform analysis.

- Separates simulation capabilities from individual user devices by having an easy to access **centralised platform**.

- Queries' data from project **Manufacturing Execution Systems (MES) and Historians** hosted on virtual machines within OpenStack.

What have we learnt from this?

- Modern private cloud platforms and automation tools **significantly cut down on deployment time** for all our requirements.

- Everything cloud platforms can provide, can be **engineered for manufacturing use-cases**!

- Manufacturing doesn't need to be pushing the boundary of compute, they need to **understand what we already know** and how best to **utilise it**.

- By creating **pre-configured images**, it provides a significant **reduction in setup and configuration time** for manufacturing, simulation and modelling workloads.
    - Simulation and modelling deployment time reduced **from two weeks, to four hours**!

- Security is still hard! The infrastructure operates in a whitelisted environment, retrieving software packages from multiple repositories with dependences proves challenging.

- A customer portal provides an **easy interface to select manufacturing solutions**, pre-configured with required software, without having to understand the working components of a cloud platform.

- The DMA team are continuing to bring new projects onto the platform, creating **new pre-configured manufacturing solutions** and providing a **reconfigurable environment to evaluate software and services**.

- **More Ansible, more automation**. We've only just started our journey in automation, can we automate more than just the core infrastructure?

- Now that we've created this environment to address a project specific purpose, how do we transition this into a fully **operational asset**, maintained in collaboration with IT and our Engineering teams.

- How can we streamline our platform, are there alternatives to consider for the key components which **simplify the deployment process**?

THANK YOU

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Learn more about the DMA: https://digitalmanufacturingaccelerator.com/

Learn more about the MTC: https://www.the-mtc.org/