Institution: University of Surrey

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

a. Context

The major output of Electronic Engineering and Materials research is technology and the impacts of this primarily create wealth and economic growth through licensing, spin-outs and by knowledge transfer to businesses through Knowledge Transfer Partnerships (KTPs) and the training and transfer of people. However the general public is the ultimate user of our technology and hence impacts relating to wellbeing and improved lifestyles are also key.

Sectors that benefit directly are industry and service providers in electronics, media, telecommunications, and materials for manufacturing. We engage with them via sector collaborations, one-on-one strategic partnerships and KTNs, KTPs, IDCs and trade associations, e.g. joint equipment and materials initiative (NMI), the Satellite Applications and Digital Economy Catapults and the TSB.

ATI has created impact in a number of fields, including new materials to sustain Moore's Law over the current decade by inventing novel low-k dielectrics and electrical interconnects, and by improving functional materials and devices for higher quality sensors, displays, lighting and photovoltaics, all of which feed into the UK and international microelectronics industry.

CCSR has created impact through playing a leading part in the formation and running of the Mobile Virtual Centre of Excellence (MVCE) which is a collaboration of some 20 industrial partners and 8 UK Universities, forming a company limited by guarantee, to address long term research in the communications sector. This has produced joint research agendas and collaborative industry-academic groupings resulting in c. 50 patents to which the companies have exploitation rights.

CVSSP has created impact in the media, broadcasting and content delivery areas by formulating new standards for improved media quality, through the transfer of knowledge via staff transfer to companies such as The Foundry, and through improvements in biometric identity and security, exemplified by the spin-out Omniperception.

MSE has created impact in the arena of structural materials at component, systems and infrastructure level. Examples include the design of nanocomposite hard coatings for tooling, the development of design tools and smart sensors for adhesive bonding in the aerospace industry, and the application of statistical fracture mechanics to asset management of public utilities.

SSC has created impact for developing countries via remote sensing, environmental monitoring, weather prediction and disaster monitoring and avoidance. The formation of the International Disaster Monitoring Club has created both economic impact via satellite sales as well as policy and user safety impacts in developing countries that now have affordable warning facilities.

b. Approach to impact

Our approach to impact has been on two primary levels:

To showcase and open our research to a wide range of users;

The Knowledge Transfer Account (KTA), awarded by EPSRC in 2009, allowed us to focus our approach on impact and knowledge transfer in the areas of materials, communications and signal processing, and nanotechnology. The KTA was a partnership with the National Physical Laboratory (NPL) who provided manpower (in the form of KT Directors in the three areas) to audit the Surrey research and to seek out and engage companies to take that research forward using

matched KTA grant funds. To embed the benefits of working with companies the KTA also provided training and support to academics. The majority of the companies were SMEs which would not have engaged had it not been for such a scheme; in total we worked with 99 companies, 10 of whom took up the IP. On average the KTA-supported projects increased the TRL by 2 points. In addition, we created 5 new spin-outs as a result of this process of discovery, seed funding and matching to industry needs. We also set up a series of sector specific industry days to match company needs to research outputs. We have continued this process using University core funding and extended it to our total research portfolio, also using the Impact Acceleration Account to progress EPSRC funded research.

To engage with users to determine their requirements and to shape our research;

We have developed longer term strategic relationships with various large industrial partners. The MVCE was an exemplar with a long term partnership with up to 20 companies and 8 Universities in the Telecoms sector being formed on the basis of a shared view of collaborative, pre-competitive research. More recently, industry horizons have shortened and the need is for innovation closer to market. With this in mind this successful strategy is being continued with the new 5GIC awarded in 2012 with £11m from HEFCE matching £24m contributed by eight core communications companies. The aim is to jointly work with industry based in the new 5GIC on the Surrey campus to produce the technology needed to put the UK in the driving seat for 5G communications. The partnership has already been extended by 6 new companies. Another example of engagement and determination of industrial requirements is the BBC Centre of Excellence in Audio and Video processing, which builds on expertise in multimedia signal processing and 3D digital content to examine critical problems in content production and delivery across both broadcast and IP networks.

The sale of SSTL to EADS provided the opportunity to engage in a working relationship with Astrium, in the form of a 5 year (£5m) research endowment to the University, adding to the long-standing collaboration with the University's spin-out, SSTL. This endowment has funded a number of research projects as well as contributing to research awards from EU/ESA and technology transfer to both Astrium and SSTL. In this way we have created a virtuous circle between the spin-out and the University. Other examples of successful one-on-one partnerships are with Vodafone, BT and Thales.

The ATI worked closely with NPL to set up a strategic University relationship that has contributed at a number of levels. At the top level, NPL partnered the University in its successful Knowledge Transfer Account (£3.5m), which delivered on the Materials, Photonics and Nanotechnology fields. NPL also jointly funded a number of academic posts in the Faculty and helped set up a very successful secondment of staff to the ATI to work on quantum metrology devices. This has enabled numerous smaller projects, and the setting up of 3 EngD projects in smart materials, carbon electronics and semiconductor interconnects.

MSE is home of the Industrial Doctoral Centre in Micro and NanoMaterials and Technologies. This EngD Programme was conceived in 2007 and received a large EPSRC grant (£6.2M) in 2008 to provide training for 50 Research Engineers (REs) over a five year period. The impact that springs from REs being based in industry for most of the programme is extremely high, and provides examples across a range of themes including Aerospace, Automotive & Marine; Defence; Energy Generation & Management; Infrastructure and Sensors & Instrumentation. Sponsors range from SMEs to large multinationals, with a significant amount of repeat business, even though our alumni base has only been in existence for little over a year.

Other approaches to impact have surrounded engagement with the KTNs in our sector and the newly formed Catapult centres. The University of Surrey was asked by the Satellite Applications Catapult to lead the Satellite Applications Applied Research Group, bringing together coordinated input from Space active Universities around the UK. The results of discussions within the group were of fundamental importance in informing the final business plan adopted by the Catapult. Following this the University has recently signed a Memorandum of Understanding with the University of Reading and NPL to form the first UK Research Centre of Excellence to be associated with the Catapult, for Global Satellite Sensing. A non-disclosure agreement is also in place with a major multinational company, discussing the potential for multi-million pound contracts with the Centre and the Catapult.

Given that much of the manufacturing in our sector is overseas, a major impact has been on inward investment to the UK. We have also worked closely with UKTI to attract new inward investors to the UK by joining with them in presentations to new companies from Japan, China, Korea and Taiwan looking to locate either onto the Surrey Research Park or in the South East. We also run a comprehensive programme of one week CPD courses for industry and these attract a total of on average 200 industrial engineers per annum onto the campus. Although the main aim is training of engineers, and this in itself creates impact, there are many spin offs that result in KT to the companies concerned as a result of exposure to our research. We also host a number of research visitors from key companies, such as NEC, ETRI, BAE, INTEL, Nokia, EADS etc. who have worked with our research teams and formed future partnerships leading to impact.

We are supported in our approach to impact by our Research & Enterprise Support group (RES) at University level. RES provides project management for the key partnerships and commercial, legal and IP expertise to help enable the creation of impact through licensing, spin-outs and the support of staff and student start-ups. RES also provides support through its incubation centre on the Research Park for early stage companies including business planning, mentoring and help raising finance from business angels and VCs via the Surrey 100 Club, and seed funding from the University of Surrey Seed Fund. Several spin-outs have started in this way and then migrated into larger premises on the Research Park. In some circumstances the University may also make available lab space adjacent to research facilities.

c. Strategy and plans

We have conducted a review of impact activity since 2008, some highlights of which are included in section b, and understand the value in creating more formalised structures and support around impact. The successes in the period have informed our strategy for achieving impact going forward. The review has also highlighted activities that could be better exploited, and in some cases work has already begun on these. The key elements of the strategy are:

Building awareness:

- Showcasing research via focussed industry presentation days.
- Closer involvement in KTNs and Catapults.
- Using CPD courses to reach a wider industry base.
- Using consultancy and hosting strategic visitors.

Strategic Partnerships:

- Continuing and expanding our existing strategic partnerships.
- Extending our sector engagements, using accumulated experience of how to manage such partnerships effectively through updates and outlining our research plans at an early stage.

Knowledge Transfer initiatives:

- Using our KT directors in RES to improve discovery of IP and link to industry needs, and to link more to the SME sector.
- Developing plans for more effective marketing of our facilities and expertise, to further improve our engagement and its relevance to the needs of our user communities.
- Ensuring staff receive appropriate training in KT so that it is embedded more effectively into our research.

Education and Reward for Staff:

- Utilising annual staff appraisals to recognise and reward achievements in impact, and recognising excellent impact at University level through annual impact awards.
- Appointing dedicated 'Impact Champions' to increase exposure and dissemination of impact activity within the Unit and to identify routes to impact of key research findings.
- Utilising sabbaticals as a mechanism to help staff to develop opportunities in technology transfer and commercialisation of their research.

Supporting nascent companies:

- Brokering and supporting early stage companies.
- Supplying early commercial management and brokering VC support.
- Supporting staff and students in establishing start-ups and external consultancy.

Standards and Policy:

- Using the 5GIC to influence standards in 5G, and to advise OFCOM and other regulators how best to administer spectrum more efficiently.
- Influencing UK Government to move towards a more energy efficient future.

Other:

- Recognising and exploiting the fact that EngD Programmes will continue to provide a particularly effective mechanism for engagement with our user communities.
- Accelerating the impact agenda through increased internationalisation and through the expanding University Global partnership Network (UGPN).
- Strengthening our alumni programme to ensure that our graduates remain advocates for the Unit's research and technical capabilities throughout their careers.
- Pro-actively using the Faculty marketing team to generate a much more widespread awareness of successes and capabilities through the use of research blogs, web video content and social media, as well as developing an independent public engagement pathway.

d. Relationship to case studies

The nine Case Studies exemplify the approaches to realising impact outlined in section b and also section c. The particular mechanisms are as follows:

Strategic Partnerships:

Our case studies on "*GIOVE-A: Europe's Pathfinder Satellite to the Galileo Constellation*" and "*An International Disaster Monitoring Satellite Constellation Spin Out DMCii*" evolved from the strategic partnership between SSC and SSTL. The University wholly owned SSTL until 2009 when it was sold, being the largest cash sale (at *c*. £50m) of any academic spin-out at that time. Part of the arrangement was to maintain and grow the long-term strategic relationship between the University

and SSTL to create a sustainable future. Both case studies resulted from staff from the University and SSTL working closely together over many years. The case study on "*Computer Vision for Stereo 3D Film Production*" resulted from the strategic relationship with the BBC Centre of excellence and through that extensive collaboration with the UK film production industry and, in particular, SMEs in the media area. Collaboration with The Foundry resulted in successful commercial exploitation of software tools for film production leading to considerable expansion of the company from 20 to over 200 people.

Discovery of IP and matching to industry needs:

The case study on "*From Satellite Control to Film and Computer Animation Spin Out Ikinema*" is a successful example of cross-disciplinary opportunity spotting, the use of KTA funding and the successful migration of staff to a spin-out. The academic and the KT Director spotted an opportunity to revolutionise computer game development by speeding up animation by orders of magnitude. The first product was developed with funding from the KTA, ESA and the Royal Academy of Engineering, and the academic is now the CEO and majority shareholder. The case study on "*Secure GSM/3G Voice and Data Communication Spin Out MulSys*" was an example of discovering IP on speech coding that could be transformed into a world-wide secure mobile phone. The application was spotted via contacts with UK security services who were looking for a system that could be operated via the speech channel so that it was universally available. Brokering the contacts has resulted in a successful spin-out where equity has been retained in-house.

Supporting and incubating new companies:

The case study on "*Automated Personal Identity Recognition Using Face Detection Spin Out OmniPerception*" describes a spin-out company that capitalised on biometrics research in the area of automatic face recognition software. The University invested in early stage prototyping of the systems and the appointment of a commercial manager to take the company to the stage of VC investment, its eventual merger with a larger company, Digital Barriers, and an exit for the University. The case study on "*Surrey NanoSystems: Meeting the International Technology Roadmap for Semiconductors*" describes another spin-out company resulting from research in low-substrate-temperature growth of carbon nanotubes and low-k dielectric materials. The University brokered early support from SEEDA and IP Group to start the business and again put in a commercial manager to take it through to VC investment.

Building awareness:

The case study on "*The National Ion Beam Facility at the Service of UK Industry*" is an example of creating awareness of Surrey research to the UK microelectronics industry. It supplies a service via use of its accelerators but also creates awareness of the research being conducted at Surrey. Besides direct income generation for industry, more recently impact has been created in the biomedical field via the installation of a vertical beam source used for proton beam therapy in the treatment of cancer. This has helped to influence policy on use of proton therapy in the UK.

Standards and Policy:

The case study on "*Integrated Satellite and Terrestrial Multimedia Broadcast System*" is an example of several approaches to impact in tandem. Firstly it resulted from a close working relationship over a long period between the University and Thales Alenia Space. This enabled partnerships through a succession of EU funded projects to develop the system; an example of KT to a large industry and the setting up of a new industry sector. More noteworthy, it influenced policy within European Regulators to make spectrum available across Europe for the first time. It also resulted in a completely new standard, DVB-SH, for the industry. Finally, from a user perspective, it has provided mobile multimedia services to remote areas to enhance quality of life.