

A new type of partnership between academia and industry could be a model for the future.

Jonathan Ward reports

Advanced  
manufacturing

# Cutting edge

**H**igher education and industry can have an uncomfortable relationship. Even in engineering, where the interests of universities could be expected to be as closely aligned to those of business as anywhere, companies sometimes find it difficult to get the best out of the country's formidable academic resources. Now a project by the University of Sheffield and industry partners is becoming a benchmark for success in collaboration between the campus and the business community.

The Advanced Manufacturing Research Centre (AMRC), between Sheffield and Rotherham was established to research and solve manufacturing problems. The £45 million centre receives funding from the EU, UK central and regional government, US aerospace giant Boeing, Rolls-Royce and more than 35 additional industry partners.

## Extension

The AMRC's current 1,000m<sup>2</sup> facility, situated on the Advanced Manufacturing Park in Waverley, is in the process of being extended through the construction of a brand new 4,600m<sup>2</sup> 'Factory of the Future'.

the Future' on the same site. The new building opened its doors at the beginning of December and, when moving is complete in spring 2008, it will contain the largest collection of state-of-the-art and experimental production equipment anywhere in the UK.

Key to the AMRC's usefulness as a service to industry is the facility's pragmatic approach to research. Projects undertaken by the centre are arranged in three tiers. At the top of the pyramid are 'innovative projects'. These are longer-term 'blue sky' research projects, usually funded by academic research grants from the EU or the EPSRC. The results of innovative projects are shared with all the AMRC's partners at the project's conclusion.

Next are 'generic' research projects. Typically, these are two year PhD research projects, carried out in association with specific groups of AMRC partners, but centrally funded. The outcomes of these projects too are shared among all the project partners.

## Research

Finally, and critical to the success of the AMRC as an industry resource, are 'specific' research projects. These are funded by a single partner, which has exclusive access to the results

of the project and any intellectual property generated.

According to Andrew Bell, advanced manufacturing technologist at AMRC partner GE Aviation Systems, this project mix makes involvement with the AMRC much more satisfactory for many of its industrial partners than conventional industry-academia partnerships. "Through specific projects we can work on challenges that affect us in the production environment today and get solutions that we can adopt in a matter of weeks or months," he says. "At the same time, our involvement allows us to benefit from the longer term findings of the generic and innovative projects."

Typical examples of specific projects undertaken by the AMRC include the identification of more efficient practices for complex machining operations, with the aim of delivering dramatic reductions in cycle times. "The AMRC guys will always aim for a very ambitious target, much more so than we would attempt in our facilities," says Bell. "Even if they don't meet that target, they

The Advanced  
Manufacturing Research  
Centre (image courtesy  
of Ian Spooner)

## Park life

The AMRC is located in the Advanced Manufacturing Park, a new development between Sheffield and Rotherham that aims to become a hub for established engineering and manufacturing companies, research bodies and start-ups.

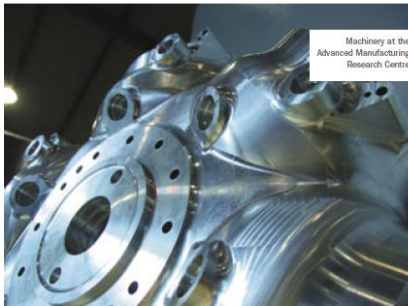
Built on a remediated colliery site, the AMP is a joint venture between UK Coal and local RDA Yorkshire Forward. The brownfield location has helped the development to attract a variety of sources of funding and, in turn, some big-name tenants. In addition to the AMRC, the park currently plays host to organisations such as Castings Technology International and the Composites and Advanced Materials and Technology Centre.

TWI Technology Centre (Yorkshire) at the AMP is an extension of the resources at the joining technology specialists' company headquarters in Cambridge. The facility complements TWI's work with key technologies, including fibre laser processing, friction stir welding, laser direct metal deposition and cold spraying. In addition, TWI Yorkshire runs a range of training courses, and enables its customers to access all of TWI's technologies and develop novel solutions through Technology Transfer programmes.

TWI Yorkshire is playing a key role in establishing a surface engineering centre of excellence - the Surface Engineering Group (SEG). SEG is run by the National Metals Technology Centre and brings together the expertise of TWI, Corus, The University of Sheffield and Sheffield Hallam University covering a wide spectrum of coating types and applications.

As it develops, AMP's owners hope that the area will become a world centre of expertise in eight core technology areas. These are:

- Advanced materials processing;
- High performance machining and cutting;
- Near net shape casting and forming processes;
- Joining technologies;
- Powder metallurgy;
- Surface engineering;
- Nanotechnology;
- Composites.



Machinery at the Advanced Manufacturing Research Centre

usually deliver dramatic savings."

Involvement with specific projects is extremely useful in other ways for AMRC partners. Steve Weston is an applications development specialist for Sandvik Coromant UK. He works full time at the AMRC, where his company supplies all the cutting tools used. "Obviously, we can use our expertise to make recommendations for more efficient machining strategies in these projects," he says. "But we also get a fantastic insight into the types of problems that our industrial customers are beginning to tackle now." This insight is fed back to Sandvik's R&D centres in Sweden, to help in the development of new cutting tools. The company also uses AMRC projects as a final testing environment for new tools, before they are released to wider market.

## Uses

According to Roger Singleton, project engineer at the AMRC, it is not only the types of projects undertaken by the AMRC that makes it so useful for its industrial partners, it is the types of researcher too. "The people who work here combine a high level of academic skill with real practical knowledge of the way modern production equipment works. That combination is quite rare in academic today." The AMRC is working hard to ensure that this unique combination of skills is retained by its workforce. In association with its partners, it provides

training in machine tool technology to all new staff and it is running an apprenticeship scheme to develop a new generation of technicians too.

The AMRC's close university connections help in the provision of other skills. Singleton notes that it is not unusual to involve representatives from other departments, such as mathematics and materials science, if a particular project requires them.

## Drive

While some companies use the AMRC primarily as a resource to help with specific manufacturing issues, others hope it will help to drive their business in a more fundamental way. Christopher Jewitt is managing director of AMRC partner Footprint Tools. His company, which manufactures a wide range of hand tools for markets world wide, is exactly the kind of manufacturing organisation that was once common in the Sheffield area. "Our products have a great reputation, and 'made in Sheffield' is an important part of that," he says. "We even write it in Chinese on export products. But while we are still extremely successful in niche areas, we recognise that increasing competition from elsewhere in the world is going to force us to evolve."

Footprint's strategy to respond to this erosion of its traditional market is to invest in its ability to carry out more advanced manufacturing activities. The company is

## Advanced manufacturing

SMD in action; and Advanced Manufacturing Research Centre project manager Roger Singleton



involved with a major EU-funded project at the AMRC entitled 'Rapid Production of Large Aerospace Components' (RAPOLAC). The goal of RAPOLAC is to increase usability of the additive manufacturing process shape metal deposition (SMD). SMD is a process pioneered by AMRC sponsor company, Rolls-Royce, and uses advanced robotics to create parts by depositing layers of molten material in a welding process.

"We are working primarily with titanium at the moment," explains Dave Spafford, the project engineer from Footprint Tools,

### Centre of excellence

At the heart of the Advanced Manufacturing Park (see other box) is a suite of office accommodation, laboratories and workshops that promises to become an important incubator for manufacturing and related activities. The Innovation Technology Centre (ITC) is a 2,000m<sup>2</sup>, environmentally-friendly building on three floors, designed to offer start-ups, high growth companies and R&D subsidiaries of larger organisations the kind of accommodation they will need to succeed on the AMP site.

Early tenants of the ITC include commercial partners of the adjacent Advanced Manufacturing Research Centre, technology start-ups and established hi-tech firms. One of the first to arrive was durability engineering specialist nCode, which moved 12 months ago from its original premises in central Sheffield. The company now uses the ITC as the base for global development and support of its fatigue analysis, test data management and general data analysis packages.

Clive Mott, a director at nCode, is enthusiastic about the move. "The office space and facilities here are first class, and we like the flexibility of the arrangements. We are proud to bring our customers to visit us in the ITC and we even saw productivity go up substantially when we moved."

The facility's role as a centre for many types of engineering and manufacturing company is also delivering benefits for nCode. "Some of our key customers are using these facilities to run seminars and organise meetings, which gives use extra opportunities to meet and work with them."

### Engines of innovation

One of the largest single sponsors of the AMRC is aero-engine maker Rolls-Royce. As a first tier partner, the company makes a cash contribution of £200,000 per year and, in addition, conducts what is currently the largest programme of project work by any sponsor - to the value of "two or three times" its annual membership contribution. Rolls-Royce also has one employee working full-time at the AMRC and the firm contributes significant management time in support of the AMRC Boards and its initiatives, including bids for government funding.

Work funded by Rolls-Royce concentrates on a number of machining and measurement technologies. The company agrees with other partner organisations that the AMRC has proved to be an effective way of developing technologies that can quickly deliver benefits on the shop floor. "Due to the relatively rapid maturity of technology at the AMRC compared to other universities, Rolls-Royce is already starting to see improved processes impacting our factories now," says Steve Burgess, manufacturing process and technology executive at Rolls Royce. "We currently have a wide portfolio of projects at the AMRC that will increasingly impact our business over the next 12-18 months."

The AMRC model has proved so effective for Rolls-Royce that the company now sees participation in AMRC projects as an important part of its R&D supply chain. "We have actively encouraged a number of the current members to join and will continue to do so," says Burgess. "Increasingly, we will expect our key supply chain partners to work with the AMRC. The main reason is that we see great benefits from jointly developing new processes in partnership with the university, equipment suppliers and end users. This will rapidly mature our collective capability, so that it can easily and effectively be transferred into production."

Rolls-Royce is now working to 'clone' the AMRC approach at other UK universities. The company is already exploring the establishment of an Advanced Forging and Forging Research Centre in the Glasgow area, for example. Ultimately, it hopes that the AMRC and centres of its type will play an important role in developing key skills and a new generation of specialist people for recruitment into Rolls-Royce.

[www.rolls-royce.com](http://www.rolls-royce.com)


who works full time on the project at the AMRC. "The aim is to produce parts that will be able to compete with forgings, producing near net shape components with a shorter lead time."

### Complexity

Today, the prototype SMD machine at the AMRC can produce a variety of simple shapes, such as walls and cylinders. The project is working to develop the geometric complexity of these shapes, as well as increasing automation and improving the properties of the resulting material. Footprint Tools hopes that mastery of the SMD process will give it, in the next 18 months to three years, a unique route into the aerospace and related high technology supply chains.

Direct involvement with the AMRC is one way that SMEs in the Sheffield area and beyond can benefit from the facility,

but such a concentration of manufacturing expertise also has trickle-down benefits. Many of the partner company representatives who work within the AMRC also provide support to other companies in the region, as Sandvik's Weston points out. "Because the AMRC is here, there are three Sandvik specialists working the area. That's a lot of experience that other firms can make use of."

The academic community is clearly excited about the AMRC model too. More than 6,000 people have visited the project over the past year and more are expected next year when the new Factory of the Future facility opens. Last month, the AMRC was awarded the Queen's Anniversary Prize for Higher and Further Education, which commends 'outstanding achievement at a world-class level'. 

[www.amrc.co.uk](http://www.amrc.co.uk)