Institution: Aston University

Unit of Assessment 13: Electrical and Electronic Engineering, Metallurgy and Materials

a. Context

The Unit comprises the Aston Institute of Photonic Technologies (AIPT), Adaptive Communications Networks Research Group, Nanoscience Research Group and the Power Engineering and Power Electronics Research Group. Photonics research dates back over 2 decades and accounts for the largest volume of research in this Unit, which is reflected in the case studies Research on Adaptive Communications dates back about 10 years, whilst the formation of the Nanoscience Group was a strategic investment made in 2009 and the Power Engineering Research dates from 2011.

Our impact is predominantly with business, on both a national and international scale occurring via: improved business performance resulting from knowledge transfer; the transfer of trained researchers to commercialise their research; the direct creation of spin-out companies. The main industrial sectors impacted to date are ICT and Precision Instruments, along with end users.

b. Approach to impact

Key to our impact agenda is an ethos that sees interactions with businesses and other partners as a natural progression from basic research, supported by having staff who understand the industrial perspective on research. This is brought about by having more than a third of the academic staff with direct experience in industry, including some with experience of running spin-off companies and three who are currently company directors. Research fellows and graduate students have also gained experience of industry, for example by undertaking short term contract work for Astasense, one of our spin-off companies. The ethos of industrially relevant research can be traced back to 1993 when high quality research was catalysed by two world-class photonics researchers newly recruited from industry. It is now formally embedded in staff and student development processes.

Impact is valued and rewarded in several ways: e.g. by direct financial returns as a result of IP licensing, or through the promotion system, where impact with industry is explicitly recognised. We continue to interact with UK industry in various ways, including major commercial exhibitions at conferences, company visits, trade shows, special events organised by Aston's Business Partnership Unit (BPU), industrial placements of students, industry secondments to the University and vice versa.

Nature of the interaction

We have in place a range of options for moving technology from conception to commercialisation. Fundamental research tends to be funded by the Research Councils, though often with a degree of industrial involvement. Once proof of principle is achieved, industry can come on board at a low level, if risk is perceived to be high - via MSc projects, Innovation Vouchers, KT Challenge or ERDF funding (described later) - before moving to more substantial involvement, using CASE, TSB, Framework 7, KTP or direct funding. Spin-offs have been used in appropriate cases. All these approaches have been used since 2008.

Underpinning the efforts to achieve impact is the discussion of the benefits of our research results with a wide range of potential stakeholders. To maximise impact with end users, we make use of business and industry relevant channels for dissemination. Researchers regularly attend and present at Knowledge Transfer Network dissemination events and other commercially focused networks, such as the Midlands Aerospace Alliance and the Institution of Engineering and Technology (IET). Staff use the industry / trade press to publicise their work, for example the SPIE newsroom, Photonics Spectra, Laser Focus World and Optics and Laser Europe magazines, and the web platform opticalfibersensors.org. Our dedicated Business Development Manager also actively promotes our research and the resulting intellectual property portfolio to his network of contacts; as an example the promotion of one patent led to an invitation in 2011 to join an industrially-led EU consortium bidding to develop optical fibre water in fuel sensors for aircraft fuel tanks. The project started in 2012 and is now acting as an avenue to exploit the technology. As an additional example of follow through, one of the impact studies explains how Azea Networks used initially CASE awards and a TSB project and later on direct funding to work with AIPT to develop advanced optical transmission techniques resulting in the company growing to employ 50 people and raising $50M in venture capital funding before being acquired by Xtera Communications.

Where there is no conflict of interest with the University, staff also engage with companies in consultancy projects, for example in a study of optical techniques for oesophageal pressure sensing carried out for Malvern Medical Ltd.

Follow through

Within the Unit, a number of initiatives have been designed to enhance the impact of our research. These also provide additional evidence of the nature of the interactions of staff with industry as well as follow-through, leading to impact:

- A £100,000 prize from the 2006 EPSRC Knowledge Transfer Challenge was used as the seed funding to create the INDEX (INovation Delivers Expansion) voucher scheme (running until 2011), providing a financial contribution of £3000 to companies to enable them to work (in the REF period) with academics to undertake a feasibility study of a technological solution.
- A similar prize the following year was split into amounts of £7,500 to £10,000 to fund a number of more substantial development projects proposed by academics. These have included helping a start-up company, Polariq, develop optical communications technology (the company was eventually acquired by Xtera; see impact case studies) and developing sensors for cardiorespiratory monitoring, resulting in another start-up company in 2012 in Serbia – Diasens.
- AIPT was granted over £1M from the European Regional Development Fund, which along with matching funding, has been used to help companies in the West Midlands to explore photonic solutions to their problems, with the assistance of two dedicated research fellows. This scheme has so far helped over 60 companies directly, with three of them moving forward to major collaborative projects with Aston, e.g. a KTP with Gas Data Ltd. started in June 2013. These SMEs represent a range of industrial sectors including optical devices, civil engineering, LED, dust control, gas sensing, water industry level sensing and metrology. Many of them had no prior experience of photonic technologies. To date, audited impact from the ERDF activities comprises: creating new jobs (11 companies), safeguarding sales (13 companies), increases in sales (18 companies), safeguarding existing jobs (13 companies), developing new products or improving an existing product (23 companies), increasing profitability (16 companies), improving the quality of products (8 companies), development of new processes and systems (10 companies), increase of own investment in R+D (12 companies). The scheme's success resulted in the recent award (2012) of a second tranche of ERDF funding (£300k). This scheme allows an agile response to industry needs. As an example; following a meeting between our Business Development Manager and representatives of Optimec on 23rd May 2013, we worked quickly to submit a KTP by 19 June deadline. The project was approved and the KTP Associate started on 16th September.
- The Group has hosted a competitively obtained Royal Society Industrial Research Fellow – Dr. Peter Foote – from BAE Systems. Part of his remit was to help inform the AIPT about industrial sensing requirements. He organised a Sensing Workshop in July 2009 attended by delegates from 17 companies and research centres.
- Working hard to exploit technology transfer and establish good relationships with companies often results in future "pull" as they come back to what they see as a trusted partner, as evidenced by the long term relationship with Azea Networks.

Use of University facilities

We have taken full advantage of University facilities and structures that enable impact. The highly proactive BPU has worked with academics to set up collaborative industrial projects. The BPU has been particularly successful in finding industrial partners to enable CASE awards (5 started since 2008). We have participated in events organised by the BPU to promote our industrially relevant research; these include "Celebrating Research", "Medical Technologies", "KTP Showcase" and "Photonics Showcase" events dedicated to highlighting the research in the AIPT and attended by typically 50 delegates. The BPU also provides assistance with contract negotiation and advice and financial support for patenting, further supported by the Staff Development Centre's courses on intellectual property management. Academics may have a significantly reduced teaching load to allow greater flexibility for work and collaboration with companies.

c. Strategy and plans

Our strategic aim is to maximise both the impact of our research and the return to the university arising from that impact. This return can be financial, resulting for example from licensing agreements or new research contracts, or it can take the form of new research outputs or the opening of new research topics.

Our plans for implementing this strategy build on the approaches described in previous sections that have over the past decade been tested and found to work.

- Focus on projects with high potential of industrial impact, e.g. work with Western Power Distribution (Power Engineering), recently awarded Marie Curie Initial Training Networks (optical

communications and sensing) and UNLOC (network capacity increase: http://www.unloc.net/)
- The appointment of a second Royal Society Research Fellow, Dr. Wladek Forysiak, cementing a relationship between AIPT and international optical communications company Oclaro.
- The development of a Translational Photonic Technology Centre, which will host short term development projects, provide incubation for start-ups and commercial training for early stage researchers. The Centre aims to train 20 postdoctoral photonics engineers in the first 5 years leading to the creation of 90 jobs in the sector.
- The enhancement of formalised photonics-related post-graduate research student education begun in 2012, which facilitates future impact by including specific courses on intellectual property and bringing in external speakers to communicate the needs of industry
- As part of our staff development process, new academics meet with the EAS Research Development Manager to develop a 5 year plan for their research, which explicitly includes the need to consider impact; they are then mentored by an experienced academic within the unit. This is now being extended to all staff.
- The creation in AIPT in 2012 of a new kind of on-going appointment, where part of the remit is specifically interaction with industry. This has created a new, entirely research focussed career pathway, which allows us to react very quickly to industrial requests. Eg in 2013 we rapidly crafted a proposal to the Aerospace Technology Institute following an approach from Airbus UK.
- The exploitation of the full range of funding mechanisms to stimulate innovation in new products in industry and exploit Aston intellectual property. We will continue to use TSB projects, KTPs, FP7, spin-outs and direct industrial funding, as well as utilising Aston investment in small scale technology development projects. For example, **Sugden** is currently working with spin-off Astasense and an Oil Industry service provider to improve the performance of sensing systems in bore-holes.
- Our priorities anticipate those appearing in Horizon 2020, which has a stronger impact focus than FP7 and should provide significant future support.

Our plans require us to work towards sharing this good practice with other research groups. In many cases this should be relatively easy, however in some cases there are benefits that arise from having a large critical mass of researchers. Several developments are planned to enable us to achieve this critical mass in research fields outside of AIPT:

- The school is implementing plans for large growth in student numbers, which in turn will lead to the recruitment of more academic staff. The school is focussing staff recruitment on the creation of self-sustaining research institutes, and prioritising the undertaking of translational research. Within the Unit the development of an Applied Physics degree programme will allow us to strengthen the Nanoscience Research Group as well as enhancing the AIPT.
- We are now targeting major industrially focussed bids involving the education of PhD students within an industrially collaborative project environment. In 2013 we succeeded in obtaining two Marie Curie ITNs as coordinator. These will bring in large cohorts of external research students for industrially-focussed training events, which will benefit all research students in the Unit.
- We are planning a research collaboration with a new Vietnamese university (VN-UK University in Danang), which will allow us to recruit additional academic staff, strengthening research in the areas outside of AIPT, as well as bringing in significant numbers of research students. The collaboration specifically targets the strengthening of impact, through industrially focussed research, designed to benefit the Vietnamese and UK telecommunications industries.

d. Relationship to case studies

The three case studies - "**From yacht masts to wind turbines and beyond…",** "**Research and development of the world's longest Terabit optical communications system**" and "**Aston photonics research impels the success of the UK telecom start-up AZEA Networks**" all arise from work in AIPT, since this is the largest research area in the Unit and has been active by far the longest. The case studies demonstrate close ties to industry, the nurturing of long-term collaborative activity and the support for spin-out activities and indeed for staff, research fellows and PhD students to move in and out of industry, thus strengthening our industry-focussed culture. The case studies also illustrate how technology transfer is facilitated through the use of direct industrial funding, TSB projects and CASE awards.