INDUSTRY'S ANNUAL REPORT 2006

Machinery

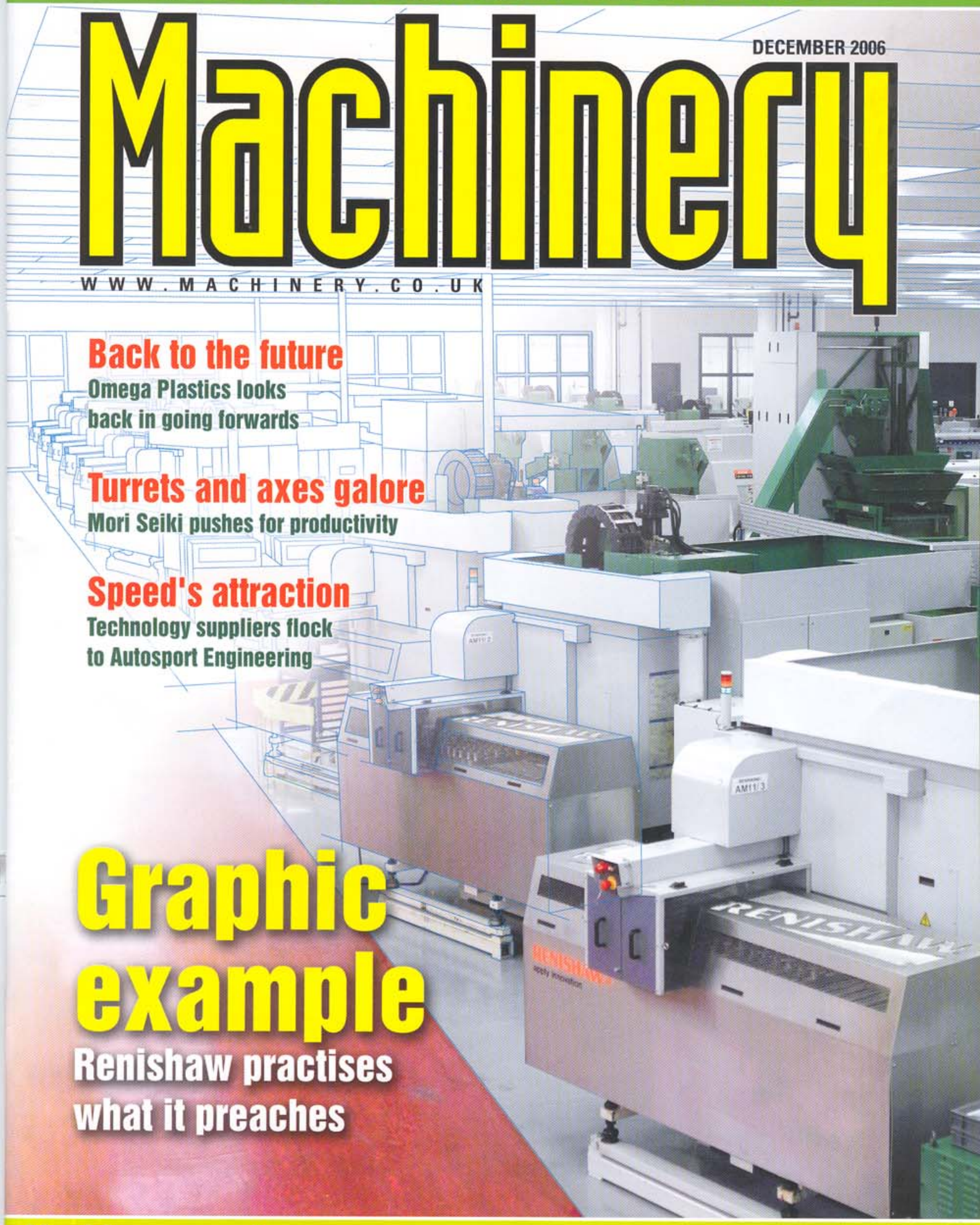
DECEMBER 2006

WWW.MACHINERY.CO.UK

Back to the future
Omega Plastics looks back in going forwards

Turrets and axes galore
Mori Seiki pushes for productivity

Speed's attraction
Technology suppliers flock to Autosport Engineering



Graphic example
Renishaw practises what it preaches

Machinery incorporating Sheet Metal Industries
Tel: 01322 221144
Fax: 01322 421549
Email: machinery@findlay.co.uk
Website: www.machinery.co.uk

EDITOR
Andrew Allcock MIET

ART EDITOR
Roland Davies

SALES DIRECTOR
Joe Opitz (jopitz@findlay.co.uk)
Mobile: 07967 169098

SALES MANAGER
John Sumner (jsumner@findlay.co.uk)
Mobile: 07967 169155

ACCOUNT MANAGERS
James Curtis (jcurtis@findlay.co.uk)
Peter Green (pgreen@findlay.co.uk)
David Harman (dharman@findlay.co.uk)

TELEPHONE SALES
Sam Barnes (sbarnes@findlay.co.uk)
Chris Warner (cwarner@findlay.co.uk)

PUBLISHING ASSISTANT
Kerry Wilkins (kwilkins@findlay.co.uk)

CIRCULATION MANAGER
Chris Jones (circulation@findlay.co.uk)

PRODUCTION
Heather Upton (hupton@findlay.co.uk)

PUBLISHER
Peter Knutton (pknutton@findlay.co.uk)

Represented in North America by
Huson International Media
Frank Lascari, 350 5th Avenue,
Suite 2719, New York NY 10018
Tel: 212 268 3344
frank@husonusa.com
www.husonusa.com

If you change jobs or your company moves to a new location, please contact circulation@findlay.co.uk to continue receiving your free copy of journal title.

Machinery is published on the first Friday of every month by Findlay Publications Ltd, Hawley Mill, Hawley Road, Dartford, Kent DA2 7TJ

Annual subscription is £115 (UK) and £170 (Overseas).

Technical articles of full page length or more are included in the Current Technology Index.
The Journal is covered in the Science Citation Index © Machpress Ltd, 2006 ISSN 1753-0482
Origination by Wyndeham Graphics
Printed in England by Wyndeham Heron Ltd, Heybridge, Maldon, Essex

Model manufacturer

It is not unusual for Renishaw to be the centre of attention for both its manufacturing efforts and its products: it is so again.

Our cover feature this issue focuses on the UK firm's new manufacturing plant in Stonehouse, Gloucestershire. Visitors to Renishaw's previous manufacturing facility at New Mills, Wotton-under-Edge (still in use but not for production) would already have been impressed, but this new site elevates the Renishaw manufacturing image to an even higher plane.

In truth, much of Renishaw's manufacturing methodology is not new for Stonehouse – minimally manned, automated machining centres that both mill and turn; a design-for-manufacture ethos backed by documented design rules; a 'release for production only capable processes' approach – all featured at New Mills, although they are being refined and extended in some areas. But the reason that the facility is likely to positively overwhelm visitors is because it still surprises.

It is still a surprise to enter a machine shop that is so clean, quiet, bright and minimally populated with people unhurriedly focused on supporting and maintaining capable processes that run automatically hour after hour, day after day, year after year, supported, of course, by intensive use of in-cycle probing.

> Despite 93 per cent of its sales being overseas, Renishaw continues to manufacture efficiently in the UK

But this is the symptom, not the cause, so to speak. The cause is attention to detail and well-defined procedures in the office environment that support the design, planning and production phases and which *take as read* the heavy involvement of on-machine probing. This adherence to process provides for the elimination of variables before tool cuts metal in production, while the company's probes then take over the monitoring of minor variables in the production process itself.

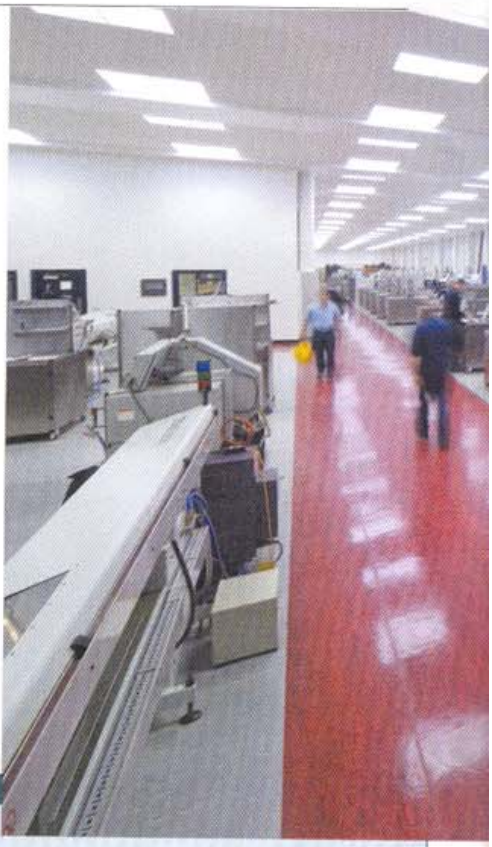
Now all this is not just to demonstrate the company's probes in action; it is a means to manufacture profitably in the UK. Despite sales outside the UK and Ireland representing over 93 per cent of its turnover, the company can and does demonstrably continue to manufacture efficiently in the UK.

As it happens, Renishaw is now providing training in the application of probes in accordance with its Productive Process Pyramid – an 11-step path to achieve part verification on-machines.

Rather than just be impressed by Renishaw, other manufacturers should be guided by it – the Stonehouse facility simply underlines this yet again.□

Graphic example

Renishaw's new shopfloor at Stonehouse, Gloucestershire, is manned by just 78 directly employed staff across three shifts, but it supports a £176 million global business. Andrew Allcock explains how it is done



Renishaw is a UK-based global business employing some 2,200 and with a presence in 30 countries. Its 160-employee Stonehouse facility, up and running since April this year, supplies the company's other manufacturing operations with metal – and some plastic – component parts. The company makes in-house "99 per cent" of the metal components used in its products, which take in CMM and machine tool probe systems, measurement encoders, laser interferometers, plus, latterly, dental parts measurement and manufacturing technology.

It achieves this with a machine shop run by just 78 people across three shifts. But this limited manned environment is also a major reason why, with sales outside the UK and Ireland representing over 93 per cent of its turnover, the company can and does continue to manufacture efficiently in the UK.

"We're fighting to keep manufacturing here in the UK," underlined assistant chief executive Ben Taylor last month when *Machinery* visited the new Stonehouse site. He added: "We will be successful if we can solve this problem [manufacturing in

Automated machining centres

Renishaw's Automated Milling, Turning, and Inspection Centre (RAMTIC) allows the company to more efficiently manage its machining operations by reducing set-up time and eliminating the need for manual quality checks during a machining run.

The company uses the RAMTIC system in a line of 25 Mazak vertical machining centres, which have been modified to include an indexer and transfer mechanism.

RAMTIC uses a portable carousel that is stocked at an adjacent off-line kitting station where, depending on the products to be manufactured, it is loaded with raw material and tools. Once loaded next to a RAMTIC machine, operator involvement is finished. The changeover operation takes about 15-20 minutes per machine and normally happens once a day.

Renishaw's probing systems assure the quality of the parts and control all aspects of the process during the manufacturing cycle. Multiple operations of parts for a product kit are manufactured in sequence with 'job set-up' being automatic and unmanned.

Use of calibrated master 'artefacts' on the machine, allow traceable measurement despite the variable thermal environment, as they are made from the same material as the workpiece and consist of similar features. The artefact allows comparative measurements to be made before updating the process.

"The artefact allows us to understand and quantify any errors introduced by the machine tool or environment. We store that data and use it to compensate all the subsequent measurements," explains principal engineer Paul Maxted. Tolerances of 50 microns can be held with this set-up, with this as good as 20 microns with component-specific artefacts.

Overall, RAMTIC provides a major reduction in manufacturing lead times. The system can run unmanned for up to 140 hours/week and the automated machine calibration and in-process inspection help achieve consistently high levels of quality and reduced cycle times. No post-production dimensional inspection takes place.

Regular checking of machine tool accuracy using its Ball Bar is also fundamental in keeping variables under control. But this established RAMTIC approach is to be re-evaluated in the light of latest mill-turn lathe technology.

high-cost UK] by selling the solution to others – a win, win where we generate jobs here in the UK as well as develop processes and products that we can sell to others."

SHOWROOM CONDITION

Activities undertaken at Stonehouse are raw material preparation, machining (predominantly steel and aluminium), and process finishing (manual/auto deburr, polish, anodise, despatch). There are some 10,000 individual piece part designs and around 300,000 parts are despatched each month to Renishaw sites at Old Town (15 miles away –laser calibration and spectroscopy assembly), New Mills (15 miles away – pre-production manufacturing and encoders), Ireland (established volume assembly), Woodchester (four miles away – established assembly and electronics), and Pune, India (high labour content, low margin – cable assemblies currently).

A walk round the machine shop reveals, for the most part, automated machines running unattended with limited numbers of personnel concerned with supporting their efforts. There is no frantic progress chasing, either, simple machine scheduling is the rule here.

It is brightly lit area with room for expansion (70,000 ft^2 shopfloor), is maintained at ±2 °C, while the usual machine shop smell is almost totally absent, courtesy of Absolent air filtration units which are now widely used. The company has standard machine tool 'platforms' – Mazak vertical machining centres (AJV and FJV – 25 machines), Citizen sliding-head lathes (B, L and M series –

Top – clean, bright, quiet, yet productive, that's Renishaw's new Stonehouse shopfloor.
Right – there's money in compacted swarf, says Mark Buckingham

20 machines) and Mori Seiki mill-turn machines (SL153-SL153Y models – six machines).

In addition to the shopfloor, 10,000 ft² is given over to washing, finishing, deburring, and anodising areas (now far more presentable and part of the official tour) and a further 20,000 ft² to office space.

Of course, visitors to Renishaw's previous machining area at New Mills, Wotton-under-Edge some 15 miles away would also have been impressed by a similar mood of efficiency, but the move to Stonehouse has allowed even the already efficient Renishaw to up its game in a number of areas as its last major machining area consolidation activity was over 10 years ago.

The measure of the success of the new facility in overall terms is that, as Gareth Hankins, general manager, manufacturing services division, explains, there has been no degradation of the overall measure of efficiency for the company – value added output per £1 of overhead cost. And that is with the additional overhead created by an investment of £5 million in buildings in September 2004 and a further £2.5 million, including £1.5 million on capital equipment (see box above). When these investments have been paid for, then there will be improvement in this measure, Mr Hankins says.

This outcome should not be a surprise because: "We started with two simple objectives: to build one of the best machine shops in the world and to be as self-sufficient as possible – to have everything we need within these four walls."

A new anodising plant, one of many investments made at Stonehouse

Stonehouse investment details in brief

- New anodising plant (double existing capacity);
- Additional four Mazak FJV machining centres;
- Auto-deburring facilities and effluent management;
- Swarf management conveyors and briquetting system for aluminium;
- New raw Kasto material processing equipment (steel and aluminium) – 1 man/1 shift not three shifts with a man on each;
- Fixture maintenance cell, kitting areas, local 'hubs' for each machine group;
- Site and plant maintenance equipment;
- Additional machine tools for medium batch/prototype machining to provide sub-contract reduction and lead-time improvements;
- Cleaning equipment throughout the manufacturing processes (MecWash Midi units with Aquasave system);
- In-house vacuum hardening facility – work in progress.

SPACE NO LONGER A FRONTIER

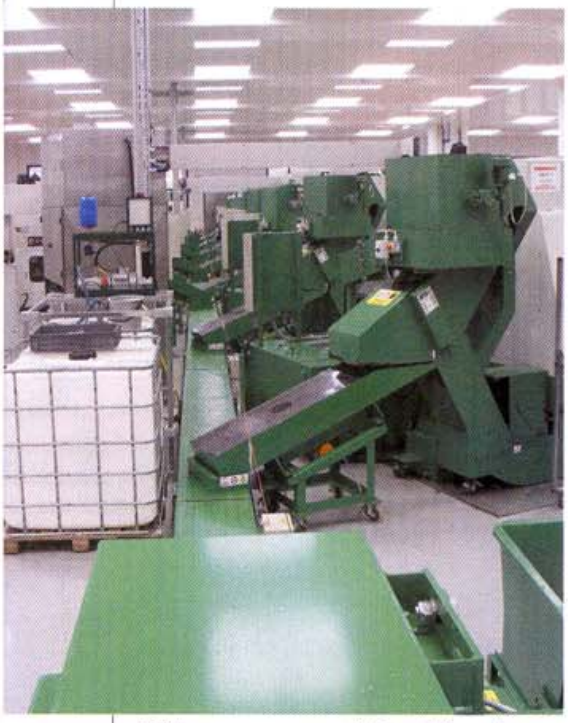
A number of significant elements have supported the achievement of the ambition. With more space available than at New Mills, layout could be vastly improved with machines and equipment placed strategically rather than where space was available (with spill over at Woodchester). So material flow through the shop is better, while there is room to implement, for example, an aluminium swarf recovery/briquetteing system for the high speed Mazak FJV machines.

As Mark Buckingham, principal manufacturing engineer, manufacturing services division, explains, aluminium costs £4,500/tonne; swarf scrap can be sold at £900/tonne loose, but when it is compressed into a briquette, which removes oil and water, it is worth another £155/tonne more. With the high speed FJV, which machines aluminium only, producing well over 100 tonnes of swarf/year, the benefits in briquetteing are clear. But the recovered coolant, up to 1 m³/week, is reused in "lower grade machining activities" such as low volume production and sawing.

Having scored success here, Mr Buckingham is now looking to recycle other materials – stainless steel 303 (£1,200/tonne) and brass (£2,500/tonne), which are produced by the turning section. But the problem is that this is mixed with magnetic stainless 416 and aluminium. Separating the mix into four buckets is the initial problem.

Distributed 'tool hubs' are another innovation, exploiting the extra space; a centralised store would have meant long walks for staff in the more capacious new factory, so this was a driver for the change. The machine group hubs are sited to service up to 10 adjacent machines and they have everything needed, right where it is needed, including locally based CMMs in place of hand-held instruments.

"The operators have taken on full responsibility for the hubs and everything that's in them," explains Robin Harper, programming manager. And building on the culture of ownership, Renishaw uses a problem-



With more space available at Stonehouse, Renishaw has been able to implement a centralised swarf system

solving system based on the Ishikawa (fishbone) diagram. "Process Improvement Cause Analysis" (PICA) boards are located on the shopfloor adjacent to the machining cells. Operators who identify a problem use Post-It notes to flag that problem, or opportunity for improvement, on the board," he says. The hubs and related equipment/systems build on the company's six sigma activity undertaken some 18 months ago, in fact.

Location of manufacturing engineers local to the shopfloor is another 'cultural' change that has improved communication, as has the introduction of formal shift-handover meetings between relevant parties.

Stonehouse's extra space has also allowed new product development and low volume production machining (>150 parts/year versus production's 50-100/month) to be separated, so there is no longer potential for disruption to either activity – new product development remains at New Mills.

This new environment and improvements build on the established principles of control at the critical product development, manufacturing process development and production stages, which support Renishaw's effective automated manufacture around the clock, five days a week regime, although the latter is also being improved at Stonehouse.

DESIGN FOR MANUFACTURE

New product development is backed by a design-for-manufacture ethos. This means providing information, via intranet, to designers about preferred product geometric features (milling and turning), materials and manufacturing processes (tools, machine tools, cutting data), so that manufacturability is designed in. Manufacturing engineers are involved at an early stage also, and manufacturing processes are proved capable in the new product development area before being passed to production.

"We have an example of each class of machine tool at New Mills. We also have what we call assembly 'nursery cells' where processes and capabilities are established before moving them into mainstream production," says Mr Harper. "As a new product moves from feasibility through to production, your ability to influence manufacturing costs progressively diminishes. We need to design and engineer products for manufacture right from the start."

Exactly the same conditions, including identical machine tools, are employed in the new product area as will be used in production.

In bringing a new product into production, both design and manufacturing engineers work according to defined Renishaw procedures and all milestones must be successfully met.

Once launched into production, the use of Renishaw probes, in process is a fundamental part of the manufacturing philosophy. This is well established on its Mazak machining centres with the company's patented RAMTIC system (see page 14), which has been operating for over 10 years now.

However, the greater integration of probing and automatic response to feedback in-cycle is now under way for its Citizen machines and has recently been implemented on its Mori Seiki lathes.

The result of this most recent initiative has been a reduction in setting time – bringing planned setting time and actual into alignment which was not previously the case. An example given is a ring for one of its encoder products. A nominal 95 mm diameter by 4 mm bore with a 40 micron tolerance was previously subject to a 1-in-10 probing cycle of the diameter, but variation following offset update was a problem. Run in this way, the process had a Cpk of just 0.32 across 23 parts.

The introduction of a single-line 'super-macro' to govern a more complex probing cycle looking at more variables saw a Cpk of 0.81 achieved over 48 parts when measuring each part and updating on the basis of this.

Eventually, it was found that variation in the amount of material removed at the finish turn stage was causing variation. The answer was to introduce a semi-finish pass which was identical to the finish pass, with the semi-finish diameter probed and the offset updated prior to the finish cut. The result is that a Cpk of 1.66 was achieved over a run of 48. The more comprehensive probing on the Mori Seikis has been running for around 18 months, now. The Citizen probing initiative, aimed at reducing setting time for these increasingly complex machines, is expected to be completed around the middle of next year.

Drawing on its own experience, Renishaw has now rolled out training for customers in the application of probes in production based on what it calls its Productive Process Pyramid – 11 steps before part verification on machines is attainable. And a visit to Stonehouse rams home the message that adherence to process and elimination of variation brings very great rewards, with on-machine probing at the very heart of Renishaw's manufacturing processes.□

Enter 100 at www.machinery.co.uk/enquiry

PROFESSIONAL ENGINEERING

Moving bridges bring communities together

Readers' views about regulating the internet

WEDNESDAY • 22 NOVEMBER 2006 • VOLUME 19 • NUMBER 21

Memory metals set for take-off

Why offshoring isn't always right

PLUS 20 PAGES OF APPOINTMENTS

PROFESSIONAL ENGINEERING
The Magazine for the Engineering Profession

1 Birdcage Walk, London SW1H 9JJ

SUBSCRIPTIONS
Professional Engineering is made available to members of the Institution of Mechanical Engineers as part of their annual subscription. Periodicals postage paid at Rahway NJ. US address corrections to Professional Engineering c/o Mercury Airfreight International Ltd, 365 Blair Road, Avenal, NJ 07001.

Paid subscriptions are available at the following rates:
Personal subscribers 2006:
North America $102.00;
Rest of World £85.00
Institutional subscribers 2006:
North America $855.00;
Rest of World £459.00
Paid subscription inquiries to Professional Engineering Publishing Orders Department, Extenza-Turpin, Pegasus Drive, Stratton Business Park, Biggleswade, Bedfordshire SG18 8TQ.
Tel: +44 (0) 1767 604 967.
Fax: +44 (0) 1767 601 640.
Email: custserv@turpin-distribution.com

MEMBERSHIP
All inquiries concerning IMechE membership to The Institution of Mechanical Engineers at the above address. Email: membership@imeche.org.uk. For changes of address tel 01952 214050 or email: subscriptions@imeche.org.uk

PRINT
Printed at Precision Colour Printing, Telford, Shropshire TF7 4QQ. Typeset by the London Pre-Press Centre, London EC1.

Commentary

... on the alternatives to offshoring in manufacturing

"Productivity gains can be achieved often at small cost in terms of capital investment"

One of the popular views that always seems to get governments hastening to prepare a denial is that it is somehow easier to close a factory or a company in the UK than it is in other countries. The denials may or may not have validity; no one can deny, though, that there have been a lot of closures and relocations of manufacturing companies in recent years.

Some of that is due to the undeniable fact that labour costs in Eastern Europe, China, India, Latin America and elsewhere tend to be lower than they are in Western Europe. And often the gap is big enough to offset inconvenience and logistical complexity.

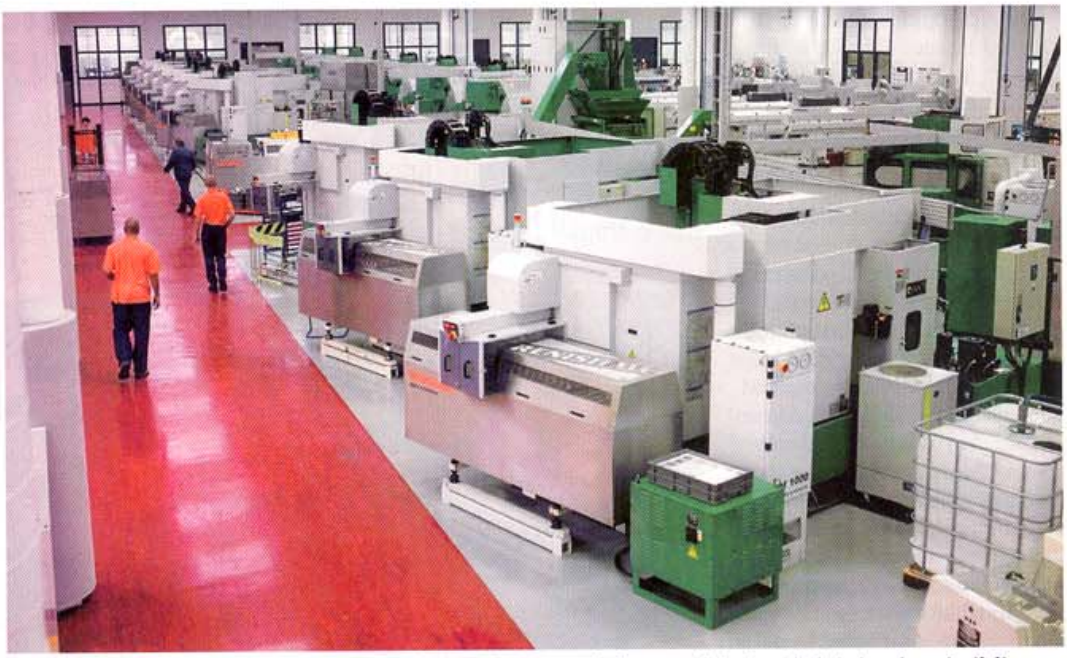
But labour costs are a declining element in the cost of virtually all engineering products. And the degree to which they are cited as the reason for "offshoring" suggests that those making the decisions all too often don't appreciate that manufacturing has changed, and that productivity gains that would make the equations look very different can be achieved often at small cost in terms of capital investment. Renishaw, shown here, is a classic case of an enlightened investor.

The difficulty, and it's maybe a subset of a second problem that affects inventions, is that UK companies are apparently pretty good at the product innovation stuff, but often less good at process innovation. And UK managers are generally pretty good at the people side of the business, but less happy in handling technology and capital assets.

It's too easy and too generalised, though, to put the blame solely on managers who are too divorced from the real business that their companies are engaged in, or too driven by the short-term considerations that their shareholders demand.

If failure to invest is a cause of the manufacturing losses, then engineers have to take some responsibility too. Engineers are the people who should be able to tell what difference a judicious bit of kit or a labour-saving device might make. And surely they should be saying so. Loudly.

John Pullin, Editor



Bright and clean: The designers of Renishaw's factory took account of ergonomic factors to help boost productivity

The wow factor

Step inside Renishaw's sparkling new factory and you get a vision of the shape of industry to come. Ben Hargreaves was impressed by the level of automation

In the struggle to convince youngsters that engineering is not a grimy, spanner-in-hand profession, those entrusted with improving the industry's image could do worse than persuade Renishaw to open the gates of its new factory to all and sundry.

Taking a walk around the facility, where Renishaw is making components for its range of metrology and spectroscopy products, is instructive.

The brightly lit, spacious, clean shop floor feels emblematic of what we're being told manufacturing in the early 21st century should be like – no wonder the company's keen to show visitors around.

Renishaw purchased the site at Stonehouse in Gloucestershire for £5 million two years ago, and has since ploughed a further £2.5 million into its development. This size of outlay is, perhaps, not surprising. The company has a track record for putting its profits to good use, and sunk £29 million – 17% of turnover – into engineering investments and research in the last financial year.

The new factory is one of the fruits of this policy. As the company was running out of space to expand manufacturing at New Mills, Renishaw's HQ in nearby Wotton-under-Edge, the decision was taken to move most of the machining operations to a new location. The original plan was to move manufacturing to Woodchester, four miles from the headquarters, but the layout of a building there that Renishaw had purchased a few years ago was less than ideal – hence the need for Stonehouse.

It's taken a lot of hard work over the past two years to get the site ready. When Renishaw purchased it in 2004, it was a very dark environment housing injection-moulding machines. The company stripped the inside of the building, cleaned it extensively, and installed new walls, ceilings, light fittings and wiring. An extraction system was also fitted to remove airborne contaminants.

Gareth Hankins, Renishaw's general manager for the manufacturing services division, says: "First and foremost, we wanted to build a pleasant place to work, but we also wanted people to walk inside and say 'wow!'."

Perhaps the biggest impression is one of space. The machine hall is spread out over 70,000ft^2, with a further 40,000ft^2 available for future expansion if necessary. An adjacent process finishing area occupies 10,000ft^2. Renishaw invested in £1.5 million worth of new equipment for Stonehouse, including machine tools, deburring facilities and an anodising unit that has double the previous capacity.

A surprisingly small number of people flit among the rows and rows of machine tools – the staff at Stonehouse number just 160, and Renishaw says its policy is to automate as far as possible to keep costs down. But those 160 people work in a facility that can produce more than 300,000 components a month.

Some machining centres are fitted with Renishaw's own measurement equipment to help control the quality of parts produced, while Stonehouse also has its own tool grinding station so the company does not need to buy in tooling, another move designed to save money.

Hubs of tooling and inspection gear are designed to leave equipment at workers' fingertips – a commonsense innovation necessary in a factory of this size. Process improvement boards are sited next to machining cells, allowing operators to leave notes identifying problems or ways in which operations can be improved. Equipment for cleaning parts uses water instead of solvents to comply with regulations to limit the use of such chemicals.

Renishaw emphasises that it vets thoroughly all investments to make sure of the returns. Wandering around Stonehouse, it's hard not to be impressed by how carefully every aspect of the manufacturing process has been thought out.

The company remains committed to manufacturing in the UK, says assistant chief executive Ben Taylor: "The chairman insists we're not going to move jobs out of here."

Although the company has established a facility in Pune, India in recent times, looking at Stonehouse feels like looking at manufacturing with a future. Other sections of UK industry could surely learn from Renishaw's approach.

Maybe it's time the firm started tours for schoolchildren too.

RECYCLING SAVES CASH

Renishaw is doing clever things with the waste from machining at Stonehouse. Aluminium swarf from machine tools is sent to a briquetting machine where it is compacted into neat blocks. Since clean scrap aluminium has a value of around £900/tonne, it makes sound economic sense to recover the waste metal in this way. The briquetting operation squeezes out waste water and oil, which can then be reused in some of the lower-grade machining activities.

Previously Renishaw sold aluminium scrap contaminated with coolants for a fraction of its true value.

The next move, says engineer Mark Buckingham, will be to carry out similar operations with steel and brass swarf.