The Viewpoint

Why We Need Young Scientists to Interact with Companies

Today we are in a world where, although necessary, neither academic excellence nor corporate muscle are sufficient to deliver an economy where innovation thrives and hence profits can be made and quality of life be maintained. It is only where there is strong interaction between companies large and small and the academic sector that innovation can flourish. There is increasing realisation by companies, governments and the universities that "open innovation" is an essential element of any progressive industrial economy. Young researchers have a significant part to play in this by embracing the challenges at the boundaries of academic and industrial research and development.

The term "open innovation" has become the buzzword for how companies develop their new products, processes and business models. It is based on the reality that, in ever more complex technologies, even the largest companies cannot sustain research and development (R&D) laboratories that allow them to cover the range of science and technology that is required for their products. They must reach outside their walls for ideas. If the world's largest companies struggle, how can the small and medium enterprises (SMEs) that form the bulk of Europe's companies also compete? Increasingly innovation is based on collaboration: company to company and company to university. Universities can no longer just be fonts of blue sky research but must be part of a community where ideas flow in every direction and innovation results from interaction at all levels.

A somewhat non-scientific but interesting report on where United States (US) innovation came from (ones that won R&D 100 Awards in the US) highlights this change [1]: "Today, approximately two-thirds of the award-winning US innovations involve some kind of inter-organizational collaboration—a situation that reflects the more collaborative nature of the innovation process and the greater role in private sector innovation by government agencies, federal laboratories, and research universities." whereas "in the 1970s, approximately 80 percent of the award-winning US innovations were from large firms acting on their own."

Europe is recognising this with a large number of recent reports from both the European Commission and European countries recognising this change and looking at policies to help react to it [2]. This is summed up in a United Kingdom (UK) Government report which found [3] "Although research is of great importance to any innovation ecosystem, little is to be gained from research in universities, research institutes and further education (FE) colleges if there are not strong links between the researchers and industry, and that is why knowledge transfer, and incentives for it, are so important." Also "Collaborative research undertaken

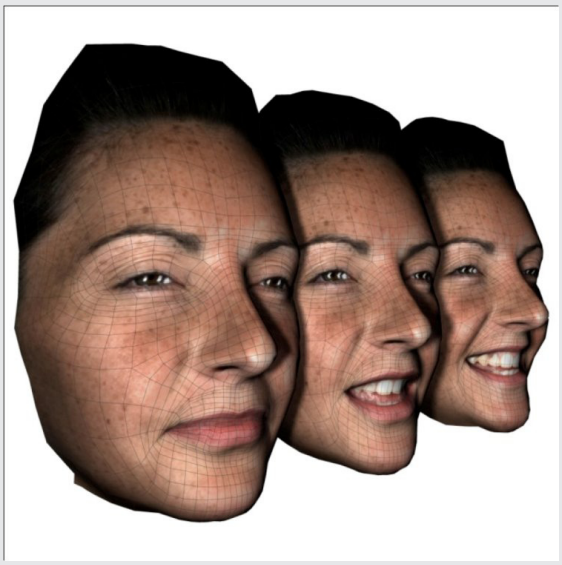

Figure 1: DI3D™ facial 3D capture system. Photo Courtesy Dimensional Imaging.

between universities and business are an essential part of gaining broad economic benefits from the UK's world class research base." [4]

These relationships are, at the end of the day, always based on people and the interaction between them. "Innovation is rarely, if ever, a solitary effort. It takes people working together to develop a goal, focus on it, generate an innovative solution, and implement it." [5]

People in industry must build relationships with academics and vice versa. "The route from discovery to patenting and licensing is not necessarily their most important contribution to innovation, but that more complex relationships involving the recruitment by industry of PhDs and researchers, exploitation of codified knowledge, joint problem-solving enterprises, and the use of the university as a public space together make a more influential contribution." [6]

Hence it is becoming ever more essential for academics, researchers, postgraduates and graduates to take every opportunity to interact with industry. For the latter it may be an essential to gaining the best jobs. A report from the Royal Academy of Engineering concluded: "A large majority of companies report using industrial experience, whether before or during university as an important discriminator in selecting job applicants for interview." And "Real industrial experience, however, remains a primary factor in the recruitment policies of the great majority of companies and is highly influential in determining the selection of job applicants for interview. The need to ensure that students gain practical experience of real industrial environments during their studies is therefore extremely important."

There are many initiatives and opportunities at universities around Europe for students and researchers to work with industry. From the UK, I should like to highlight a couple of examples that have proved particularly successful.

Knowledge Transfer Partnerships (KTP) [7] is Europe's leading programme helping businesses to improve their competitiveness and productivity through the better use of knowledge, technology and skills that reside within the UK knowledge base. The company has access to an "associate" working at the company location with support from an academic.

Established in 1997 and based in Aberdeen, Piezo Composite Transducers Ltd (PCT) designs and manufactures bespoke high performance acoustic transducers for a variety of demanding applications in underwater, non-destructive testing and medical markets. The Associate brought a PhD in Engineering to this successful project and a background in finite element analysis (FEA). In return, the Associate was able to gain practical experience of working for a specialist manufacturer and learn more about transducer design, project management and commercial aspects of projects. He also had access to specialist training to further the KTP project and benefited from more general tuition in project management, working as a team, leadership styles, design and bringing a product to market. The Associate was offered a position with the Company as an Acoustic Design Engineer.

Royal Society of Edinburgh Enterprise Fellowships [8] offer an early career researcher who wants to develop a spin-out business around their technological idea: a year's salary to develop their commercial proposition and product, hosted at their university or HEI, Business training to give them the knowledge to prepare a viable business plan, Access to networks of mentors, business experts and professional advisors. RSE Enterprise Fellowships are variously funded by BBSRC, STFC and Scottish Enterprise.

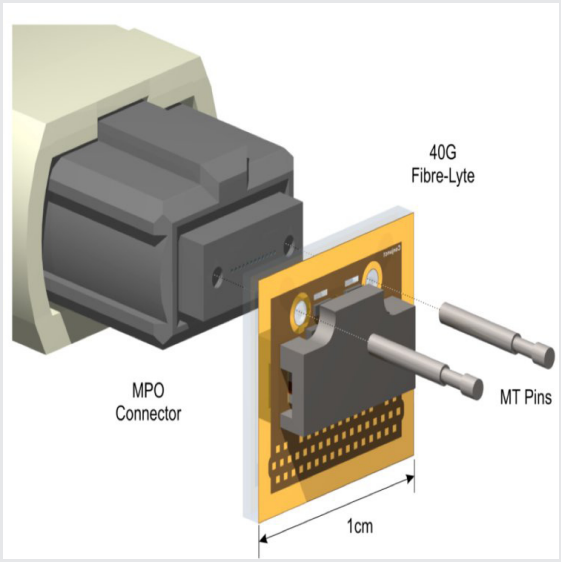

Figure 2: Fibre-Lyte - Optical Sub Assembly. Photo courtesy Conjunct Ltd.

Dimensional Imaging's [9] DI3D™ facial 3D capture systems have been used to reduce costs, increase efficiency and improve treatment & planning in a number of different fields of medical sciences. In entertainment applications, by combining one of Dimensional Imaging's high resolution 3D capture systems with the Shape Transfer and Material Transfer tools, it is possible to create the most realistic games characters in a matter of hours, complete with accurate 3D geometry and incredible texture and normal maps. The founder, Colin Urquhart, started his RSE Enterprise Fellowship in Nov 2002 and soon after (Jan 2003) founded the company which has become a world leader in providing 3D capture using standard digital stills cameras and "4D capture" using standard machine vision video cameras. Colin was inspired to start his own company after previously being involved in technical roles in a number of technology companies that didn't quite make it. Colin says "I can also remember dreaming about starting my own software company in about 1981 after I got my first computer: a Sinclair ZX81. Another seminal moment was meeting Dick Bolt cofounder of Bolt Beranek and Newman (BBN) in Cambridge MA in 1990. I had just started working for BBN after graduating and this was the first time I can remember meeting a real life company founder!"

Conjunct and its unique OSA, Fibre-Lyte. Conjunct is to-

day's most innovative designer and supplier of Optical Sub Assemblies (OSAs) for a wide range of Datacoms applications. Conjunct's unique OSA is its Fibre-Lyte which combines all the optical functions on to one glass substrate and very creative embedded optics which completely eliminate the need for any active alignment. The founder of Conjunct, Keith Symington was completing his PhD at Heriot Watt University in Scotland. He saw a potential opportunity to start a company based on the technology. He had interfaced with several companies during his PhD and felt his career would move in an industrial direction. He won an SE/RSE Enterprise fellowship in 2003 And went on to start his own company Conjunct in 2004. Conjunct now deliver Datacoms components to global markets from its base in Scotland.

SU2P [10] Entrepreneurial Fellowships are to enable exceptionally talented early career researchers to spend one year at Stanford University or one of its affiliated laboratories. The aim of the Fellowships is to allow successful applicants to develop and grow their entrepreneurial skills under mentoring provided by Stanford Photonics Research Centre (SPRC). They also have the opportunity to interact with the Industrial Partners of SU2P and the Industrial Affiliates of SPRC. SU2P is a collaboration of 6 universities that delivers a disruptive new approach to business engagement, with facilitated, flexible interactions between UK industry and university researchers in Scotland and the US.

The Universities of Strathclyde, St Andrews, Heriot-Watt, Glasgow and Stanford together with the California Institute of Technology (Caltech), are collaborating in SU2P supported by Research Councils UK (RCUK), the Scottish Funding Council and Scottish Enterprise. This groundbreaking, commercially-oriented collaboration commenced in September 2009 and builds on Scotland's universities world-class research outputs in photonics and strong links to Stanford and Caltech.

The project, SU2P, is designed to capitalise on leading research in the photonics sector, in fields including life sciences and renewable energy, and the commercial opportunities the research offers. It will also bolster existing links between universities and businesses in the UK and the US. The collaboration works hand-in-hand with industry partners to understand their needs and then identify relevant investigators motivated to provide expert advice and/or deliver flexible project solutions to company requirements. The programme also provides an effective way for industry to contribute to and sustain the research and teaching of the departments and programs in which they have long term interests.

• Weisheng Lu received the PhD degree in electrical and electronic engineering from the University of Nottingham, UK in 2009. He pursued his doctoral research on the molecular beam epitaxial growth and characterization of III-V dilute nitride semiconductor materials and devices. Weisheng's work at Stanford University focusses on the development and characterization of 1.3 um mode locked integrated-external-cavity surface emitting lasers, which can be used as light sources for bioengineering and medical applications.

• Keith Mathieson completed his PhD at the University of Glasgow on semiconductor pixel detectors. Since then he has pioneered the development of high-density microelectrode arrays to study the response of retinal tissue to optical and electrical stimulation in collaboration with the University of California Santa Cruz and the Salk Institute for Biological Studies in San Diego. Keith's work at Stanford involves using high-density microelectrode arrays to characterise how the retina responds to subretinal stimulation by the optoelectronic prosthesis under design by the group of Daniel Palanker.

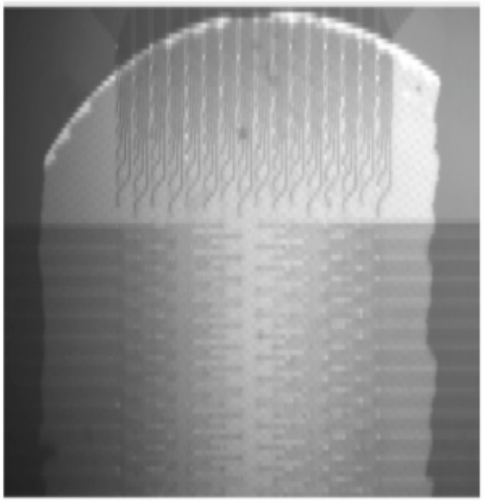

Figure 3: In-Vitro testing of a silicon retinal implant. Photo courtesy SU2P.

All these successful schemes are based on enabling young researchers to interact, in a variety of ways, with industry. The interactions have and will enhance innovation, innovation that transforms knowledge into money [11].

The examples above showcase young researchers who have used the opportunity of industry engagement to further their careers, by joining a company, by forming a company, and by continuing their research driven by the problems highlighted by industry – whose problems usually are related to their customers' demands and hence wider societal drivers, such as energy, communication, health, food and environment.

There are many opportunities for researchers to enhance their engagement with companies; there are opportunities to network with industry at events run by trade associations and by the universities. There are opportunities to participate in industry/academic fora such as the KTNs in the UK and Photonics21 in Europe. If companies are visiting your laboratory take the chance to ask what they need,

what problems your research could solve for them. Take opportunities to talk with colleagues who work with industry, take opportunities for internships in industry to learn firsthand how companies' R&D laboratories operate and why. Take benefit of the many courses run by universities in innovation, entrepreneurship and commercialisation. If you have an idea for a product remember to talk to your university office about protecting the intellectual property, but then make sure you talk with people who have experience of starting and running a new company or have taken products to market and who have invested in new products or ideas. Always be able to describe your idea in a way that quickly highlights the benefits to potential customers (usually how it will save them money!) but does not require you to describe the core technology (your valuable IP).

Readers of this article must be proactive in ensuring that there is an open and on-going dialogue between university researchers and companies if innovation is to lead our society out of the current recession and into a period of sustainable growth. Become involved in collaborative projects, attend networking events, and take placements. The challenges are great but the opportunities global.

[1] Where Do Innovations Come From? Transformations in the U.S. National Innovation System, 1970-2006: by Fred Block and Matthew R. Keller, July 2008, The Information Technology & Innovation Foundation.

[2] A more research-intensive and integrated European Research Area Science, Technology and Competitiveness key figures report 2008/2009, European Commission.

[3] The Race to the Top, October 2007, A Review of (UK) Government's Science and Innovation Policies, Lord Sainsbury of Turville, October 2007.

[4] Streamlining University / Business Collaborative Research Negotiations, Sir Keith O'Nions, An Independent Report to the "Funders' Forum" of the Department for Innovation Universities and Skills.

[5] The Innovation Process, Energizing values-centered innovation from start to finish, William C. Miller, IEEE-USA E-Books and the IEEE-USA Innovation Institute.

[6] Universities and innovation: the challenge for Europe, League of European Research Universities, November 2006.

[7] http://www.ktponline.org.uk/

[8] http://www.royalsoced.org.uk/research_felloships/enterprise.htm

[9] www.di3d.com

[10] http://www.su2p.com

[11] "Research is the transformation of money into knowledge. Innovation is the transformation of knowledge into money," attributed to 3M.

Iain Ross

Iain Ross is the Director of SU2P, a programme that links for Universities in Scotland with Stanford and Caltech in the USA with a view to encouraging and enabling commercialisation and entrepreneurship in photonics. He also acts as a mentor supporting high growth technology start-up companies in Scotland. Iain has a background in lasers and photonics, spanning more than 35 years in industry, economic development, and tecnoogy transfer consultancy.