DIGITAL MANUFACTURING ON A SHOESTRING

Creating digital solutions that work for manufacturing SMEs

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Connected Everything Conference
26 June 2019

UNIVERSITY OF CAMBRIDGE Department of Engineering
IfM MANAGEMENT TECHNOLOGY POLICY
DIGITAL MANUFACTURING ON A SHOESTRING
EPSRC Engineering and Physical Sciences Research Council
University of Nottingham Institute for Advanced Manufacturing

Digital Manufacturing?

The application of digital information [from multiple sources, formats, owners] for the enhancement of manufacturing processes, value chains, products and services

Nb: scope includes automation and computer based applications

Global *Digital Manufacturing* Initiatives…

Smart Manufacturing

Industrie 4.0/
Platform Industrie 4.0:

Korea Smart Factory:

IIoT/ Industrial Internet Consortium:

Made in China 2025:

Intelligent Manufacturing Systems: *(1990s)*

EU Factory of Future (2000s):

Challenges / Limitations for Digital Manufacturing Initiatives?

- DM seen as a Strategic weapon / new paradigm
- Primarily technology Driven
- Need to accommodate existence of legacy Systems
- Perceived high costs & complexity of Business Case

- … particularly difficult for SME manufacturers

The digitalisation challenge for SMEs

"77% of companies consider missing digital skills as the key hurdle to their Digital Transformation."

"59% of companies cite high investment and operating costs as another major obstacle."

[Saam et al. (2016)]

Digitalisation is perceived as *inaccessible* by many companies.

expensive

complex

A Low Cost, Tactical Approach to DM

Development of individual digital solutions for which the total cost of deployment is kept low

- Features of Low Cost DM:
  - Keeping equipment / development / deployment cost low
  - Exploiting off the shelf technologies and openly available software

Digital Manufacturing on a Shoestring





With suppliers

In the office

On the shop floor

Shoestring Vision:
Increase digital capabilities throughout the company using low-cost, easily accessible "off-the-shelf" components.

Shoestring Partners

bsi.

Atos

CATAPULT High Value Manufacturing

BTL PRECISION manufacturing solutions . . .

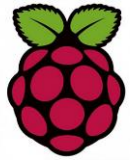
SIEMENS Ingenuity for life

MAKE uk The Manufacturers' Organisation

NMN Nottinghamshire Manufacturing Network

WARREN SERVICES

Cambridge Hack



Greater Manchester Chamber of Commerce Connect. Communicate. Create.

CATAPULT Digital

PCML

SMAS Scottish Manufacturing Advisory Service

PA CONSULTING TECHNOLOGY INNOVATION

Mazak

MTA The Manufacturing Technologies Association

IfM Education and Consultancy Services

+ 6 new partners
+ ~100 SMEs in workshops

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Research Challenges

- Solution Priorities: Is it possible to identify a set of digital solution requirements that are common across a large number of SMEs?
- Common Modules: Can a systematic “building block” approach to combining different low cost technologies/open source software elements be developed?
- Incremental Architecture: Can an industrial IT architecture be developed for combining solutions that evolves as additional solutions are added?
- Industrial Viability: Will low cost solutions adhere to typical requirements for industrial digital systems such as reliability, interoperability and security.

Shoestring Programme

1. Digital requirement assessment

What are the current needs of a small manufacturer

2. Solutions development

How can available technologies, algorithms and software be combined into accessible solutions?

3. Prototyping / Pilot testing

…of the developed technologies and methods in partner SMEs

4. Incremental integration

Implementing and integrating solutions in an incremental manner?

5. Engagement / Dissemination

Application of the approach in a wide array of companies & labs

Digital Requirements Assessment

Identifying specific digital solution priorities via analysis of SME business / operational issues to and translating to digital needs

Approach:

- Initial identification key solution types
- 1-2 hour prioritisation workshops
- Deeper dive company meetings
- So far: 6 workshops by mid July,
- 8-10 more planned

Exercise: Digital solution priorities

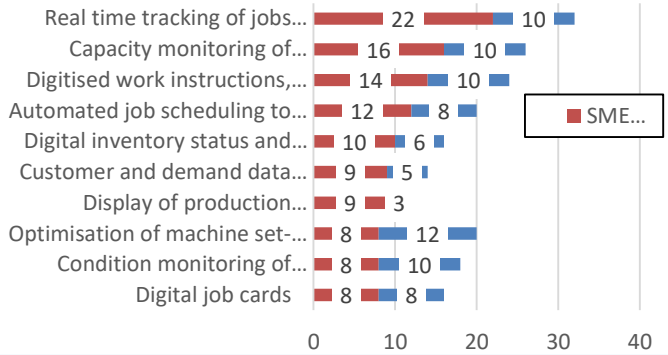
Please stick your dots to the solutions on the sheets with your priority **order winner / business constraint**

3x **Most relevant:** "We really need this"

Max 6x **Useful:** "This sounds useful, but is not a priority"

Not interesting: No dot

10 min



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Solution Development

Off The Shelf Technologies

Building Blocks

Standard combinations

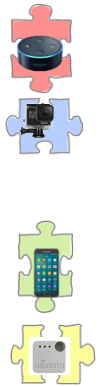
Solution

Computing

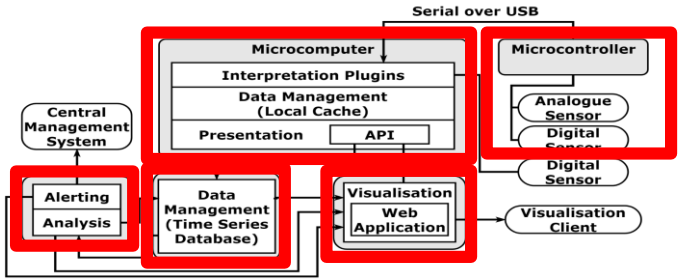
Sensing

Cloud

Interface

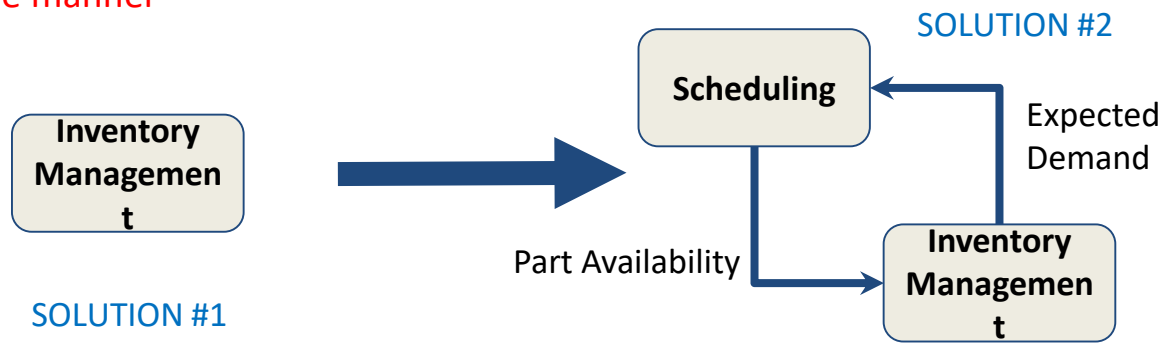


Example: Monitoring Solution



Incrementally Integrating Solutions

Development of an approach for specifying and implementing Shoestring solutions such they evolve a fully functional architecture in a simple, step wise manner



- **Requirements**:
  - **Incremental, Modular and Flexible** - SMEs should be able to install and improve solutions one at a time and in any order
  - **Interoperable and Synergistic** - Solutions should be able to interact with other solutions, and "legacy" systems, to provide additional features/ enhanced performance
- **Service Oriented Architectures** (SOAs) identified as a promising approach

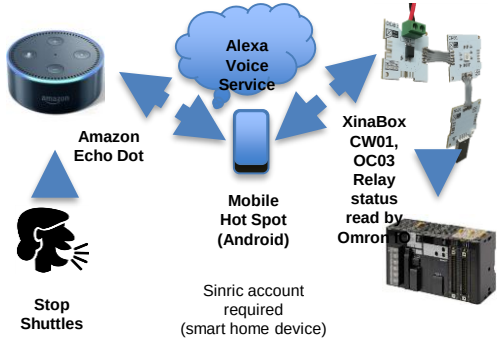
Low Cost Solution Demonstrators & Pilots

Building demonstrators and company based pilots in order to assess solution approaches, capture development approach, and provide practical examples of new and legacy-interfaced solutions

The Shoestring demonstrator development is carried out by:

- Addressing the SME solution requirement priorities / ranking
- Creating/integrating the relevant Shoestring building blocks
- Making solutions compliant with incremental architecture specification
- Capturing development approach used

Rank	SME solution requirements	*Go Pro product tracking*	*Voice controlled production*	*Phone based AR driven monitoring*
1	Real time tracking	✓		✓
2	Digitised work instructions	✓	✓	✓
3	Process monitoring		✓	✓

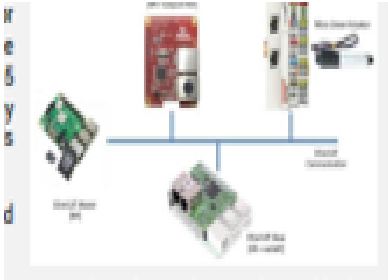


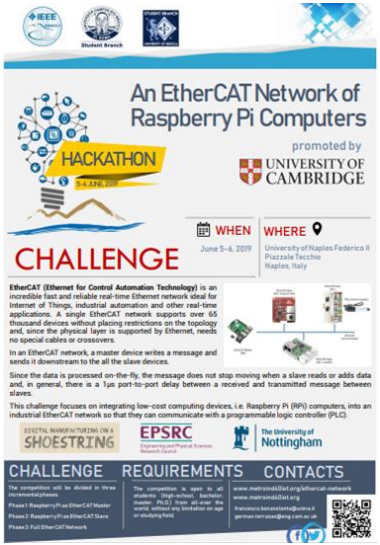
Outreach: Competitions, hackathons

Initiating, recording and codifying low cost digital solution developments through informal development environments in order to capture new solutions and/or development approaches

- Highlighting industrial challenges to student/hacker communities
- Using adhoc developers to produce prototypes and to guide / capture development processes

- observed HackMed, April 2019
- Challenge @ IEEE International Workshop on Metrology for Industry 4.0 and IoT, June 2019
- Cam Uni Eng Society and HackCam event in October
- Nottingham hack early 2020





http://www.metroind40iot.org/ethercat-network

Summary

- Requirements workshops match SME business issues to digital needs to identify solution priorities
- Solutions to be built from reusable `building blocks‘ extracted from existing technologies, demos, pilots, etc
- Solutions to be added/bolted incrementally to existing legacy manufacturing facilities
- Outreach through hackathons and competitions
- Extending to India, Australia, New Zealand, Korea, Thailand ...