

Integrated Manufacturing Group



**Advanced Manufacturing
Research Centre**



Using NI tools to push into I4.0

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CATAPULT
High Value Manufacturing



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Overview of the AMRC

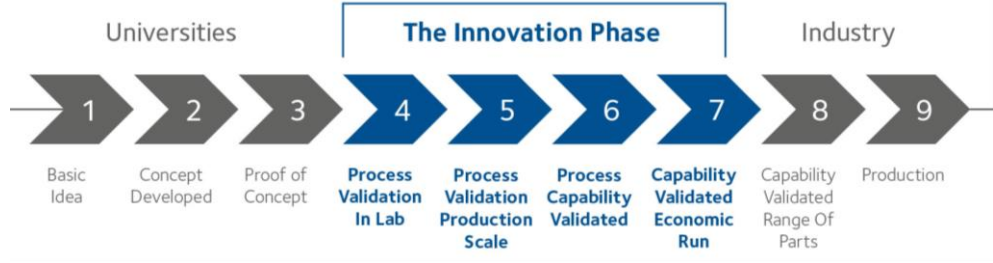
The AMRC with Boeing is a core part of the HVM Catapult research centres

At the forefront of industrial research for a range of multi-national engineering firms

Our aim is to take research from TRL 3/4 to TRL 6/7 (Technology Readiness Level)



Advanced Manufacturing Research Centre



Overview of the AMRC

Established 2001 – part of University of Sheffield – 750 staff, £250m research assets

New methods, tools and techniques – UK manufacturing focus

4 main themes across the AMRC:

- Machining
- Assembly
- Composites
- Design and Structural Testing



Overview of the AMRC

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Overview of the AMRC

Established 2009 - Integrated Manufacturing Group (IMG) focuses on assembly related tasks

Moved to purpose built £43 million facility, Factory 2050, in January 2016

Main research themes:

- Automation
- Large Volume Metrology
- Informatics
- Digitally Assisted Assembly



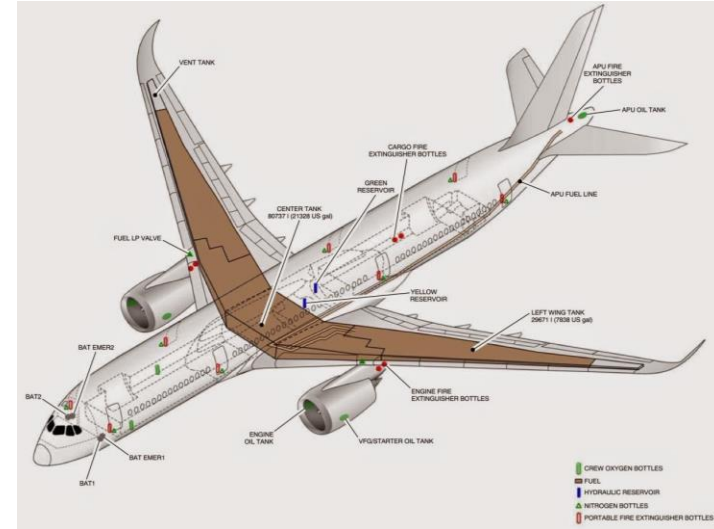
Fuel Tank Sealing – Challenge

Part of large-scale Innovate UK project for Spirit AeroSystems, 2015-2016

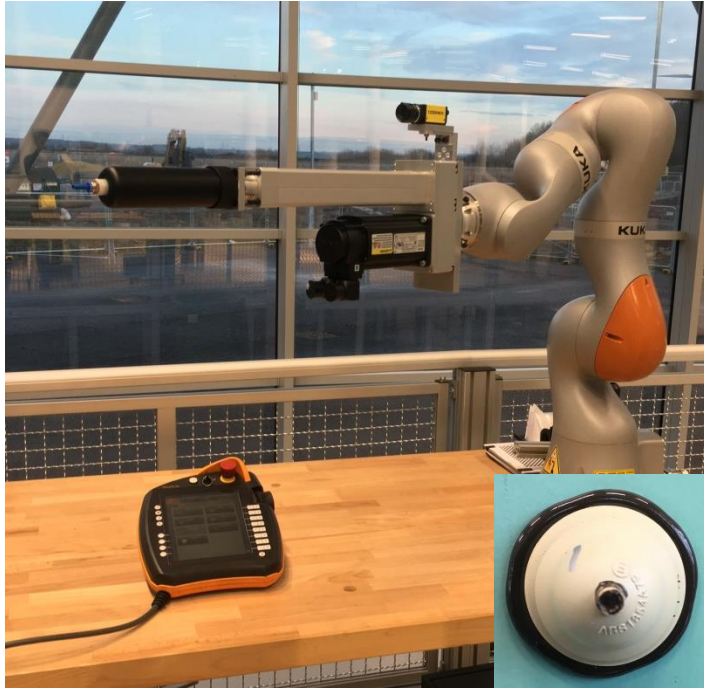
Overall goal is the development and integration of intelligent systems to improve overall productivity and part quality

Challenge was to automate very manual fuel tank sealing task to increase quality and rate

Due to high cost of materials and operator time, there is a strong business case for some degree of automation



Fuel Tank Sealing – Solution



- To meet requirements, needed complex control algorithm based on feedback from linear actuator
- Use LabVIEW control algorithm and feedback from brushless DC motor to accurately dose viscous fluid
- Use CompactRIO to run interfacing algorithm results robotic hardware, Linear actuator, cameras etc.
- Use of TDMS to auto record process quality data

Fuel Tank Sealing – Benefits

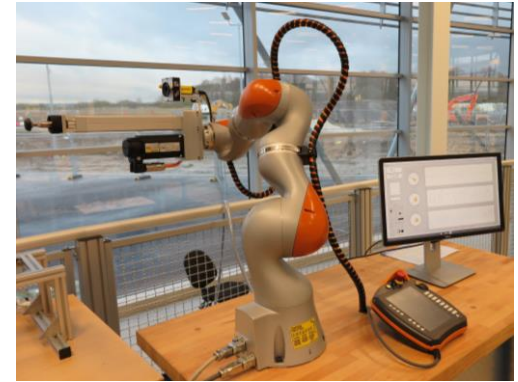
- Allows for semi-automation of the nutcap sealing process
- Allows for accurate dosing of sealant (+/- 0.1g)
- Allows for automatic recording of quality data
 - Allows manufacturer to get confidence in process
 - Allows customer to confidence in product
- Semi-automation fits extremely well with existing factory layout



Fuel Tank Sealing – Role of NI Products

Using: CompactRIO, Digital IO/Thermocouple modules, EtherCAT communication, and LabVIEW

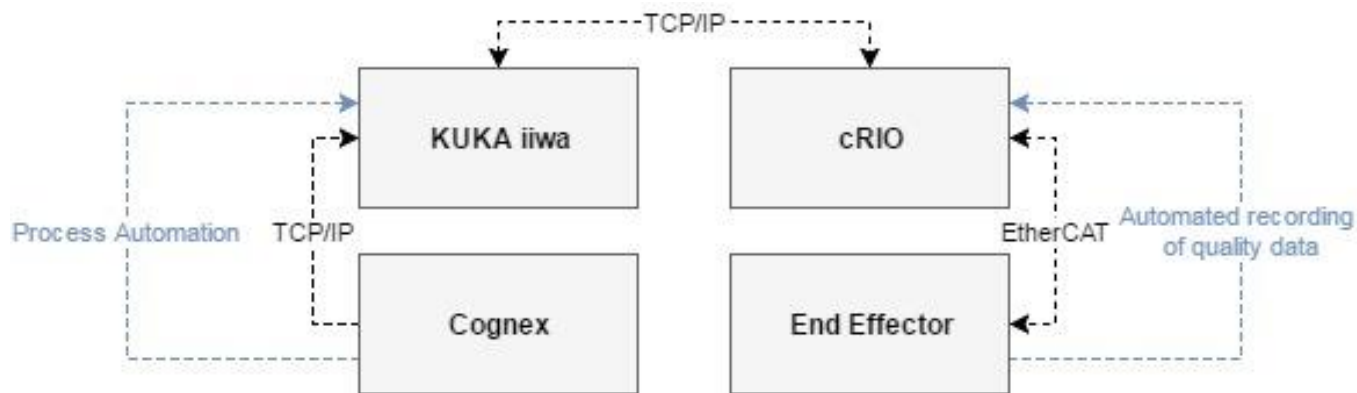
- The CompactRIO allowed development from prototype hand tool retrofit to automated cobot solution
- Shared control code and data analytics throughout development stages



Fuel Tank Sealing – Role of NI Products

Using: CompactRIO, Digital IO/Thermocouple modules, EtherCAT communication, and LabVIEW

- The CompactRIO allows for input/output of multiple types of data/protocols (TCP/IP, CAN Over EtherCAT, and Direct IO)



Airframe Adhesive Application – Challenge

Challenge

Application of adhesive to a variable bondline can be difficult

Can't risk underfilling

Overfilling causes wastage and FOD risk – post-processing may not be possible



Airframe Adhesive Application – Solution

Solution as part of Innovate UK program with industry

Apply adhesive correctly first time every time

Bondline measurement using Leica T-Scan

Adhesive application using Viscotec system

Fully automated process – no human interaction required



Airframe Adhesive Application – NI Products

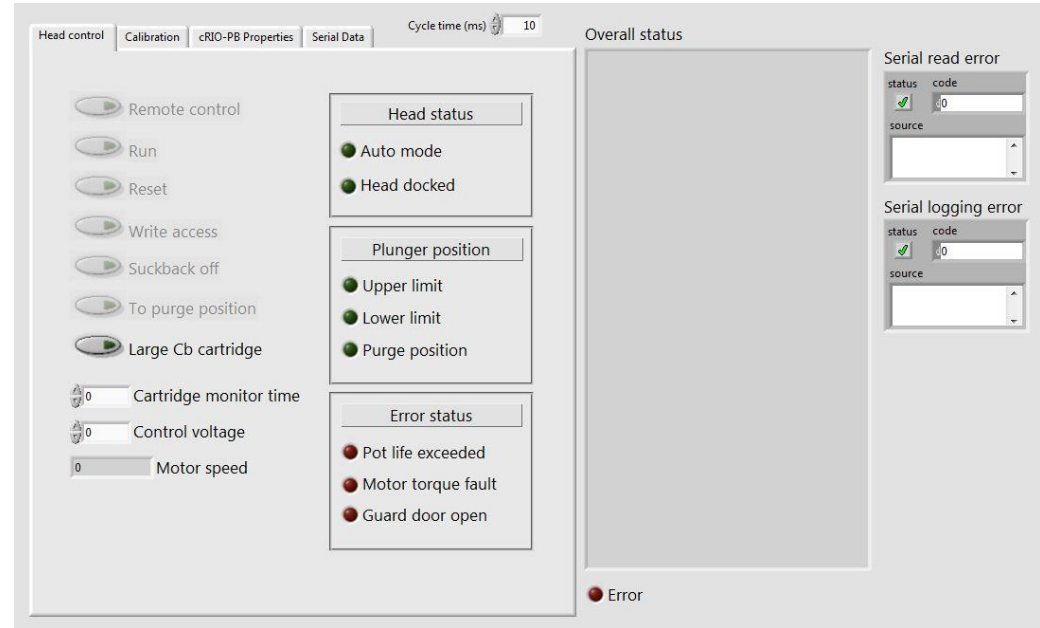
cRIO 9039, eRIOs, various modules

cRIO acts as a central control and monitoring hub via GUI

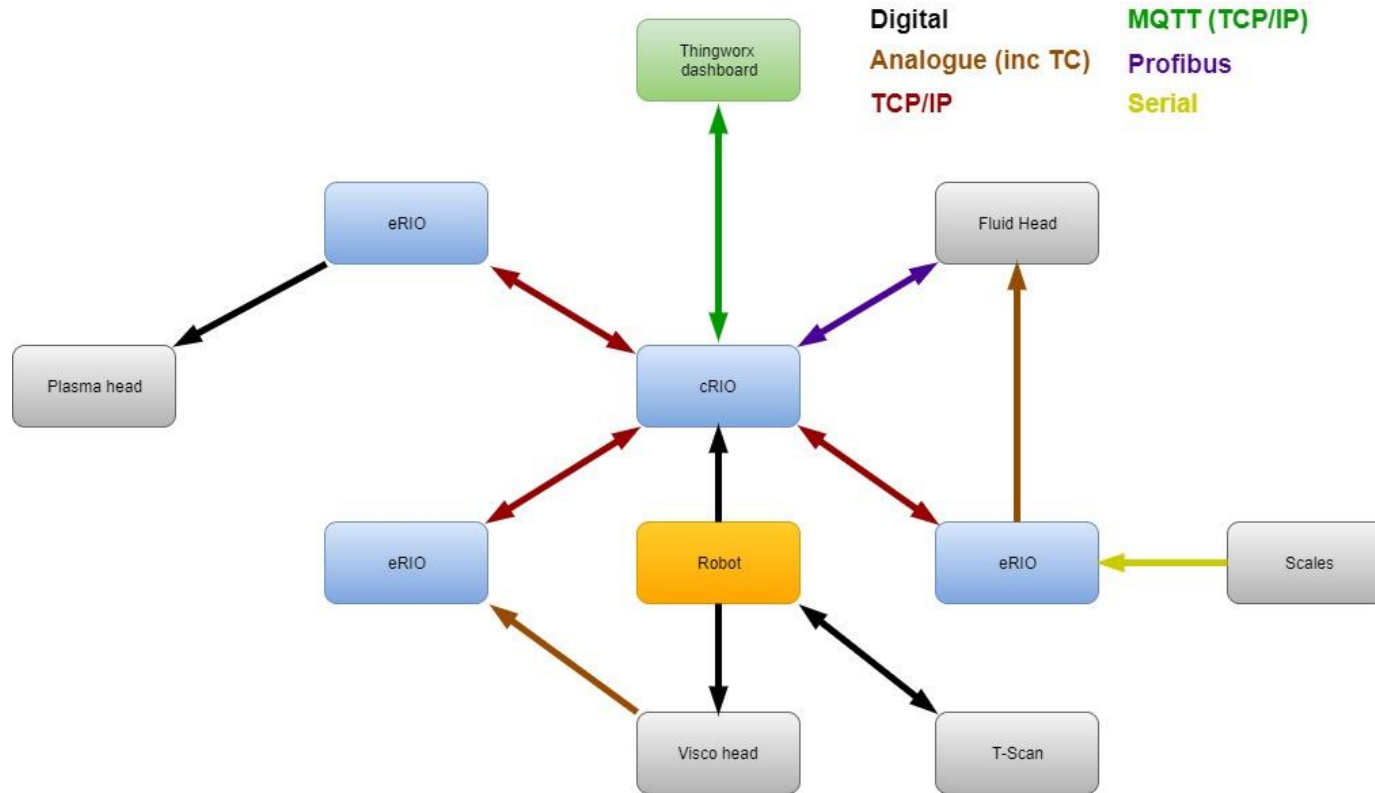
Process variables monitored and outputs controlled wirelessly via eRIOs

Ties a disparate cell together

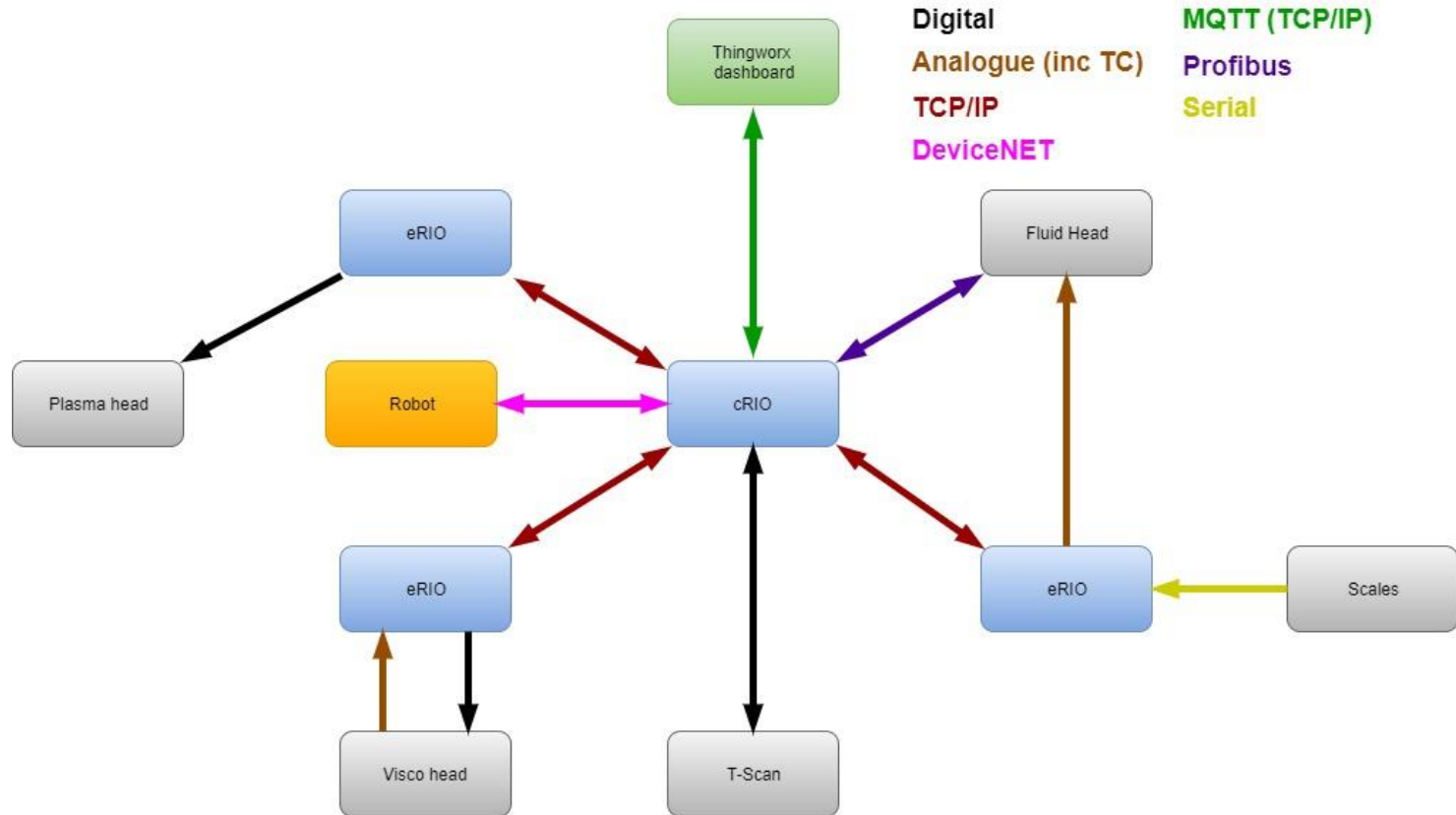
cRIO feeds into factory-wide architecture via MQTT – I4.0



Airframe Adhesive Application – NI Products



Airframe Adhesive Application – NI Products – Future



Conclusions

- CompactRIO/LabVIEW used for a range of control and monitoring processes in several sectors
- CompactRIO and LabVIEW provide benefits such as:
 - Ease of interfacing
 - Re-use of code
 - Shared skill-set across projects
 - Speed (FPGA) ideal for extremely high-rate data processing
- Flexibility/future-proofing allows this work to fit with I4.0 principles



Thank You

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