

Digital Manufacturing

High Value
Manufacturing
Catapult / MTC

point of view

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EU & Research Partnership Manager

Nottingham, 30th November



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HVM Catapult - History

Ingenious Britain
Making the UK the leading
high tech exporter in Europe
A report by James Dyson
March 2010

**The Current and Future Role
of Technology and Innovation
Centres in the UK**

A Report by Dr. Hermann Hauser

For Lord Mandelson

Secretary of State
Department for Business Innovation & Skills

Technology Strategy Board
Driving Innovation

Technology Strategy Board
Driving Innovation

A landscape
for the future
of high value
manufacturing
in the UK

A study conducted for the
Technology Strategy Board

High Value Manufacturing
Strategy

February 2012

HVM Catapult

- 7 World class centres of industrial innovation
- Cutting-edge equipment for industrial scale up
- Lowering risk for business
- Platform for skills development at all levels
- Cross sector capability
- Supply chain partnership

HVMC linked to university network

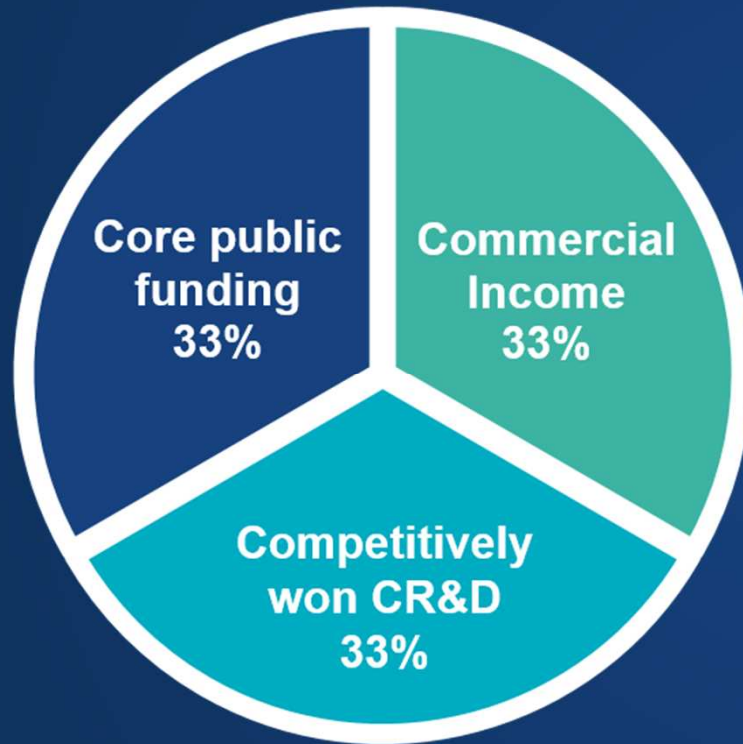




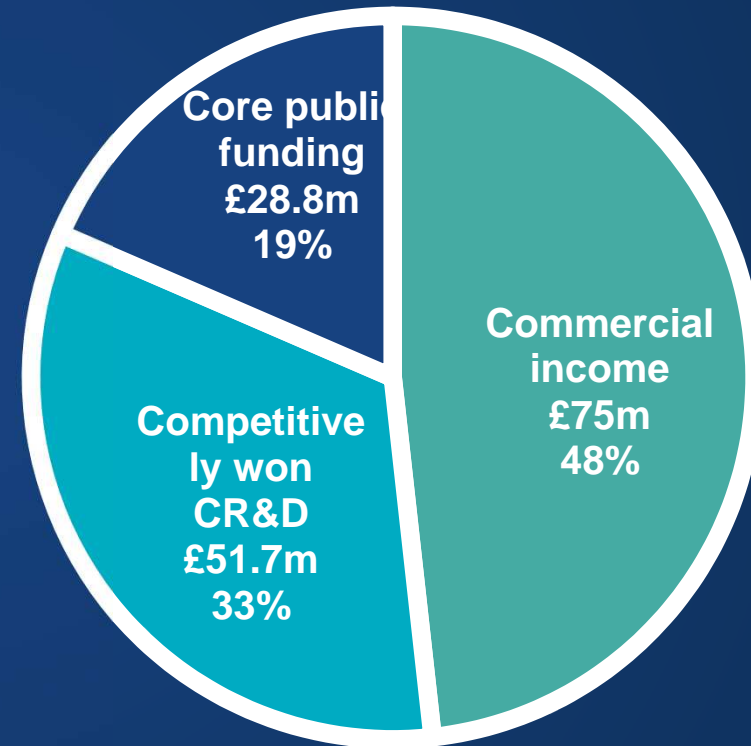
CATAPULT
High Value Manufacturing

Industrial Membership of HVM Catapult centres

The Funding Model



Model



2014-15 Actual

Digital Manufacturing at MTC

- **MTC Background, approach, strategy**
- Challenges – Vision - Technologies
- Main messages to end users
- International engagement
- Summary and way forward

"Industrie 4.0" at MTC

Context management replaces operative planning
The smart factory organises itself decentralised in real time

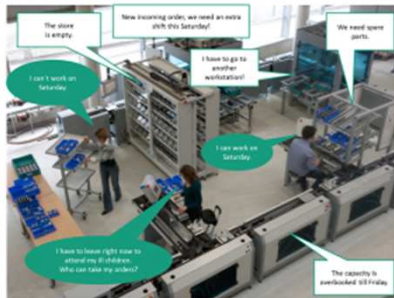
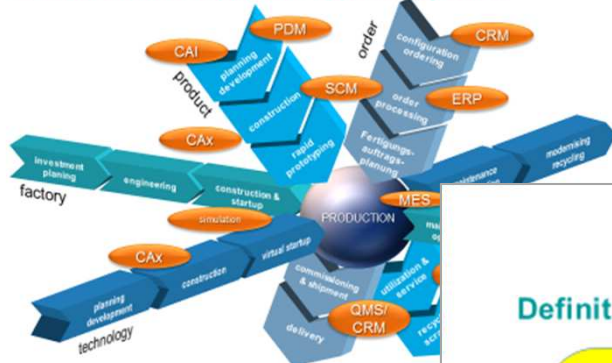


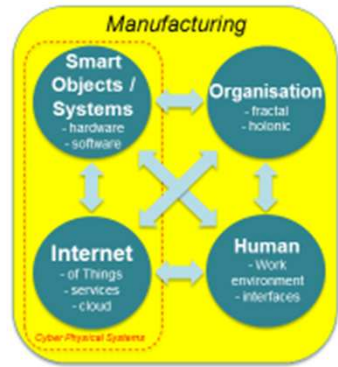
Image source: Fraunhofer IPA

The 4 life cycles in the industrial manufacturing ... and how added value is supported by the IT



"Industrie 4.0" at MTC

Definition



Challenges

- Integration**
- IT structure (MES, ERP, CAX, device)
-
- Supplychain
- Capability
 - Availability
 - Knowledge
 - Product & process data
- Big Data**
- Use of big data in manufacturing (selecting, adapting, predicting, self-learning)
 - Create new products and services
 - Who owns the data
 - Data security

Optimisation of manufacturing systems and supply chains !

The Industrie 4.0 Platform
 Opened on 9th April 2013 by Federal Minister of Economics and Technology Dr Philipp Rösler



Structural Challenges

Technology Objectives



End-Users

End-User Engagement

- Technology awareness
- Lack of understanding of technologies
- Hidden business Benefits
- Cost/benefit relation not clear or evident
- Risk and disruption
- High levels of investment, legacy equipment and systems

Standards and Interoperability

Definition and Adoption

- Several established standards, professional organisations needed

Systems Communication

- Communication between third party systems, harmonise different solutions in the same platform

Skills

Lack of manufacturing systems skills

- In own teams, supply chain, technology providers and IT providers

Skills on relevant technologies

Use of relevant tools

- Skills on usage of relevant tools and tool's usability

Better Decisions

Data Visibility

- Data capture, data selection, data preservation, big data, data life-cycle

Data Analysis

- Data visualisation, get information from data, diagnosis, use data for making decisions, prognosis

Connectivity

Data

- Data visibility, history of components, real-time capacity, synchronisation, coordination

Standards

- Consistency, interoperability, dialogue

Channels

- Wired, wireless, satellite, radio

Autonomous Decision Making

Predictive maintenance

- Data driven, real-time, preventative and scheduling

Self-adaptive processes

- Intelligent machines & processes, mass customisation, autonomy level, scheduling

End-User Engagement

Technology awareness
Hidden business Benefits
Risk and disruption

Dissemination

- MTC Forums;
- Events: EstNET Wales, Advanced Manufacturing Conference, Industrial Automation Seminar, MTA, I4.0 in steel industry.

Drawing Investment

- UKTI collaboration
- Working with: BIS, Innovate UK, KTN, European Commission
- R&D investment: FoF9 I4MS support action, FoF11 Flexible Manufacturing.

Demonstrators

- CRPs and collaborative projects generating demos;
- 12 I4.0 demonstrators underway;
- Demonstrator portfolio being developed.

Standards and Interoperability

Definition and Adoption
Systems Communication

British Standards Institute

- Definition of requirements;
- Best practices;
- Standards;
- First event on May 26th.

MT Connect

- Open standard for connectivity;
- MTC joining as an observer member for pilot project;
- Planning to join as full member.

Technology Mapping

- Technology mapping of standards in relation to connectivity;
- Matrix initiated and being refined at the moment;
- To be presented soon.

Skills

Lack of manufacturing systems skills
Skills on relevant technologies
Use of relevant tools

AMTC

- Demonstrating facilities sponsored by members;
- Manufacturing systems programme;
- Future apprentices.

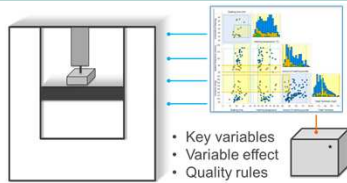
University Collaboration

- EngDoc and PhD students sponsorship;
- CDT in embedded intelligence;
- Supporting relevant EPSRC projects.

Others

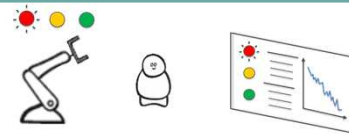
- First steps with TechPartnership;
- Women in Engineering;
- Industry 4.0 challenges.

Better Decisions



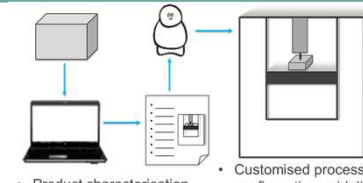
- Key variables
- Variable effect
- Quality rules

MACHINING PROCESS CHARACTERISATION
Support for process design and product quality



- Diagnosis – probable root causes of failure
- Prognosis – predicted failures
- Advice – Suggested maintenance actions

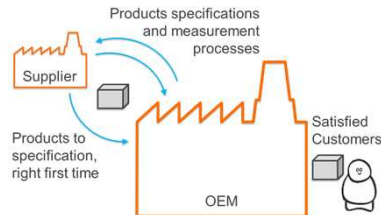
PREDICTIVE MAINTENANCE DASHBOARD
Support for maintenance decisions and activities



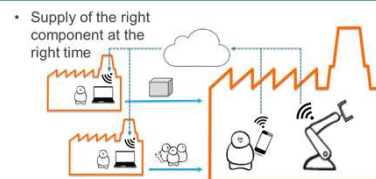
- Product characterisation
- Customised process configuration guidelines

PROCESS CONFIGURATION GUIDELINES
Support for process configuration for new product variants

Connectivity

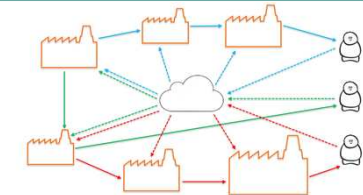


PLM INTEGRATED MEASUREMENT PLANNING
Supply chain quality assurance / management



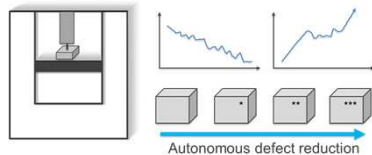
- Supply of the right component at the right time
- Automated supply of maintenance services
- Maintenance information shared with partners

COLLABORATIVE MAINTENANCE AND REPAIR
Automated workflows for maintenance and repair

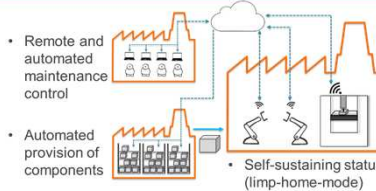


RECONFIGURABLE SUPPLY NETWORKS
Supports different supply network configurations for different demand signals and requirements

Autonomous Systems

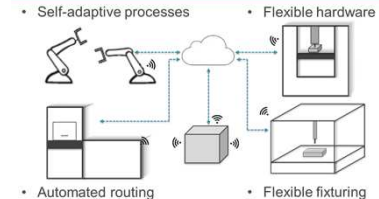


SELF ADAPTIVE QUALITY IMPROVEMENT
Processes that are quality aware and can adapt accordingly to improve product quality



- Remote and automated maintenance control
- Automated provision of components
- Self-sustaining status (limp-home-mode)

SELF-SUSTAINING MANUFACTURING SYSTEM
Autonomous provision of maintenance parts and services, and self-sustaining equipment



- Self-adaptive processes
- Flexible hardware
- Automated routing
- Flexible fixturing

FLEXIBLE MANUFACTURING SYSTEMS
A system that can self configure to produce different product variants in the same shop floor

Product Quality

Equipment Health

Flexible Systems



Expert selection of commercial and novel technologies



Strategic collaborative relationships and partners



Discovery of ICT / I4.0 innovation opportunities



Academic Partners



Technology Partners



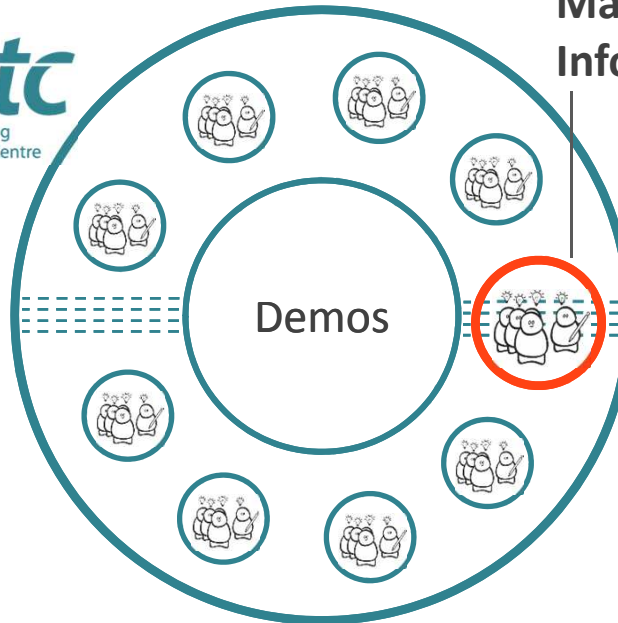
Appropriate communication channels for knowledge transfer



Manufacturing sandpit environment for system demonstrators



Methodologies and capabilities to design and deliver ICT systems



Manufacturing Informatics



End-User Partners

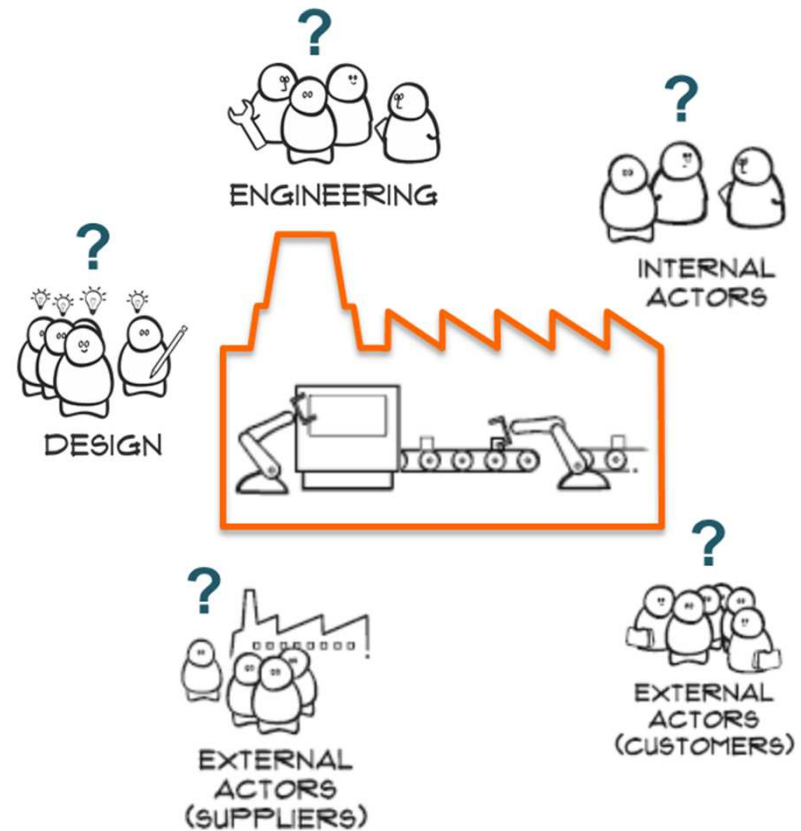


Digital Manufacturing at MTC

- MTC Background, approach, strategy
- **Challenges – Vision - Technologies**
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INDUSTRY 4.0 – THE CHALLENGES

- ▶ Lack of connectivity
- ▶ Unexploited intelligence technologies
- ▶ Lack of responsiveness and autonomy
- ▶ High entry barrier to ICT





INDUSTRY 4.0 – THE CHALLENGES and VISION

- ▶ **Lack of connectivity**
- ▶ **Unexploited intelligence technologies**
- ▶ **Lack of responsiveness and autonomy**
- ▶ **High entry barrier to ICT**



- ▶ **Seamless connectivity (Internet of Things)**
- ▶ **Smart factories**
- ▶ **Cyber Physical Systems (CPS)**
- ▶ **Service oriented ICT**

INDUSTRY 4.0 – THE TECHNOLOGIES

▶ Seamless connectivity (Internet of Things)

▶ Smart factories

▶ Cyber Physical Systems (CPS)

▶ Service oriented ICT

▶ Seamless connectivity

- Wireless communications
- Standards
- Cross-site communications
- Security

▶ Smart factories

- Advanced statistics
- Data mining
- Decision support
- Artificial intelligence
- Embedded intelligence

▶ Cyber Physical Systems

- Ubiquitous sensors
- Tracking
- Reactive hardware
- Mobile devices

▶ Service oriented ICT

- Applications
- Cloud
- New business models

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MAIN MESSAGES

- ▶ **Digitising Manufacturing increases the ability and potential for business improvement, innovation and change.**
- ▶ **Not all Digital Transformation paths are the same; defining the right path requires great awareness of your starting point and informed strategic decisions.**
- ▶ **An effective Digital Transformation journey depends on the early demonstration of value creation.**

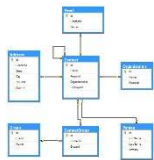
Value extracted from data



Innovation



Intelligence



Structure

A	B	B
Name	Number	Number
John	10023	10023
John	10024	10024
John	10025	10025
John	10026	10026
John	10027	10027
John	10028	10028
John	10029	10029
John	10030	10030
Mike	10031	10031

Data



Digitising Manufacturing



Isolated Solutions

Hierarchical Integration

Industry 4.0 Architectures

ICT Technology Strategy

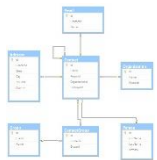
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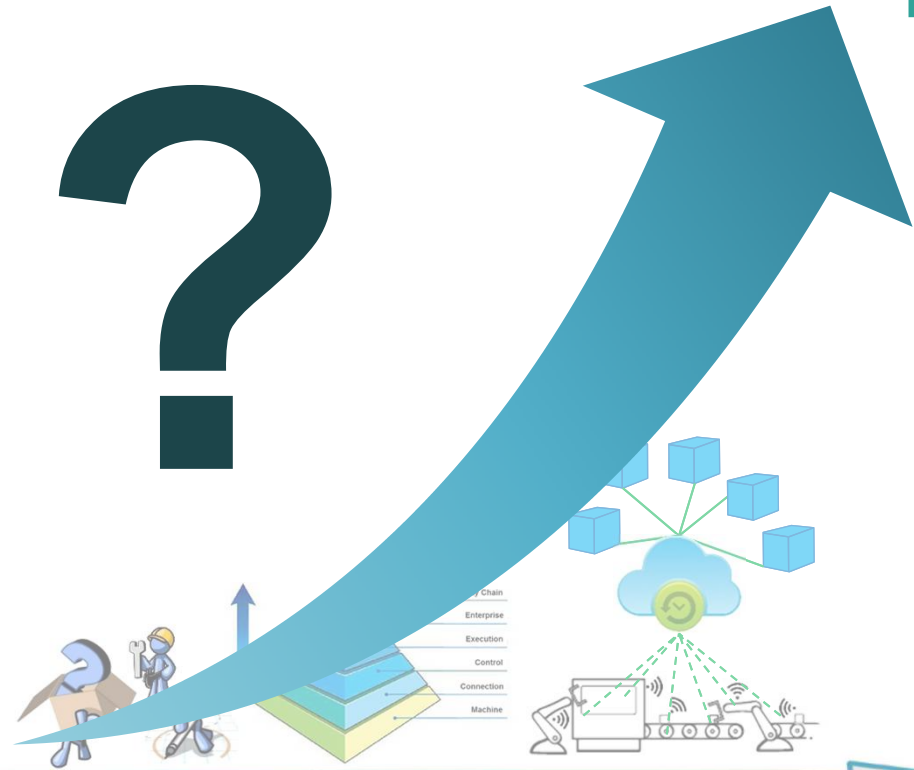
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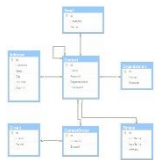
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Intelligence



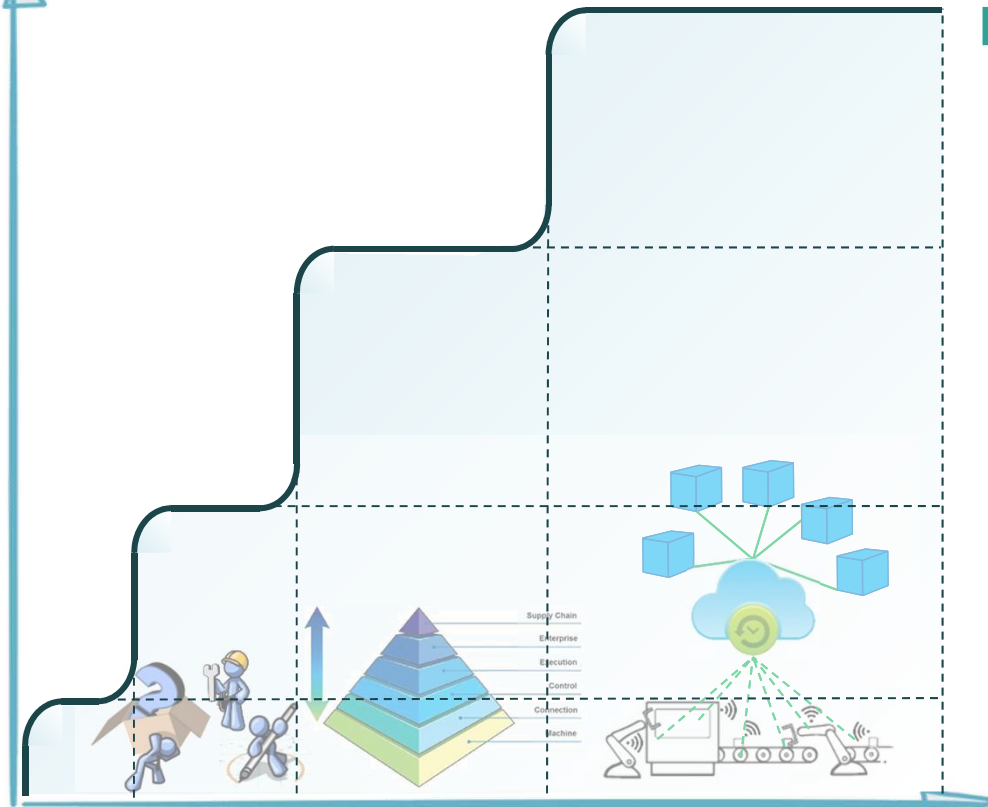
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Digitising Manufacturing



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Value extracted from data

“Self-Check”

Digitising Manufacturing

Innovation

Intelligence

Structure

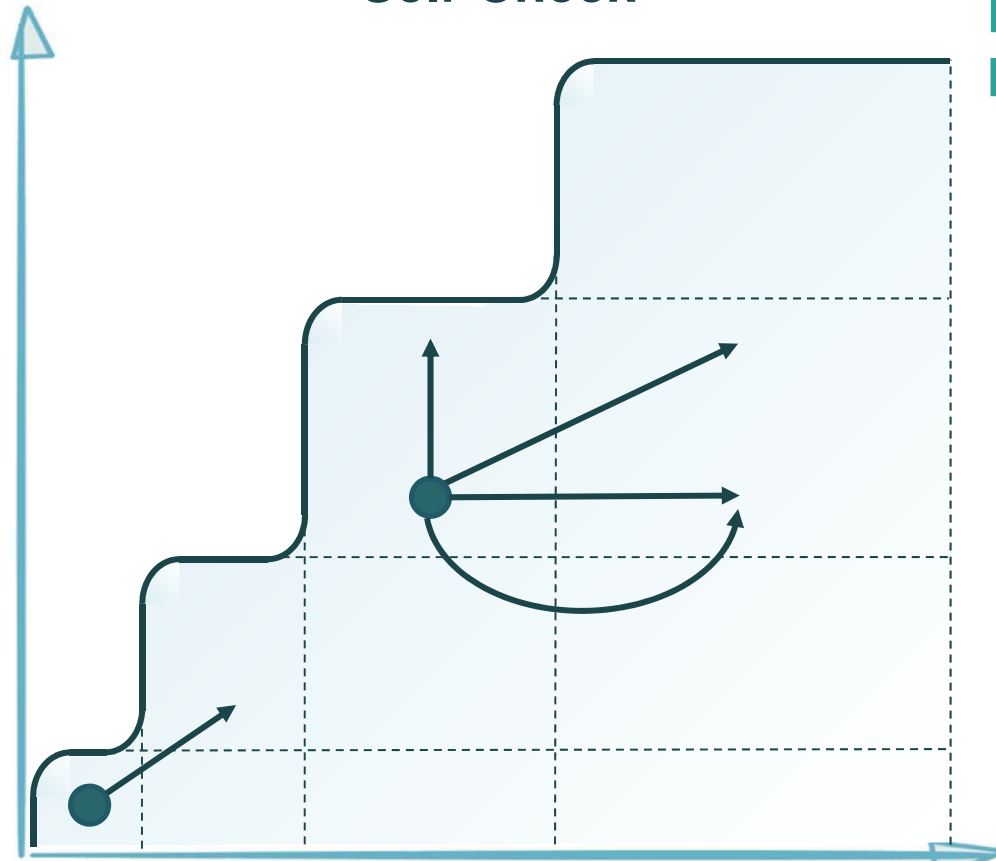
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ICT Technology Strategy

Isolated Solutions

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MAIN MESSAGES

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Value extracted from data

Innovation

Intelligence

Structure

Data

“Demonstrators”

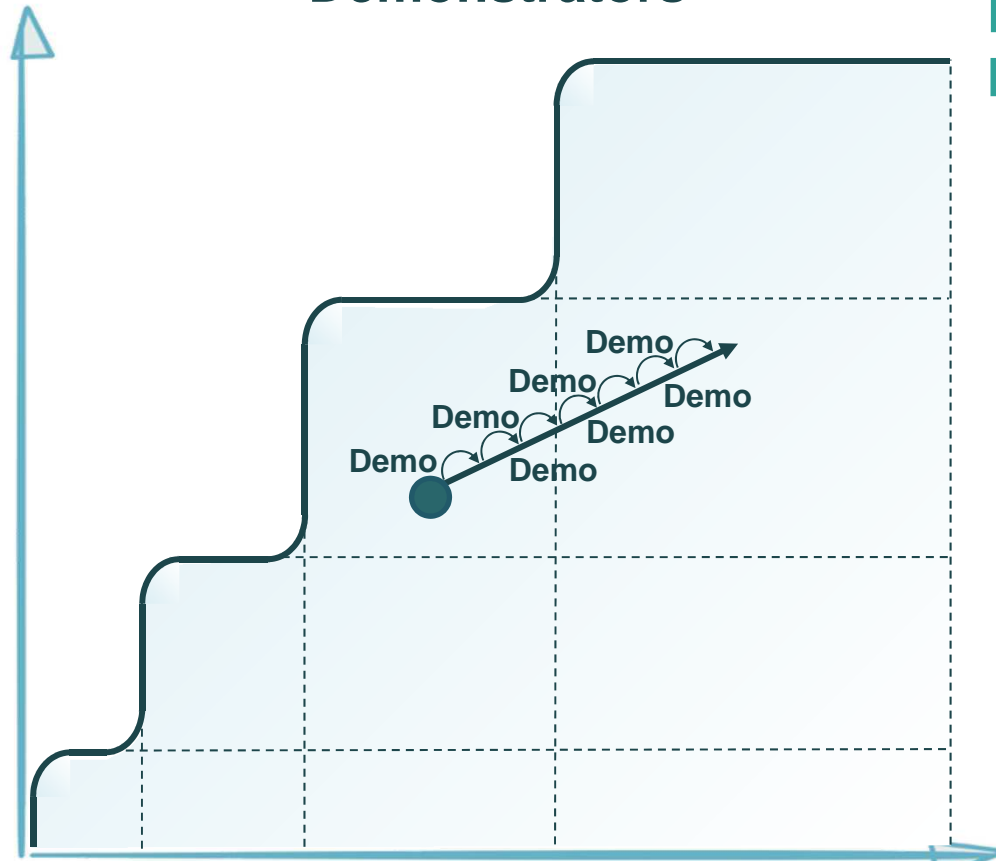
Digitising Manufacturing

ICT Technology Strategy

Isolated Solutions

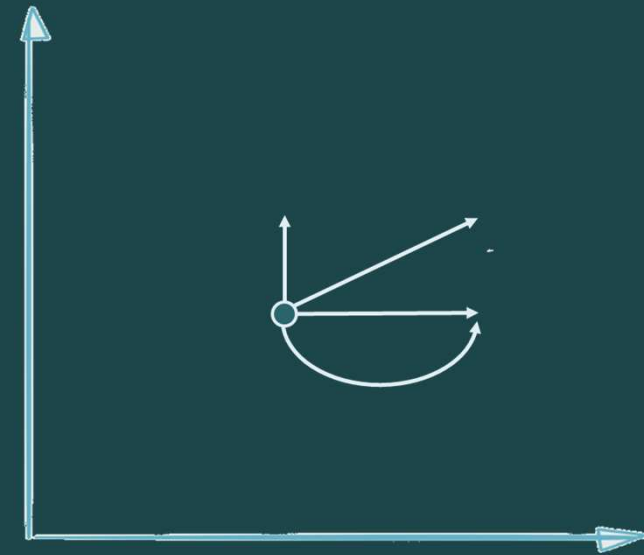
Hierarchical Integration

Industry 4.0 Architectures



KEY INSIGHTS

- ▶ The end destination is not obvious
- ▶ The path is not straight forward
- ▶ You might have to take a step back before you move forward



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Collaboration and access

Virtual Fort Knox – Industrie 4.0 Service Platform

VFK - Overview

- Secure federative platform for service-orientated applications providing manufacturing-IT services for manufacturing companies
- The development forms part of a project sponsored by the state of Baden-Württemberg
- Extensive involvement of SMEs from the areas of IT and manufacturing in development process





Overview of Digital Manufacturing Initiatives across Europe

- EU-level Initiatives**
 - Application PPPs: FoF, SPIRE
 - I4MS
 - Smart Anything Everywhere
 - ICT PPPs
- Multi-region Initiatives**
 - Vanguard

- United Kingdom**
 - High Value Manufacturing
 - Innovate UK
 - Action Plan for Manufacturing (Scotland)

- Belgium**
 - Made Different
 - Flanders Make/iMinds (Flanders)

- France**
 - Usine du Futur
 - FoF Ile-de-France

- Portugal**
 - Produtech

European initiatives are in red
National initiatives are in blue
Regional initiatives are in green

European Commission
DG CONNECT, Unit A3, ML

- Sweden**
 - Produktion 2030

- Netherlands**
 - Smart Industry

- Finland**
 - FIMECC PPP Programmes (MANU, S-STEP, SIMP, S4Fleet)
 - Industrial Internet Business Revolution
 - IoT pilot Factory (IoT PFF)

- Poland**
 - INNOMOTO
 - INNOLOT
 - Digital manufacturing for the SME (Mazovia)

- Germany**
 - Industrie 4.0
 - Smart Service World
 - Autonomik für Industrie 4.0
 - It's OWL (Ostwestfalen-Lippe)
 - Allianz Industrie 4.0 (Baden-Württemberg)

- Austria**
 - Produktion der Zukunft

- Italy**
 - Fabbrica Intelligente
 - Ass. Fabbr. Intell. Lombardia

- Greece**
 - Operational Programme in Region Western Greece

- Spain**
 - Estrategia Fabricacion Avanzada (Basque region)

Wide spread adoption of digital technologies: Starting point

4MS

under the PPP
Factories of the Future



Components & Systems

Smart Anything
Everywhere under

Status:

- 102 M€ – 11 projects – 70 centres – 300 experiments
- New wave through 2015 calls ~53M€

H2020 CSA: X2I4MS

- Generating 20 – 30 new Innovation hubs
- Partners: TNO, VTT, Fraunhofer, MTC

PERFoRM - Production harmonizEd Reconfiguration of Flexible Robots and Machinery

FoF-11-2015: Flexible production systems based on integrated tools for rapid reconfiguration of machinery and robots [\(IA\)](#)

Coordinator: Siemens, Germany

Total budget: € 7.1 mio

MTC & partners: Partner budget €1.412 mio

❑ MTC (€612k)

❑ Loughborough University (€380k)

❑ GKN Aerospace / SE (€420k)

MTC role: Demonstrator for “Self-Adaptive and Reconfigurable Machines and Robots” at the MTC

Project duration: 3 years; October 2015 – September 2018

Collaboration with German Industrie 4.0 Programme



CoCoS

Plug-and-play networking in production

Consortium

Robert Bosch GmbH (lead), DFKI, DMG Electronics GmbH, trustsec IT-solutions GmbH, TU Berlin, XETICS GmbH



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MTC summary and way forward

- **Utilising the MTC partnership** (academics, technology provider, end user)
- **Providing demonstrator environment**
- **Engage on international level**
 - “Industrie 4.0” platform Germany and other national platforms
 - H2020 and I4MS (establishing new Innovation Hubs)
 - EC stakeholder workshops
- **Build a national community and platform**

26th November

*Germany and the UK will grab the chance
of Industry 4.0 to remain leading manufacturers
in the 21st century*

Peter Ammon

German Ambassador to the Court of St. James

THANK YOU

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