

# Competing cleverly

**Renishaw probing is key in two companies' manufacturing performance and success, but they are two very different examples. Andrew Allcock reports**

**B**K Tooling has just five employees. Based close to Stansted airport, Essex, the company makes plastics injection mould tools and produces mouldings from them. Director Bob Tunks started out on the journey towards smart manufacturing some 15 years ago, although it was not a clear-cut path or plan from the off. At that time, the company had manual machine tools – Bridgeport turret mills – and was marking out parts on benches. “Good old-fashioned toolmaking skills,” he offers wryly. And he asked himself a question: “I’m 35 years’ old, I’ve got another 30 years in this business, where am I going?” At the time, there was a buzz around CAD/CAM and high speed machining, while the manual/CNC combination machines were also making their appearance.

Attending exhibitions, he saw automated mould tool making cells combining high speed machining, EDM and CMMs. But at a cost of many

£100,000s or even more, that technology was out of reach.

He comments: “Like most toolmaking companies in the UK, we only have a few employees, so we had to think about things a different way. How could we get those benefits without paying out that sort of money – hopeless without large contracts which even then had started to disappear to the Far East.”

Unable to commit to such expenditure, Mr Tunks started out at the hybrid, CNC/manual combination end of the technology scale with a 2-axis XYZ Protrak turret mill. A 3-axis Protrak turret mill followed – as did a CAD/CAM system some 12 years ago. However, when Mr Tunks found himself driving to work at 3 am to change tools, because he knew a machine would have finished that part of the program, he knew it was time to get a machining centre.

It was then that Renishaw probing entered the equation. Seeing a 3-axis machining centre from one supplier, and with a Renishaw probing package offered at half price – the key influence in the decision to purchase or not, it is admitted – Mr Tunks asked XYZ if it would offer the same deal; it did and so probing came to BK Tooling in 1998.

## PROBING REVELATION

“Now I didn’t know quite what probing would do. I had an inkling; I knew that I had spent many hours checking things.” But as time progressed, the benefits of probing became “very, very apparent”. And underlines Mr Tunks: “I can only say that if you took the probes away, I wouldn’t be able to do my job. Well, I

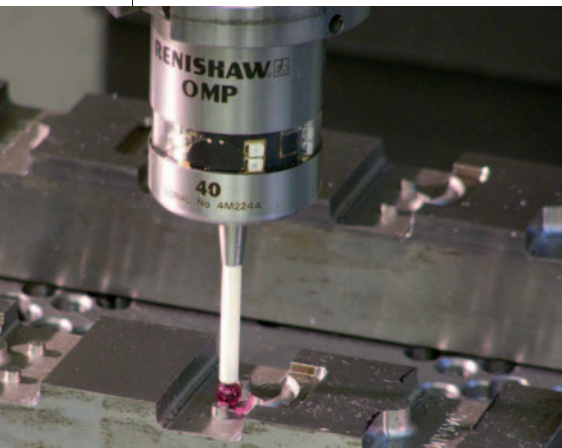
could, but it would take much longer and I would not be able to achieve the sort of accuracy that I get by using probing.”

With its third machining centre, the company has now moved to high speed machining – an XYZ 1060 HS vertical machining centre installed in early 2007 is delivering major benefits. He explains: “It’s not just about spindle speed, it’s about the overall rigidity of the machine, the quality of its build, and the way in which it accelerates and decelerates.

“The 1060 HS is also equipped with a Siemens 840D ShopMill control that looks ahead to convert a multitude of straight lines into a smooth curve. This machine can drive a 6 mm diameter cutter at 2,500 mm/min with a 0.1 mm step-over and produce two halves of a mould tool that fit together perfectly on a three-dimensional split line – that is five times faster than the last machine!”

BK Tooling uses probing for part and tool probing on its latest machine (OMP 40 and TS27R, respectively). The company recognises that the fewer times the part is moved, the more accurate it can be made. Machining is all metalcutting – 3D cavity machining, no drilling or tapping, so tooling is coated carbide ballnose or radiused endmills – which means that when tools are changed these must match perfectly with the previous cut surface. “We are now working with anywhere between a 16 mm diameter ballnose cutter down to a 0.4 mm diameter die-sink cutter with a 0.1 mm radius. We couldn’t do the job without probes,” he confirms.

In exemplifying what this all means in practice, Mr Tunks highlights one



*BK Tooling's probing journey started in 1998*

customer, Aquapac, a maker of waterproof containers for mobile phones and such like. The containers each have a clamping mechanism to seal them. These mechanisms are produced in a multi-impression mould tool which makes four backs and four fronts at a time. However, because there are three different lengths of clamp, mould tool inserts are required to support this variation. The ability to use inserts in any cavity together with a minimal visible split line could not be achieved without the use of probes, Mr Tunks underlines. A gap of just 20 to 30 micron would result in plastic flowing to the wrong places. It is this quality level that differentiates BK Tooling and was crucial to the company's success with this particular job, he says.

#### HEAVY CAD/CAM USER

But if probing is key to reduced inspection time and increased part accuracy, the smart manufacturing element takes in more than this and high speed machining. Today the company is a heavy user of CAD/CAM – Vero's mould and die package. Mr Tunks says: "I think I have just about every one of their packages, the latest being a moulding package similar to Moldflow." Using this, a standard, systemised approach to mould tool design is used, while BK Tooling also applies standard tool sets on its machines, and therefore programs using a standard set, while a single set is used to support cutting of all materials to further reduce tool inventory. In addition, it uses System 3R Refix table and tooling, plus its own in-house pallet system, to support electrode manufacture, complementing .

"When I have cut something, I need to know that I don't need to do any more to the mould tools. And we have had to do all this because I can't compete against low-wage economies. I have high labour costs; I have had to come up with ways to remove manual labour from processes."

And by doing it all, BK Tooling has



*BK Tooling's Bob Tunks with an Aquapac unit – probing helps deliver the quality required*

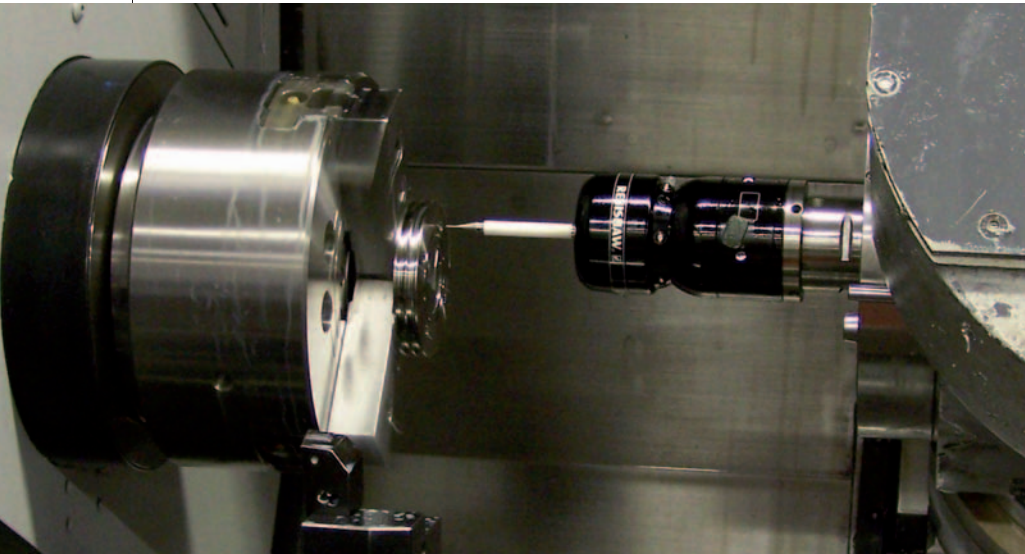
been able to find its niche – in between the rapid prototyping process and the manufacture of volume production tooling made in low-cost economies – for its rapid mould tool/moulding service.

"A recent example was a company that gave us CAD data on a Thursday afternoon and asked when they could have the mouldings. I said 'beginning of next week'.

"I walked into the company on the Monday morning with mouldings from a two impression tool which featured two side actions, so not simple open-and-shut

tooling. But they had already decided that I wouldn't be able to achieve this, so had commissioned rapid prototypes – I arrived two hours after these turned up!" The follow-on order is for 60,000 moulded units before the job moves to a low-cost economy.

Having established a smart manufacturing environment, Mr Tunks believes that the company has achieved something special. Indeed, he is setting up a consultancy to advise small engineering companies of the BK method of smart manufacturing.



Probing plus analysis of results on a per tool not per feature basis is key at Martin Aerospace

Moving to a somewhat larger concern, Martin Aerospace is a major supplier to Rolls-Royce. The Lanark, Scotland-based company undertakes turning, milling and thread rolling as core processes. In the thread rolling it is one of few players. The firm has some 30 machines, employs around 60, but is looking to introduce mill-turn lathes and more VMCs, aiming for one-hit machining.

But in so doing, the company must produce components that are correct, for as managing director Bertie Phimister underlines, the key is controlling the process on the machine and not inspecting afterwards. Renishaw probes and a GSPS CNC Reporter process monitoring package (see *Machinery*, November 2006, page 26) have therefore been introduced to reduce machining lead times and improve consistency.

A major new contract for a Rolls-Royce engine part was the prompt. It is a part that features tight tolerances and is made from Inconel – so no remachining can be entertained.

As the company machines each feature on a Mori Seiki NT turning centre which has driven tooling, every one is probed with an MP700 probe. Before installing the CNC Reporter system, however, the results of probing were

printed off, analysed and the program updated via manual intervention. Batch sizes are around 200-off for the part.

Martin Aerospace contacted GS Productivity Solutions because it wanted to understand what was happening in more detail on a part-by-part basis, and ideally in a paperless fashion. CNC Reporter not only supports the generation of inspection reports but also provides information about process capability. "Is the process in control?; if it is, how long has it been in control?; for example," explains GSPS' Guy Brown.

**A CLEAR VIEW FOR DECISIONS**

"The whole point is to give people visibility to make decisions. Martin Aerospace thought it wanted a package to replace its paper-based inspection reports; instead we introduced the company to process capability and control, which has allowed it to make decisions that will save time and to make parts quicker and to a higher quality level than before."

The details at Martin Aerospace are that the company is using standard Renishaw Inspection Plus macros on the Mori Seiki machine, with these integrated into the machining process so that measurement of parts in real time is

achieved with trends made visible. But, importantly, says Mr Brown, dynamic process control – automatic tool updating – was not part of the set-up to begin with because the idea was to understand the process influences. As an aside, he offers that no after-the-event inspection can ever tell you about roughing process results, yet variation here will also cause variation in finishing processes.

The focus of attention with CNC Reporter is not the actual features on the part but the tools used to produce them. "The part can be any shape, in fact," Mr Brown offers. Measuring the part tells you what is happening to the tools over time, so a trend for the tool, and hence part features, can be established. At Martin Aerospace a result from this has been a change of tooling policy, for example.

There were four machined holes being cut with new and re-ground tools that went out of tolerance after cutting about 40 holes. CNC Reporter collated results that proved that it is only cost-effective to use new tooling. Although more expensive, new tooling can cut over 80 holes before going out of tolerance. There's also less toolchanging downtime. Martin Aerospace's Jim McFarlane, machine operator and programmer, comments: "For a long time I've thought that on tightly toleranced work, re-ground tools are a false economy, now I can prove it."

In another area, grooves that take seal rings are coated and then ground with driven tooling on the Mori Seiki mill-turn machine to within 'four tenths of a thou', an incredibly tight tolerance. This is now achieved reliably with probing and CNC Reporter software.

The probing/CNC Reporter package will be rolled out across other machines in the future following the results of the initial implementation. But for now, the company has halved its total process time, taking machining and inspection together. Better than that, Rolls-Royce has been impressed, indeed, is itself now adopting the same thinking in-house. □