UNITED MACHINISTS

Network Site Visit
Case Study

United Machinists
Flipping cobots at it again!

INDUSTRY 4.0 Network

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CallaghanInnovation
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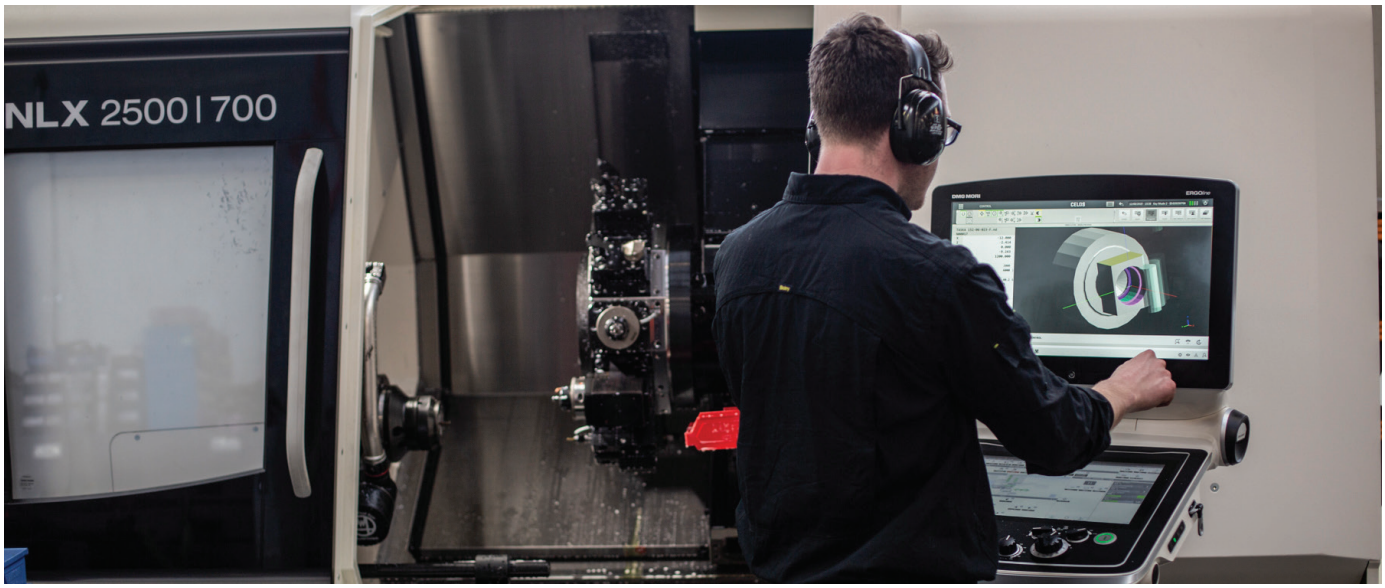

The Profile

United Machinists precision engineer critical components for high-tech manufacturers across the aerospace, medical, mining, and marine industries – we like to say we "machine possibilities".

Founded in 1977 by Doug Ramsay, we have a long history servicing leading New Zealand manufacturers.

Today, owned by the next generation Alex & Sarah Ramsay, our vision is to be the machine shop of the future, working in partnership with New Zealand's leading product innovators. To achieve this, we have invested heavily in new capabilities, plant, and machinery.

- 12 mills and lathes up to 5 axis
- 'Lights out' 24/7 production capability, with custom process automation for production clients
- Dedicated research and development team, focused on process automation and consulting on design for manufacturing
- Real-time live customer production links showing all work on order, stages of production and scheduled delivery.
- Vision CMM (Coordinate Measuring Machine), capable of measuring up to .002mm tolerances.
- Assembly and sub-assembly – in-house assembly of mechanical products. Sub-contracting and project management of electronic assemblies.

The Background

In order to secure several purchase orders for some extremely high tolerance, small aluminium components used in high end prosthetics, United Machinists has upgraded their CMM capability.

These machined components, being less than 20mm (H) and 10mm (W), often ordered in quantities of several hundred with a requirement for 100% inspection, created a significant capacity bottleneck. Each individual component

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would need to be placed in the jig on the CMM, the measurements programme completed, the component flipped, and the process repeated. The order quantities being sporadic meant this task was often attended to by flexible part-time labour, at additional cost. United's continuous improvement mentality meant they transitioned rapidly to multi-part fixtures and expanded programmes so batches of up to 50 could be processed (on one side) at a time. This gave increased flexibility of up to one hour of unsupervised work by the machine, however this was still not utilising the fully automated capability of the CMM. The task remained to extract all 50 and 'flip them' – disrupting operators from other tasks and extending lead-times.

It was likely from their strong relationship and ability to deliver on time, that United Machinists would secure more orders for similar components in the future. This helped create a flexible method of automatically measuring the components which was essential to efficiently be able to deliver on their work.

The Solution

United's Chief Technical Officer, Alex – after attending a Callaghan organised trip to visit manufacturers in Singapore (pre-COVID) saw the capability of cobots (collaborative robots) to work alongside people and other machines to optimise efficiency. Upon his return, he explored options for bringing this methodology into the business.

After exploring different cobot options, the team settled on a 5kg universal robot, as it had the required physical capability, but also a good user interface. The weight rating was a key consideration, knowing that attachments would be required to manipulate the components, taking up a portion of this working weight, they were keen to leave capacity in the weight for utilising the same philosophy on larger, heavier components in the future. This was the beginning of a journey. Keen to establish a sustainable benefit, and upskill internally, United employed Rovin, a recent mechatronics graduate to deliver the project. Internalising the skillset was a key decision. Not wanting to rely on external resource has given them greater flexibility, but also training Rovin in other areas of the business to ensure he could add value and understand the value chain was essential, whilst still working on this project.

Integrating the cobot and the CMM machine had multiple barriers. These included, not having the full range of motion to complete a sufficiently accurate 'flip' of the product to inspect both sides, interoperability between the CMM controller and the robot PLC, alongside different voltage requirements. By following an iterative approach to prototype and solve individual issues, the team made quick, relatively cheap progress.

Rovin programmed the cobot to remove components from a much larger (400) seat fixture and place them in the correct location on the CMM fixture. This fixture itself was designed to be smart, by fitting servos and motors alongside an Arduino PLC it was possible to do the fine manipulation to provide the rigidity to the component for measuring. It also functions to complete the required 180-degree flip between measurement which acted as the barrier to maximising efficiency previously. The fixture, servos and motors were prototyped several times before they could operate effectively.

When the signal for the completion of the programme is recognised by the fixture PLC, it clamps the part in place allowing for measurement, where the data is captured directly into an excel folder for each order, acting as a detailed inspection report. When

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the first programme completes the fixture motors and servos flip the part to allow the second programme to complete the measurement. Upon which the cobot removes this part and replacements sit with the next.

Although the individual cycle time of each component remains similar, this permits almost 24/7 operation, assuming the large pallets of parts are filled prior to commencing the operation.

The next steps are to finalise the last production version of the hardware and validate it for full production use. Following this, the same design principles can be applied to the next part types, ultimately turning the CMM operation for production parts into a fully automated process.

Key Learnings and Benefits

- The skills required for programming and integration of cobots are available from New Zealand universities.
- The retrofitting of cobots to automated machinery can enable 'lights out' operation of large production runs of components, reducing the investment required (in brand new machine tools or measuring equipment) to enable this capability.
- The interoperable requirements between machine tools / measuring equipment are the largest single risk in enabling this retrofitting activity.
- Research trips to other sites provide opportunities for using technology in ways we hadn't previously considered.

About the site visits and Industry 4.0

The purpose of the Demonstration Network is to drive uptake of Industry 4.0 technologies among New Zealand manufacturers with the aim of increasing their productivity and global competitiveness. The Network of Site Visits (NSV) are part of the Industry 4.0 Demonstration Network, which also includes a mobile showcase and smart factory showing cutting-edge industry 4.0 technologies in action. The NSV takes selected companies through a fully-funded assessment process to help them accelerate their own journey towards Industry 4.0, and sees them share their knowledge with other manufacturers.

Further questions?

To find out more please contact the EMA or Frank Phillips at LMAC

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