

Partnership**More hands make less work**

CMAC is effectively demonstrating how academic and industry partnership can transform the growth curve, says Ginny Clark

Pioneering research project CMAC — Continuous Manufacturing and Crystallisation — is not only working to transform the manufacture of high-value pharmaceuticals and chemicals, it is also creating a remarkable model of academic and industry partnership in an 18-month trajectory that has already taken the vision from seed funding to the global stage.

With its hub at the University of Strathclyde, the aim is to create a world-class partnership with industry, academia and public bodies, all working in pre-competitive collaboration.

Drugs and other high value chemical products are currently manufactured in traditional ways, often taking more than a year's lead time and using processes that can be inefficient, while 'continuous manufacture' offers more control, less waste, and the opportunity to access new products.

CMAC also involves six other academic institutions and it is this unique relationship that is key to the project's strength. With colleagues at Glasgow, Heriot-Watt, Edinburgh, Cambridge, Loughborough and Bath Universities all contributing skills and expertise in chemistry, analysis, chemical engineering, crystallisation, pharmaceutical sciences, manufacturing and operations management, the result is an exceptional multi-disciplinary academic team.

The CMAC vision was born out of Chemical Sciences Scotland discussions, a pilot study with GSK, Nitech and the University of Glasgow, and with seed funding from the Scottish Funding Council, more than £32 million has been raised in just 18 months.

With AstraZeneca, GlaxoSmithKline (GSK) and Novartis the founding industrial tier 1 members, the CMAC board chair is Dr Clive Badman OBE, the vice president of investigative medicines at GSK, and Craig Johnston is operations director, with the crucial role of engaging the industry base. Johnston, a Fellow of the Institute of Chemical Engineers and currently chair of the Chemical Sciences Scotland Innovation Group, has previously worked for ICI, Zeneca, Avesia and Fujifilm, and was also a board director with industry/academic consortium Britest Ltd. He stresses just how vital industry relevance is to the CMAC vision, an evolving project that has always been demand led.

"Before we started out, we had a number of workshops with the major companies to define the research challenges," explains Johnston. "We're a UK national centre and continue to benefit



from senior industry support and commitment. We must ensure CMAC's industry relevance, and are working closely with companies to maintain that, from multi-nationals down to micro SMEs, such as specialty pharmaceutical, chemical and technological companies accessing CMAC's facilities. At our first open day last autumn we had more than 30 different companies with a world-wide footprint all keen to progress research in Scotland. Scottish Development International have really helped international engagement."

Professor Alastair Florence leads the key research platform, the Engineering and Physical Sciences Research Council (EPSRC) National Centre for Innovative Manufacturing in Continuous Manufacturing and Crystallisation, led from the University of Strathclyde. Last October 2012 an EPSRC doctoral training centre started, which provides a further 45 PhD students across the CMAC network — in addition to the 13 professors and more than 50 students and researchers working across the portfolio of activities.

Essentially, the project is focused on the manufacture of crystals and powders — which are important in producing a range of materials such as drugs, inks, pigments, paints, and even computer screens. It is the structure and properties of these crystal and powder particles that determine the ease of manufacture, and also the function and performance, of the final product.

Complex crystal formation processes means their size, shape and structure can vary, and that can affect quality and lead to variations in the way the material performs during manufacture. This could ultimately improve a medicine's performance, for example.

The EPSRC Centre plans to revolutionise the current processes by delivering new continuous manufacturing technologies with improved quality and flexibility. This is cutting-edge research, exploring new continuous methods of crystal formation, particle and powder production, and preserving their optimised properties

through isolation, drying, formulation and final product manufacture stages. Achieving that will not only make development and production quicker and cheaper, but also provide cleaner and greener manufacturing processes.

In 2014 the Centre will expand into the new Technology and Innovation Centre, which is supported by Strathclyde University, Scottish Funding Council and Scottish Enterprise, marking another landmark step for CMAC.

"The vision, scope and programme have been developed through close collaboration with industry and in particular our founding strategic partners GSK, AstraZeneca and Novartis who have provided significant input and support throughout the last year," says Florence, EPSRC centre director. "With the Centre now established and the flagship research projects and platform activities underway, a key focus in the coming year is the delivery of the research programme and infrastructure supporting our forward plans. Designs for the new continuous manufacturing research facility in the Technology and Innovation Centre at Strathclyde are well advanced, and from 2014 will house world-class facilities for collaborative research. These are exciting times for the Centre and our partners and

The EPSRC Centre plans to expand into the new Technology and Innovation Centre in Glasgow next year



Professor Alastair Florence of CMAC

Oasis of varied expertise

Next year CMAC will move into the University of Strathclyde's £90 million Technology and Innovation Centre, a state-of-the-art building in the heart of Glasgow that has been developed with, and for, industry. Researchers, engineers and project managers from academia and industry will work on projects vital to economic regeneration in Scotland and further afield. SSE, the Weir Group and ScottishPower are among the major partners, with the centre also keen to

attract small and medium sized partners in innovation.

Dr Steve Graham, executive director of the Technology and Innovation Centre, says new centre will enable industry to rapidly develop research and technology, and access world-leading academics, research, facilities and graduates.

"We're bringing together expertise from every area of the University — business, science, engineering and social science," he says.

“We're now looking at how we can work on a global scale and recently visited Singapore and the US

we look forward to continue to develop our relationships with the wider national community concerned with Continuous Manufacturing and Crystallisation."

It's an exciting time for everyone involved with CMAC, a project — a concept — that continues to evolve, and to grow.

"We're now looking at how we can work on global scale, and have recently visited Singapore and the US to explore the opportunities," said Johnston. "We've raised £32 million in 18 months, so we're now a global player, and what we've already achieved is significant. Companies that historically worked on their own are now collaborating, and manufacturing is returning to Europe, and being competitive. The UK government through the Technology Strategy Board is very supportive. I think we've definitely captured the zeitgeist."

The CMAC model of an academic institution and industry working together is clearly not unique; however, the interdisciplinary aspect brings an exciting dynamic to the project, and one that offers benefits to both the institutions and the businesses involved.

"These collaborative centres are the way forward, and the Scottish Funding Council recognises that," says Johnston. "We're certainly benefiting from the strong industry support and leadership we've had, but the attitude of the researchers and professors has been crucial. It's that mindset, of working across disciplines from chemistry and chemical engineering to manufacturing systems, where in the past they'd be operating in isolation. We've also had strong support from the University of Strathclyde, from the very top, and with funding for the 45 PhDs, we're involved in providing the scientists of tomorrow, and giving these students the exciting opportunity of spending time in each of the seven different universities."

Going forward, CMAC is keen to broaden engagement with the whole supply chain and it is also looking at the potential for production of high value, low volume products, some of which are not commercially developed because they are considered to have limited opportunities for profitability.

"This has been a very exciting start in understanding and designing the supply chain of the future," says Dr Badman, Chair of the CMAC Board. "I've been impressed by the way Alastair, Craig and the team across the universities have worked with GSK, AZ, Novartis and the other partners to progress innovative research against a well defined, user-led scope. In addition to the on-going core focus on continuous crystallisation, I look forward to the development of continuous processing research in the interface areas."