Distributed Information and Automation Lab
Activities & Industrial Adoption

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Institute for Manufacturing
University of Cambridge
Department of Engineering
• DIAL Overview

• DIAL and IFM ECS: Towards Adoption

• 3 DIAL Consulting Tools
  – Automation Assessment
  – Information Quality
  – Resilience Audit

• Wrap Up
Distributed Information & Automation Lab

MISSION
• smarter, distributed ways of automating systems
• Getting better value from industrial information and quantifying it
• Managing systems subject to disruption and change

SEGMENTS
• Manufacturing
• Industrial Energy
• Logistics
• Supply Chain
• End of Life
• Service
• Maintenance & Asset Management
• Construction as Manufacturing

(Time critical) Decisions
(Sensing) Loop
(Actuation) Loop
(Physical) Operations
Requirements

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Resilient, Adaptable Production

Projects:
• DISTAL - Disruption Tolerant and Lean Factories [Boeing]
• OPTIMORS PRIME: Organising Production Technology Into MOst Responsive States - 3D PRInt Machine Enabled Networks [EPSRC]
Intelligent, Customised Logistics

Projects:
- PhD Projects: Customer Oriented Logistics, Interventionist Order Picking
- ITALI: IT Architectures for Logistics Integration [Y H Global]
- VIPR: Virtual Intelligent Production, Procurement Prediction System [Boeing]
Smart Asset [Information] Management

Projects:
- Valuing Asset Information [EPSRC]
- Infrastructure Futureproofing [EPSRC]
- Information Futureproofing [EPSRC]
- Rail fault data management approach and fault-diagnosis tool [Hitachi]
Self Managing Repair & Reuse

Projects:
• Automated Repair of Domestic Appliances
• *Perpetual Products Programme*
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About IfM ECS

IfM Education and Consultancy Services Ltd (IfM ECS) provides a rapid dissemination route for research and education outputs developed at the Cambridge University Institute for Manufacturing (IfM).

- Industrial practitioners help companies of all sizes in all industries to apply research-based improvement techniques.
- Practical solutions based on the latest applied research
- Live feedback to help set the agenda for new research
- Single point of access to relevant expertise from the University of Cambridge
- Education programmes configured to client company needs and context

IfM ECS is a wholly owned subsidiary of the University of Cambridge.
## Model 1 - Support for Industry Consortia

- Key industry partners working together on common aims
- Typically 1 to 3 year time frame

<table>
<thead>
<tr>
<th>Programme</th>
<th>Aims</th>
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</thead>
<tbody>
<tr>
<td>Auto ID</td>
<td>Methodologies for tracking and tracing objects</td>
</tr>
<tr>
<td></td>
<td>Management of product information networks</td>
</tr>
<tr>
<td></td>
<td>Quantifying the impact of different Auto-ID technologies</td>
</tr>
<tr>
<td></td>
<td>Use of Auto-ID technologies in Manufacturing / Logistics</td>
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<tr>
<td></td>
<td>Leverage Standards and Services to support Internet of Things</td>
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<tr>
<td>Aero ID</td>
<td>Remove barriers to widespread ID deployment in the aerospace sector</td>
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<tr>
<td></td>
<td>through timely and effective R&amp;D</td>
</tr>
<tr>
<td>Airport Operations</td>
<td>To improve airport operations, through optimised design of processes,</td>
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<td></td>
<td>enhanced data sharing between organisations across the airport and the use of new technologies such as Auto-ID</td>
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</table>
Aero ID Programme

Aim: Remove barriers to widespread ID deployment in the aerospace sector through timely and effective R&D

Structure: 18 month programme, addressing 5-6 key research themes.

Approach: End user driven, cross supply chain, focussed on interoperability

Themes: ID applications, Lifecycle ID, Item tracking, sensor fusion, data synchronisation

Research Team: EPFL, Keio, ICU, Univ SA, Bremen, Cambridge

Outputs: Aero ID Forum – 80 Guests, Data Sync methods, ID Application Matching approach, Part ID Aggregation methods, Value of sensor information
Model 2 - Company Scoping Projects

- Helping companies articulate and understand a problem
- Validating solution options and solution providers
  - DIAL may not provide the solution
  - IfM ECS may not provide the solution
- Typical examples:
  - Outside core expertise of the business
    - Laing O’Rourke – automation of off site manufacture
    - Travelex – automation of cash handling
  - Where next?
    - Electrolux – Global Network Design
Travelex
Automation of Cash Handling

Background:
One of the world’s largest multi-currency vaults
> 90 currencies, consumer and commercial orders
Intensely manual, severe space and time constraints

Structure: Partner engaged for design and supply of an automated solution

Issue: Internal uncertainty over project scale and management

Support:
1. Identify Technical Hurdles
2. Ensure plans are in place to address these
3. Review Project Definition and Implementation Planning
Model 3
Consulting Projects

- Working with a client company to solve a specific problem
- May work with other partners
  - Heathrow Airport Operational Freedoms
- May come from scoping work
  - Laing O’Rourke automated joining processes
- May use one or more of DIAL tools
  - Foxconn Automation Assessment
Heathrow Airport - Operational Freedoms

**Aim:** To investigate how new operational processes can enhance airport performance. Specifically investigating the use of dual arrival, dual departure and special operations for A380 / Small Aircraft.

**Structure:** Audit function carried out over two trial periods. Interviewing participants, verifying data collection and analysis methods used.

**Approach:** To provide an independent auditing function to BAA LHR trial activity. Partner organisations include South East Airports Task Force, DfT, CAA, NATS.

**Outputs:** Experimental design, runway usage modelling, airport performance analysis.
Model 4 - Co-Development of Tools

- Codified approaches to generic problems
- Informed by industrial engagement and research
- Analytical and process based
- “do it with you not for you”
  - Equip the business for broader roll out
- Specific tool examples
  - Automation Assessment
  - Information Quality
  - Resilience Audit
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Information Risk Assessment Tool
Motivation

Information provides competitive advantage ... digital age ... Big Data ...

**Utility company**: “errors in meter readings ... errors in customer database ... incorrect bills ... overcharged customers ... loss of customer confidence ... ... regulator fines ... customers leave to competitor”

**Major UK supermarket**: “incorrect inventory data ... errors in supplier database ... stock-outs ... lost sales ... dissatisfied customers ... customers leave to competitor”

Poor quality information has a direct adverse impact on business performance
Key Questions

… what is the impact of poor quality data on my business?”

… I have lots of problems with my databases… how can I prioritise my improvement projects?”

“… is it worth investing in new IS/IT?”
Total Information Risk Management

A structured process...

...supported by a rigorous model
Case Study: Scottish Water

**Objective:** To quantify the impact of information risks in the area of water supply recovery and bring significant risks to the attention of senior managers.

**Outcomes:**
- Identified major data quality issues in the asset management systems.
- Uncovered risks amounting to around £2M per annum.
- Developed a business case for an integrated GIS system and improving information governance.

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<tr>
<th>ID</th>
<th>Process Title</th>
<th>Risk Overhead</th>
<th>Annual</th>
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<th>3500</th>
<th>13700</th>
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<td>Capital Investment Delivery Process</td>
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<td></td>
<td>TOTAL</td>
<td>1,984,000 £</td>
<td>5.16</td>
<td>3600</td>
<td>3500</td>
<td>14600</td>
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</table>
Automation Assessment Tool
Motivation

- Develop / Support a company’s automation strategy
- Identify Automation Opportunities & Feasibility Challenges
- Tailored to enhance existing production capabilities
- Collaborative approach with in-house production engineers
- Deliver a structured and prioritised implementation pathway
  - Semi or fully automated options

- Increase customer demand
- New product launch
- Joe wants me to look at some new Robot

- Labour costs keep going up
- Jack is off with strain injury again
- Keep get product returns with quality issues
- Bill & Fred retire at the end of the year!
- Industry 4.0? Data Sharing?
Key Questions

Automation Opportunities
- Improve operator safety
- Reduce labour cost
- Increase production rate
- Reduce floor space requirement
- Improve product quality
- ...

Feasibility Issues
- Number of assembly operations
- Complexity of assembly operations
- Ease of Automation
- Material delivery (logistics)
- Ease of integration
- ...

Romanesque University of Cambridge
Methodology

Overview of Products and Plants
• Overview of products, processes and current level of automation.

Opportunities
• Identification, ranking and scoring of automation opportunities

Feasibility
• Score specific potential automation solutions against Feasibility Criteria

Assessment
• Develop a progressive and integrated automation strategy.

Step 1
Step 2
Step 3
Step 4
Outputs / Results

- Plot different solutions by Opportunity / Feasibility. This graphical method will help prioritise the projects.

<table>
<thead>
<tr>
<th>Feasibility</th>
<th>Opportunity</th>
</tr>
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<tbody>
<tr>
<td>Low Opportunity</td>
<td>Low Opportunity</td>
</tr>
<tr>
<td>and High Feasibility</td>
<td>and High Feasibility</td>
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<tr>
<td>High Opportunity</td>
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</table>
Case Study
Foxconn Automation Project

- Foxconn aspiration to improve operations and reduce head count
- Context of:
  - Rising labour costs
  - More automation capability (external)
  - Demanding customers
  - Limited design input
  - Multi-site manufacture – flexible and changing footprint
- External facilitation
  - Step back / overview
  - Stimulate higher level view of automation benefits and issues
  - Structured assessment
- Foxconn now running roll out programme
Operational Resilience Audit
Effectiveness of operations affected by disruptions?

Unclear exactly why things go wrong?

Can the impact of disruptions be reduced?

Routes to building resilience of operations?
Resilience Auditing Approach

• Originally developed for manufacturing production.
• Used in numerous companies [Britvic, Alcatel, Boeing, Alled Steel & Wire, Unipart, … Luton Airport]
• Assumption that conditions are predominantly “steady” and disruptions infrequent
• Used to assess historical, real disruptions and ability to manage them.
Disruption Audit Approach

Step 1
- Plant Operations
  - Products
  - Processes
  - Volumes

Step 2
- Production Goals / KPIs
  - Key Goals
  - Production Targets

Step 3
- Disruption Analysis
  - Assess
  - Classify

Step 4
- Impact Analysis
  - Direct/Indirect Costs
  - Knock on effects

Step 5
- Response Capability
  - Potential
  - Utilisation

Step 6
- Improvement Areas

Material Pre-Analysed for Workshop

Workshop Group Activity
Disruption Audit

The output of the Disruption Audit can help:

• Prioritise improvements to current processes (Process Capabilities, Operational Adherence & Stability, Material Specifications.)

• Identify the requirement for new process capabilities to better cater for disruptions.

• Focus the development of next generation processes. Providing flexible production capabilities, for new products, using new technologies, with changing business demands.
Case Study: G’s Growers

- responsible for the growth and selling of 104 different products,
- supplied to major grocery retailers, wholesale distributors etc
- Iceberg lettuce a key product
- Short & long term issues
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Wrap Up

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Current Adoption Pathways
- Industrial research projects
- Adoption / transition projects
- Software handover / adoption
- Consulting tools
- Industry White papers