Making parts fast

With most motorsport racing series now in mid-calendar, Steed Webzell reports on how this exciting industry sector is impacting on UK manufacturers

The regulatory switch from Michelin to Bridgestone tyres looks set to impact Renault more than any other team in 2007. To this end the development engineers at ING Renault F1 Team's Technical Centre in Enstone, Oxfordshire, are working flat out on grip and aerodynamics.

New components and component modifications are coming through thick and fast, providing even more work than usual for the team's busy machine shop where 18 high specification CNC machine tools supplied by DMG (UK) are rising to the challenge. Three new machines have been installed in the past 12 months alone.

"Towards the middle of last year, it became clear we would require additional machining capacity," says machine shop manager Jeff Fullerton. With two DMC64V CNC vertical machining centres with linear drives already cutting at full tilt, the ING Renault F1 Team opted to install two more of these compact machines

Mori Seiki boosts Honda Racing F1 Team's production

Three Mori Seiki NT 4250 DCG and one NL2000Y mill-turns installed at the Honda Racing F1 Team's headquarters in Brackley, Northamptonshire, have produced a 10-fold improvement over previous manufacturing capability, according to Richard Smith, machine and fabrication manager.

A complete refurbishment of the machine shop was driven by a need to cut work in progress, maximise the creativity of workshop engineers and manufacture more complex components in-house by using 5-axis machining.

During machine evaluation, Honda benchmarked the machining of an axle. The roughing cycle was reduced from 8 to 3.5 hours on the NT. "The mix of milling and turning in our components is a 75/25 split towards milling," says Mr Smith. "We needed to achieve this on one machine to reduce our WIP. The power and rigidity of the milling head on the NT far exceeded that of the other machines we considered." The NT machines produce the surface finish demanded, cutting rework rates down to 0.3 per cent and eliminating the need for hand finishing.

With the move towards one-hit machining, additional operations are now mainly confined to manual and EDM, while a change in sub-contracting is seeing low cost items sent out and high cost items brought in house.

Having three identical NT machines with a common fixturing system and common set of tooling allows jobs to be allocated to any available machine. Mr Smith adds: "Batch sizes are small, normally less than 20. We record metrics for set-up and run cycles which suit the reactive nature of our business. Commonality of tooling reduces set-up times and we currently average 87 hours' utilisation per week on each machine across the workshop."

The learning curve was less than expected, allowing Honda's machinists to develop new production methods taking full advantage the NTs. "We are migrating to all-5-axis machining on our jobs. The capabilities of the NT will give our machinists the scope to develop their skills without being limited by the machine tool."

Collaborative working with suppliers is important to the Honda F1 Racing Team, so the support available to the company from Japan and the Paris Technical Centre was crucial to its decision to select Mori Seiki as its preferred supplier. "The biggest driver for us was the milling capability of the NT; it is as substantial as a 5-axis milling machine. Mori Seiki was able to supply machines to fit all our needs. Their performance is critical to us, enabling us to respond to the demands of the racing circuit and manufacture a greater range of components as well as parts which, previously, we could not make ourselves," concludes Mr Smith.

Above – seven Matsuura machines form the core of Honda Racing F1 Team's prismatic machining capability; Left – the company has also installed Mori Seiki mill-turn technology; Below – A hydraulic manifold machined on DMG technology by ING Renault F1 Team

recently. Two of the four now on the site feature fourth axes.

On the 5-axis side, the team has also expanded its capacity recently in the form of a DMU80P duoBLOCK machining centre – and one component to benefit is the car's hydraulic gearbox manifold, machined from a solid round billet of L168 aluminium alloy. Such is the challenge presented by this component that extra material has to be grafted on so that special fixtures can be used to hold the part.

In a single set-up, the DMU80P sets about producing angled bores, complex surfaces and thread-milled holes. One further set-up is required to remove the grafted material, making a total of two set-ups. This is a considerable improvement over the eight set-ups required using a non 5-axis machine. To date 14 manifolds have been produced in a cycle time of around 19 hours each.

Elsewhere, the installation of a brand new Cincinnati CFV5-i 5-axis CNC machining centre at motorsport sub-contract machinist Nicel Precision Engineering is having a profound effect on productivity, helping eliminate operations and reduce overall job times by as much as 50 per cent.

Until recently, the Northampton-based company machined complex prismatic components in several operations via 3-axis milling.

"The time came to make a decision," says managing director Kevin Banks. "We could continue with our existing process, or we could invest in new technology and move forward. Although the choice seems obvious, it was a big decision as we are still a young company with relatively modest financial resources."

Having narrowed a shortlist of suitable machines down to three candidates, the company chose a high performance Cincinnati CFV5-i with on-machine Renishaw probing. Installed in February 2007, the machine has been set to work producing a host of complex parts for customers such as the Ford World Rally team and Cosworth Racing, largely from exotic materials such as titanium and inconel. Tolerances are often in the order of 0.01 mm with typical batch sizes being around 20-off.

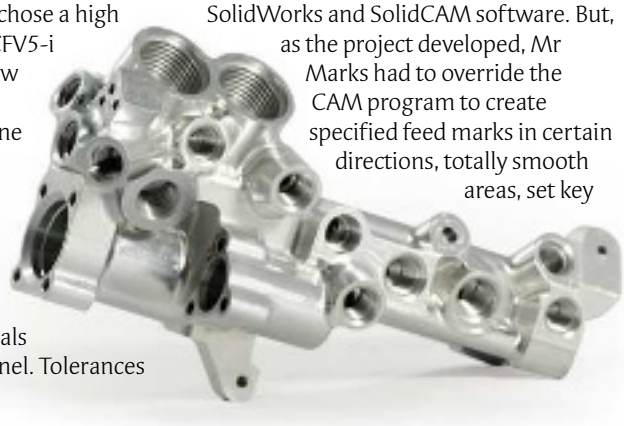
"By making parts in a single operation on the CFV5-i, we not only reduce the number of operations, we also reduce the associated extra programming and planning," explains Mr Banks. "I would estimate that we have cut total job times by as much as 50 per cent in some instances. This is a massive benefit in the motorsport sector where short lead-times and responsiveness are paramount."

ON YOUR BIKE

When a racing motorcycle development engineer walked into Hemlock Engineering's 5-axis production centre at Nottingham with a sketch for a new style of radial foot component for the front forks of a new Superbike, it set in motion a totally new challenge for the company.

According to Hemlock's 3D machining specialist Nick Marks, "what followed was an intensive CAD to CAM component and process development cycle involving intricate 5-axis machining cycles. We even had to manually override the CAM system at the machine to create exactly what the customer required."

On paper, the left- and right-handed components were straightforward to machine out of a solid block of 7050 aluminium. Hemlock offered its two Mikron XSM 600U high speed vertical machining centres with six pallets and Open Mind's hyperMill/hyperCAD GSM, SolidWorks and SolidCAM software. But, as the project developed, Mr Marks had to override the CAM program to create specified feed marks in certain directions, totally smooth areas, set key



lines between the smooth blending areas of different profiles and completely avoid any indication of mismatch.

"To produce the initial batch of components we pushed 5-face machining technology to the limit," he says. "The final method involved the use of 48 tools over three separate operations. Each part took three hours to produce. When final measurements were taken, the machined component was within 0.1 per cent of the original solid model, demonstrating the high repeatability of the machine and process."

Kettering-based precision component manufacturer, Cougar RED (Race Engineering Design), also produces parts for racing motorcycles. These include a new high performance oil cooler system for Honda CBR1000RR bikes and a whole host of spare and replacement performance parts designed and produced for motorbike specialist company Dave Cooper Racing.

Parts machined by the company include cylinder heads, power valves, oil coolers, injection inlets, brake and clutch levers, slipper clutches and various chassis parts, many of which are required in small batches. Furthermore, lead times are always tight.

To help the company maintain its competitive edge, Cougar RED has recently made significant investments in Hardinge CNC machine tools. To date this has included two Bridgeport 760 XP3 vertical machining centres and a Hardinge Elite 8/51 lathe.

"We are a relatively new company, but we live and die by the quality and reliability of our products and the manufacturing processes that underpin them," says company director Paul Copperwheat.

Hardinge has also had success selling turning technology to Peterborough-based Radical Sportscars which has recently purchased a Talent 10/78 lathe.

Examples of the type of job machined on the Talent lathe (installed in March 2007) include the manufacture of high precision front and rear wheel hubs. In a job manufacturing front hub

Nicel Precision is seeing cycle times cut by as much as 50 per cent

sets, the Talent lathe is used for all four machining operations – two roughing and two finishing (after heat treatment) operations. Cycle times are typically 50 minutes per part. The hubs are machined to ±0.01 mm tolerance and to a surface finish of Ra 0.5 micron.

INTERPRETATION ROLE

Triple Eight Race Engineering Australia (888), which competes in the Australian V8 Supercar series, uses EdgeCAM Solid Machinist from Pathtrace.

Senior machinist Neil Prior (formerly with Williams F1) investigated the market to find the best combination of CADCAM software and CNC machine tools. Two systems reached his shortlist and EdgeCAM was selected to operate with Haas lathes and mills.

"We chose EdgeCAM because it met our requirements for mill-turn, providing a range of machining features and ease of solid model transfer with our CAD system," he says.

"A recent investment was a fourth axis attachment that we fitted to our Haas VF3 to produce our components in fewer processes," he adds. "We have also reprogrammed a part for the fourth axis that originally took seven operations. Using EdgeCAM this was quickly reduced to two – and the ability to run the machine unattended came as a welcome bonus. The system has also enabled us to tap into the full potential of our Haas SL30 CNC lathe and its live tooling capability."

The complexity of many motorsport parts means racing teams often have to look beyond milling and turning technologies. This has been the case at the Brackley headquarters of the Honda Racing F1 Team (see also box , page 60), which has recently invested in three high performance EDM machines from GF AgieCharmilles: two RoboFil 440 CleanCut wire and one RoboForm 350 die-sink model.

Over the past few years an increasing number of Formula One car components are being manufactured from lighter, tougher materials – titanium, exotic alloys and composites – as a route to optimising the weight of the cars and increasing their performance in terms of reliability, speed and responsiveness.

"Our upgraded EDM capability reduces the potential for scrap and/or re-working of expensive parts," says machine shop manager Richard Smith. "This has also meant that we can reduce the amount of EDM work we need to sub-contract, which again has had a positive impact on our part quality and ability to meet stringent lead times."

The EDM installation is part of a £4.5 million investment at Brackley that has also seen seven Matsuura MAM72 5-axis, vertical machining centres installed – all equipped with 32-pallet storage systems – to form the core of the a prismatic metalcutting capability at the company.

"Our aim was to reduce higher cost components produced by outside sub-contract machinists," explains Mr Smith, "and at the same time reduce set-up times and our dependency on using multiple machines to produce any given component." □

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