Argenta – Capability Overview

Argenta have a team of engineers with wide experience of developing test, measurement, control and automation solutions. We exists to solve problems, we love taking a challenge within a process, understanding it by utilising our client's experience then using our experience to design a solution together. We focus on designing and delivering validation pathways and solutions which ensure products and services meet or exceed your customers' expectations.

All of our solutions are developed specifically to meet each client's requirements. We can provide either a software only solution or, in conjunction with a number of strategic partners, a turnkey solution. This includes specification of the system requirements, CAD designs, fabrication, software development and commissioning.

For our test, measurement, control and automation solutions we have experience of working with:

- NI hardware
  - cRIO
  - PXI (Real Time (RT) and Windows)
  - cDAQ
  - Vision
- Software
  - NI LabVIEW (including FPGA & RT)
  - NI Veristand
  - Various PLC
- Application Areas
  - Machine Vision
  - Control -open loop, closed loop, PID etc. across a number of different communication protocols, Ethernet, Serial, Modbus, CAN.
  - Test automation in Aerospace and Automotive

As well as our expertise in test, measurement, control and automation, we also have extensive experience in these areas:

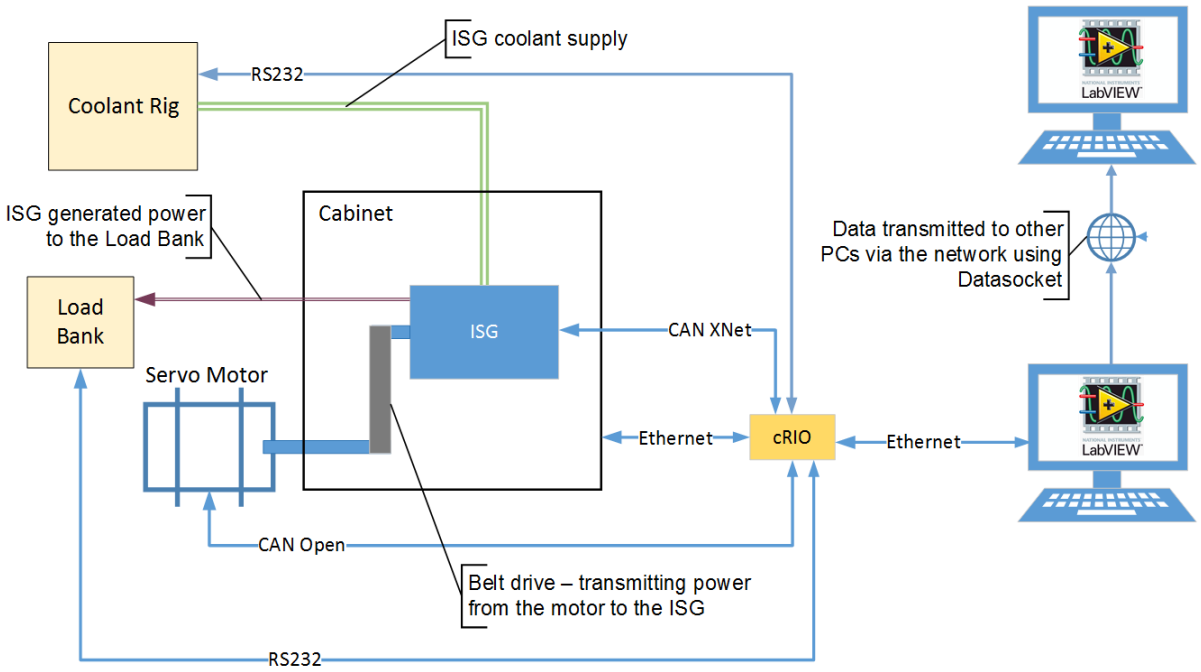
- Manufacturing - Process Improvement
- Supply Chain – Demand Planning and Forecasting

Appendix A contains some example test, measurement, control and automation projects and appendix B contains some sample projects from our other areas of expertise.

A1 Automated Dynamometer Test Rig

The objective of this project was to build a test rig to enable drive from a motor to be transferred to the Integrated Starter Generator (ISG) under test via a belt and pulley set. The ISG is situated within an environmental chamber to allow for varying temperatures to be set throughout testing. There is also a load bank that allows the simulation of the ISG in generation mode, acting as a store for the energy generated by the ISG.

Below is a diagram to illustrate the test rig setup;



The NI Compact RIO (cRIO) is responsible for all signals coming into and out of the system utilising the Field Programmable Gate Array (FPGA) and real time operating system. The cRIO platform enables the system to be run headless, without the PC being connected.

The main challenge with this project was ensuring all communication links with the hardware were reliable, responsive and synchronised. To ensure this, all systems were commissioned individually prior to being brought together to perform system testing. This ensured the reliability and responsiveness of each piece of hardware on an individual level, so that when system testing commenced the focus could be on synchronisation alone.

A separate application was developed and commissioned for the PC to allow the operator to setup test profiles and start and stop tests. It also gives the operator a live picture of the current cycle graphically and how many cycles have been completed.

The process for an operator to carry out a test is detailed below, showing what the system has to do at each step.

The data outputs from the system included the following;

- Cycle data captured at 10Hz
- Critical error data capture at 1kHz 5 seconds before event and 10 seconds after
- ISG CAN message data during the cycle

A2 Hydro Mechanical Metering Unit Test Automation

UTC Aerospace systems use a number of test rigs to ensure that the engine components they produce meet very stringent quality criteria.

The objective of this project was to transfer the testing capability for one of their Hydro mechanical Metering Units (HMU) from an existing rig to a newly installed one. Due to the fact that the existing rig only had LabVIEW in a manual capacity, the solution required a completely new LabVIEW application.

The hardware installed on the new rig consists of two PCI DAQ cards, one connected to a SCXI 12 slot chassis and the other connected to an externally manufactured test box used to simulate the EEC on the aircraft.

The test box is directly linked to the HMU via electrical harnesses. The SCXI chassis had AI, AO, DI and DO modules installed that were connected to various sensors on the test rig including pressure transducers, three way valves, temperature and pressure control valves. Additionally, the PCI DAQ cards were synchronised using a RTSI cable.

The initial stage of the project was to commission the manual functionality of the application. This involved testing all aspects of the acquisition to ensure the digital outputs were controlling the correct valves and the analogue outputs were tuned to control the relevant parameters in a smooth and accurate manner.

Following the commissioning of the manual functionality, the next stage was to commission the automation of the test procedure. This involved running the Product Assurance Test (PAT) for the unit to ensure that:

- all set points were met satisfactorily
- results were displayed in the appropriate location
- each test executed as expected.

For dynamic tests, such as unit shutdown timings, where signals from the SCXI and the test box are being acquired, it was important that the acquisition was synchronised so as to ensure accuracy of timings.

The final stage was correlation of the unit. This involved running 3 full PATs on the existing rig and 3 on the new rig to ensure that testing integrity is carried over to the new test rig.

A3 Machine Vision - Pattern Recognition and Object Measurement

The objective of this project was to determine the performance of a particular process applied to a product. The understanding of the performance would then be used to adjust the process to improve the quality of the product.

Technically this involved developing an application to perform the following functions

- Acquire and display an image at 10um resolution in less than 4 seconds
- Execute an algorithm to detect a pattern on the product surface and take measurements to assess process performance
- Through a User Interface (UI) an operator can start the analysis process and review the results of previous products via numeric and visual data displays

This involved an initial feasibility study to assess the viability of the approach, followed by a complete prototype for use on our client's site.

All image acquisition and algorithm development was completed using LabVIEW. The hardware used involved a 16k camera with a Camera Link HS frame grabber.

The project involved developing a collaborative relationship with our client utilising our experience in machine vision to guide the hardware and software requirements.

A4 Viscous Cooling Fan Test Rig

Technical Services supply engine cooling systems to specialist vehicle manufacturers. To improve their business offering they decided to design and build a test rig to be able to analyse the performance of cooling fans under a variety of operating conditions.

Argenta were commissioned to provide a LabVIEW solution to automate the control of the rig and capture environment and performance data.

The test rig consists of a motor with the fan to be tested connected to it at one end of a tunnel. At the other end there is another motor blowing air into the tunnel. Parameters such as the speed and position of the fan and the temperature of the air being blown into the tunnel are controlled by the solution.

The hardware being used is a PXI rack with a multifunction DAQ card, an 8 channel analogue output card, a 4 channel accelerometer module and a 20 channel PT100 module,

The initial stage of the project consisted of two elements:-

- A calibration function to setup the scaling of the signals being acquired from the data acquisition system.
- A running screen used to view and control all the signals being acquired and output data to a TDMS file

The second stage of the project will be to automate the testing process, output the results and have the ability to analyse previously saved results.

B1 Automotive Tier 1 Supplier – Traceability and Route Enforcement System

B1.1 Background

The customer, a driver information systems manufacturer, makes instrument clusters for car dashboards and head-up displays, and is the European manufacturing hub of their Japanese parent company.

They were establishing a new production line, which was delivered without a traceability system that met their needs, and therefore an improved solution was required. A more robust route enforcement and rework system was also required because if the rules were overridden or overlooked by staff, there was the possibility that an incomplete or faulty product could ship. When mistakes are caught in the final quality control check, that's the most expensive time to fix them. They needed to ensure that any parts that failed a quality check did not proceed further through the manufacturing process without being rectified.

Argenta won a competitive tender to introduce traceability across two of its manufacturing lines, one of which was a conveyor assembly line and the other was made up of individual assembly stations.

B1.2 Solution

Each station now has a PC that runs a LabVIEW application to collect data and check the assembly requirements against a new central database. A web API is used to communicate with the database, which collects all of the assembly and test information relating to each build. The solution connects to their ERP system, so each time a work order is released, the Argenta system updates the database with the parts that are required for the work order.

When components are received at the factory, the Goods In department adds an Individual Traceability Label (ITL). That unique label contains purchase order and lot information from the supplier, so that components can be traced from a final product back to the supplier.

When the components arrive at a station for assembly, they are scanned by the operator using a barcode or RFID reader. The new Argenta solution consults the database to check that the correct parts are being used, and only allows the operator to proceed if they are. The operator completes the build process, and the solution then ensures that the necessary quality control tests are carried out. Depending on the part and stage of assembly, these tests might include:

- Vision-based testing, for example to make sure that connections are straight and check that speedometer movement and labelling is correct;
- Torque and angle tests for automated screwdrivers, helping to ensure that the correct screws are being fitted to the correct holes;
- Linear Variable Differential Transformer (LVDT) testing, to measure height down to a resolution of 3 microns, for example to check whether a connector is open or shut; and
- Noise checks, to ensure that head-up display internals and speedometer needles move without creating noise.

When parts are passed to the next assembly station, the solution checks that the parts have passed the quality tests of the previous station before the process can proceed, enforcing the correct route through the factory. The solution can also keep track of rework limits, ensuring that components are

not fitted into a part more times than the specified maximum. While components may be expensive, and reuse is desirable, each pass through the assembly line can weaken the fixing and reduce quality, so reuse limits have been agreed with the parent company.

All of the data in the Argenta solution is collected into a new database, providing a single source of traceability data for all the parts produced by these two lines. In the event of a query on a part, they can show its customers the quality control results at each point of assembly, and trace the components back to their original suppliers.

B1.3 Outcomes and Benefits

The new system stops parts being sent out that are incomplete, wrong, or somehow damaged during assembly. It's much easier to get information now, previously there were daily reports, now updates can be accessed as required.

If a high failure rate was reported at a station it used to take a day or two to collect evidence to trace the root cause. Now, they can see the current performance and more quickly resolve any issues with supplied parts, machinery or staff. To refine the production line, they can use the new database for Statistical Process Control (SPC), analysing the fluctuations and repeatability of many of the production processes.

In building this solution, along with our client, we had to come up with some innovative workarounds. In some cases, the data needed to be intercepted on its way to the machine controller so it could be used by the new solution. Some parts, such as plastic housings, came without part-level traceability and only had generic barcodes that revealed nothing about the part or its origin. Argenta ended up using the length of the barcode to work out what part it was, since this was unique to each part (luckily!).

B2 Steel Manufacturer – Supply Chain Modelling Tool

B2.1 Background

This tool was developed to support a major European steel manufacturer's supply chain improvement projects. It was originally intended to support the establishment of decoupling buffers between the melt shops and the downstream units. However, it has been developed in such a way that it could be used for a wider variety of supply chain improvement projects.

B2.2 Capabilities

In supporting the design of decoupling buffers the tool has the following capabilities :-

- Identification of the most suitable point in the supply chain to establish a buffer
- Identification of products or groups of products which are suitable for inclusion in a decoupling buffer through demand analysis
- Establishing the initial size of the buffer determined by target service levels based on recognised statistical methods

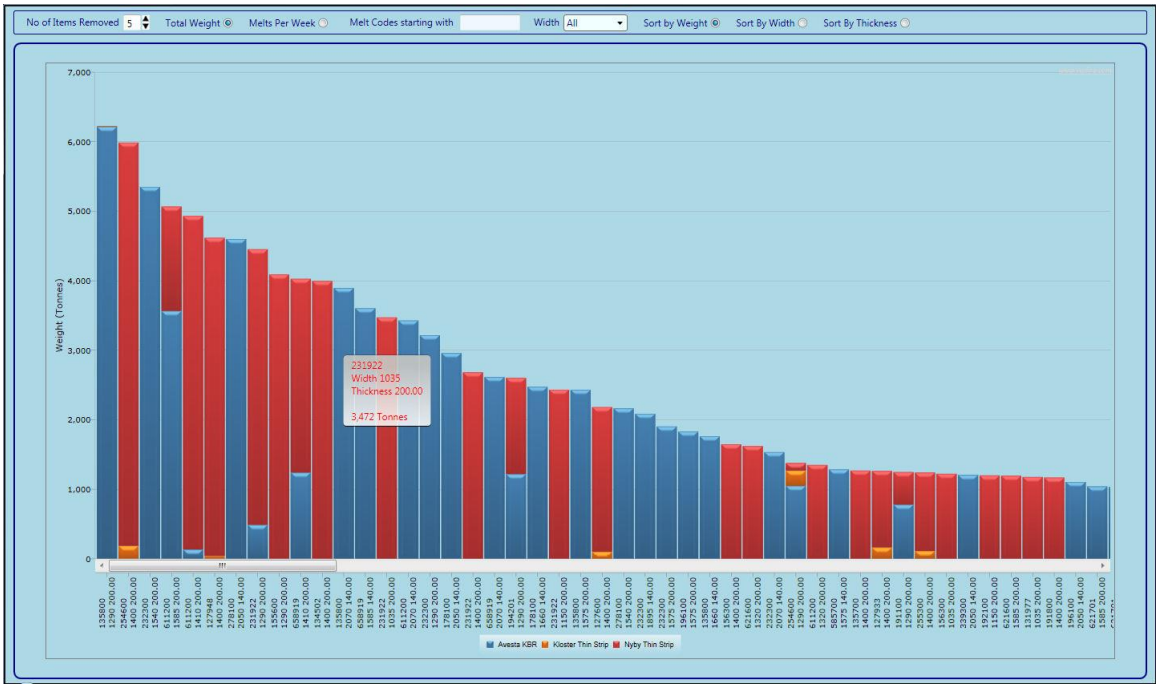
In addition these capabilities can be applied at any level in the supply chain ranging from end (external) customer to melt shop.

Wherever, possible the tool uses graphical displays to help the user make decisions. It also contains a statistically-based forecasting capability.

B2.3 Methods Used

The tool is designed to model the supply chain as a series of interlinked resources. A Resource is a site which has the capability to add value to material in the supply chain.

Each Resource has a number of products allocated to it, these are known as Steels. Each Steel is defined by a number of Attributes such as Melt Code, Width, Thickness, Surface, Length and Weight.



Each Steel has a Link to another Steel allocated to a Resource at the next level up in the Supply Chain. The Links are determined using Rules defined in the tool. For example a Rule might say that for a given Melt Code and width of Slab, thicknesses between 2.5 and 3.2 mm are produced from 6mm Steel of the same width and Melt Code.

Historical Demand data can be imported into the model for any Steel. This data can then be used to generate the effective demand for Steels at levels above it in the Supply Chain by using the Links described above. For each Steel it is possible to define a Loss Factor. This Loss Factor is used to amend the demand defined at the next level. For example if a particular Steel has a demand of 100 tonnes and a loss factor of 5% the tool will assume there is a demand of 105 tonnes at the level above.

The total demand for a given period and Resource can be displayed as a chart as shown in the screenshot on the previous page.

Using the actual or generated demand at a particular level the tool has the ability to analyse the demand and allocate a Demand Category to each Steel based on the volume and number of periods with zero demand.

The demand history of each Steel over the previous 24 months is used to develop a forecast for the next 12 months. The forecast, in conjunction with analysis of the demand history and other parameters, can then be used to determine the amount of inventory required to provide a given service level for downstream customers.

The tool also has the ability to define a number of different Scenarios and compare the results from each Scenario.

B3 Flu Vaccine Manufacturer – Resource Planning Tool

B3.1 Background

The manufacture of 'flu vaccines involves the incubation of vaccine material in hens' eggs in a number of process steps. Some of the steps require a significant amount of manual labour of varying skill levels and quantities. Vaccine production is seasonal and takes place over a six month period each year. Each season requires the production of three different strains of vaccine.

As batches of vaccine take a significant amount of time from start to finish it is necessary to have a number of batches in process at the same time. This results in a profile of labour requirement which can vary significantly from shift to shift.

The client wanted to develop a way of using the available labour as effectively as possible with a combination of permanent and temporary staff.

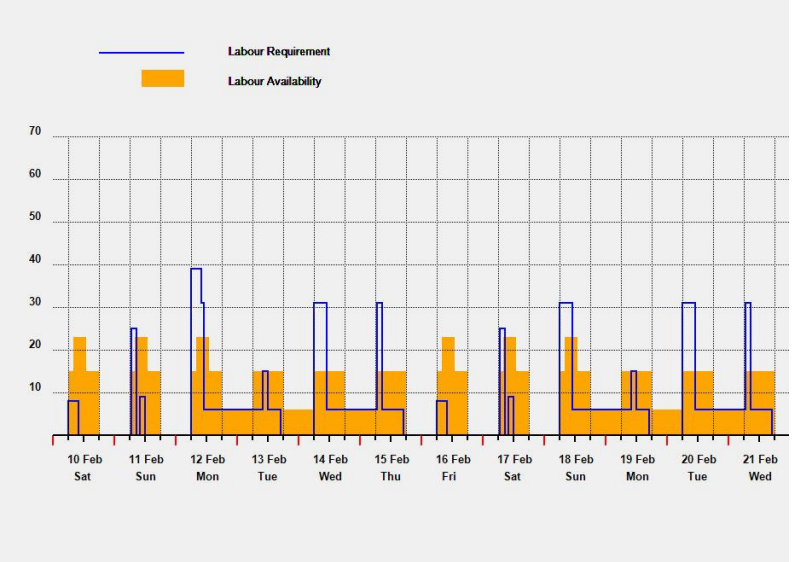
B3.2 Methods Used

The first stage in the project was to establish a clear and accurate view of the labour required for the production of each strain of vaccine. This showed that although the duration and quantities of labour varied, each strain contained the same process steps. This meant that a template could be established consisting of a number of production steps. This template could then be adapted for each strain by defining the duration and the type and quantity of labour required for each step.

The next stage was to establish a process for generating the labour requirement for a schedule containing a number of batches. This needed to compared with the available labour defined by the shift pattern selected.

The initial process was based on a simple Excel spreadsheet application. However, this proved to be too slow and involved too much manual effort to be able to investigate different scenarios effectively. However, it was effective as a prototype for a more sophisticated solution.

The final solution holds the data in a relational database and has a graphical display to demonstrate the comparison of the labour requirement and availability. It also has a number of facilities for making the tool easy to use. For example the ability to schedule a collection of batches by defining the time offset between each batch.



Different scenarios can then be developed by varying the production schedule and the shift patterns to obtain a best fit between the labour requirement and availability.

B4 Forensic Management Information Tool

B4.1 Background

Since 2002 when the Forensic Science Service (FSS) stopped being the only supplier of forensic services for police forces in the England Wales the number of private companies providing those services has increased significantly. The management of contracts with these companies is handled by two teams; the West Coast Consortium (WCC) management team and the Home Office Forensic Marketplace management team.

Accurate management information is critical to enabling these teams to fulfil their roles. Timely provision of forensic evidence can be vital to the success of police forces' criminal investigations. Delivery of the contracts therefore needs to be monitored to ensure that contracted service levels are met. Understanding cost variances and ensuring services are priced correctly also helps ensure that police forces receive value for money at a time when they are under increasing financial pressures.

Recognising these needs, and aware of Process Evolution through their forensic process improvement work, the WCC first approached Process Evolution in 2008 to develop a prototype system for managing delivery of the initial contracts. In 2009 Process Evolution were then commissioned by the Home Office to provide a fully-fledged national management information

solution to enable both teams to manage their contracts effectively and to allow the Home Office team to monitor the overall forensic marketplace.

B4.2 Solution

The solution, Forensic Management Information Tool (FMIT), is based on a relational database which enables it to capture and store the large volume of data required. This data includes a great deal of detail relating to each submission including the type of material submitted, the number of exhibits, the timing and type of services provided, the outcome of the analysis and the cost. As part of their contract, suppliers need to be able to provide the necessary data in a predefined format on a regular monthly basis.

FMIT is web-based so that users in the management teams as well as suppliers can gain access to it without the need for specialist equipment. The majority of suppliers extract data from their internal management system and upload it directly to FMIT using a dedicated portal. This process includes stringent validation so that the data in the system is as accurate as possible.

Once the data has been entered into the system it is available for analysis and reporting by the management team users. The main feature of the system is the ability to run bespoke queries and present the results graphically in chart form. This includes the ability to filter the data based on parameters such as date range, lot, supplier, force and outcome. There are a series of options which enable users to select different ways of grouping and colour coding the results. In addition the query results can be saved as image files or the data exported to Excel.

B4.3 Benefits

There are a number of benefits to using FMIT, particularly in relation to assisting with contract management and performance monitoring of the Suppliers as well as helping Forces better understand their supplier's service provision. Key benefits include:

- Direct data capture from Suppliers (often automated) preventing the forces from having to do any data collection/collation themselves.
- Monthly data uploads to FMIT giving access to 'live' information on all previously delivered cases.
- Ability to drill down into data detail allowing analysis of turnaround times, correct contractual allocations, price variations, national spend, savings and market shares.
- From a national perspective, ability to build up a picture of good practice around the country and disseminate lessons learned.
- Web based application allowing FMIT access from any internet connection without any specialist software or hardware.
- Compliance with Information Assurance National Policing Accreditation protocols.

"The development of FMIT has not been easy but now that we have a working system in place it is difficult to see how we ever managed before. It has quickly become a very useful system indeed and paying dividends in helping manage the national forensic marketplace. A close working partnership has developed with Process Evolution/Jeff Woodhams whom I have found to be very knowledgeable, proactive, extremely flexible in approach and a joy to work with "

John Armstrong (Head of the Home Office Forensic Marketplace Team)...."