Institution: University of Kent

Unit of Assessment: 15 General Engineering

a. Context

The main user groups and beneficiaries of our research are aerospace, astronomy, automotive, consumer electronics, defence, healthcare, manufacturing, power generation, security and telecommunications sectors where our reach extends from an important role with local and regional SMEs to work with major national and international players.

The impact of our research extends to the economy, environment, health, public policy and wider aspects of society. Technologies developed by the Broadband and Wireless Communications Research Group support the aerospace, astronomy, automotive, defence identification and telecommunications industries as well as the National Health Service. For example, research on frequency selective surfaces has produced sub-reflector designs (mm and sub-mm satellite borne radiometers for earth resource observations) for aerospace (BAE Systems), while work on small antennas and RFID has supported the automotive industry (Harada) and manufacturers producing digital televisions (through Mitsubishi VIL). Instrumentation technologies developed by the Instrumentation, Control and Embedded Systems Research Group have enabled combustion engineers to diagnose large-scale complex combustion processes and optimize coal and biomass fired power plants (Drax Power), enhancing combustion efficiency and reducing greenhouse gas emissions. Meanwhile, instrumentation research on optical coherence tomography has allowed advanced imaging and subsequent diagnosis of the eye in clinical environments such as the New York Eye and Ear Infirmary. The Image and Information Engineering Research Group impacts on the technological development of practical biometrics through industrial take-up, leadership of the development of standards for the commercial marketplace and policy input to UK Government. We have, for example, developed the EFIT-V facial modelling system which is used by 85% of British police forces and deployed in over 30 countries for police support to improve offender identification. Work with the International Organization for Standardization/International Electrotechnical Commission (ISO/IEC) has influenced the development of international travel and identity documents and other applications. We have provided practical and policy-level support to the Government Biometrics Assurance Group, Home Office, the Identity and Passport Service (IPS) and the IEEE Certified Biometrics Professional (CBP) programme.

b. Approach to impact

Our impact strategy is focused on developing long term strategic relationships with industrial and end user partners, disseminating the results of our work appropriately and providing internal management and planning structures to support staff with integrating an impact agenda in their career planning.

The School Enterprise Committee (SEC) led by a senior academic with 12 years of previous industrial experience and holding the role of School Director of Enterprise has operated throughout the REF period. Its aim is to identify and support opportunities for commercialising our research successes and hence maximize the impact of our research. The SEC determines our enterprise strategy receiving annual plans from individual academic staff and research groups. Resulting enterprise plans are supported by appropriate investment, an infrastructure of professional enterprise support services and recognition in the Work Allocation Model (WAM). The SEC has made a key contribution to formulating and managing KTP (Knowledge Transfer Partnership) projects as well as industrial CASE awards. Over the assessment period the submission unit has undertaken five KTP and 12 industrially supported PhD projects including CASE. As well as multinational companies and global players, our industrial partners include C-Matic Systems Ltd, C-Scope Ltd, EMS Ltd, Innovative Small Instruments Ltd, Martec Ltd, Naneum Ltd, Procon Engineering Ltd, Realli-Ski Ltd, Sontay Ltd and Timeplan Ltd, all of which are regional SMEs. To elaborate, the KTP project with Martec Ltd has generated a novel product, the pin-less electronic connector for use in hostile environments and led to a new product division in the company. In recognition of the impact of this KTP project, the partnership was awarded the University's Academic and Business Collaboration of the Year Award in 2011. The SEC has oversight of marketing our research facilities and consultancy expertise. For example, the Mechanical

Workshop, part of our research support infrastructure, made a significant contribution to Nano-ID, a nanoparticle spectrometer marketed by Naneum Ltd which won the Inaugural Innovation Award from the Institute of Physics in 2012.

Kent Innovation and Enterprise (KIE) is the University's commercial arm that provides professional support to develop business collaborations to exploit research for commercialisation, consultancy and training. KIE identifies potential end users and answers initial inquiries from potential industrial partners and organizes networking and information exchange events attended by representatives from targeted industrial organizations (e.g. DSTL) and from SMEs. Its Enterprise Hub offers a range of services to help potential entrepreneurs to develop and commercialize their ideas. For example, VisionMetric Forensic Imaging which markets the EFIT-V facial modelling system is located in the Hub. The SEC works closely with KIE staff, and over the assessment period KIE helped staff including Howells (Metrarc) and Podoleanu (Optopod Ltd) to start up or run their limited companies. Support is provided for identifying and gaining follow-on funding and for leveraging external funding and co-funding, costing, negotiating and managing enterprising projects. KIE offers a number of schemes to support this activity including Time Out for Reach Out, Innovation Fund, Ideas Factory pump priming, a Patent and Commercialisation Fund and SME Innovation Vouchers. With guidance from the SEC, staff made good use of such opportunities throughout the assessment period. For example a biomass imager was developed by the Instrumentation, Control and Embedded System Research Group as a result of two consecutive Ideas Factory grants awarded to help its commercialisation. The imager has helped organisations such as RWE npower and RJM International to quantify some of the physical properties of biomass fuels which are difficult or impossible to obtain using conventional equipment.

Industrial and End User Partners are routinely invited to join a research project steering committee at project inception to facilitate close engagement of end users with our research developments. Letters of support from end user partners are obtained and once the proposal is approved, a collaboration agreement between the University of Kent and the partners is signed. During the course of the project, the end user representatives and, where agreeable, additional industrial users attend quarterly or six monthly project review meetings and dissemination workshops, often making their facilities or equipment available to the academic research team. Some project review meetings are held purposefully at the end user partners' premises, giving the opportunity for more engineers or practitioners of different backgrounds to communicate and interact with the academic research team. Group emails and project web sites (with private areas) have been found an efficient way for the end user representatives and academic researchers to exchange information. Minutes of project review meetings along with relevant project documents are also made available to end user representatives. A good example of this approach is the formulation and execution of the EPSRC project (EP/F061307/1) which involved industrial partners RWE npower, E.ON, Alstom Power and China Datang Corporation (one of five major Chinese companies in the electricity production sector). In PhD studentships funded by BCURA (British Coal Utilisation Research Association)/BF2RA (The Biomass and Fossil Fuel Research Alliance), CASE and KTP projects, industrial supervisors are appointed to maximize the impact of the research on the industrial partners. In some cases end user partners were also co-authors of research outputs in recognition of their contributions to the work. In addition to collaborations with industrial partners in EC/UK government funded projects, we have worked with more than 80 industrial organisations through contracted research or consultancy work in the assessment period. For example, throughout the assessment period we have worked with NTT DOCOMO, the largest mobile communications company in Japan; RWE npower, a leading power generator who operates Tilbury, the largest biomass fired power plant in the world; and Smart Sensors Ltd, who develop iris biometrics technology.

The School Industrial Panel (SIP) has operated throughout the assessment period and comprises senior industrialists from a diverse range of national and local industrial sectors. The SIP incorporates industrial and end user partners who are engaged directly in research projects but has a strategic focus at unit level. Current members include Axicon Services Ltd, BAE Systems, Charis Technology Ltd, Delphi Diesel, Energy Solutions Ltd, Everything Everywhere, Haag-Streit UK, Harada Europe R&D Centre, Imagination Technologies Ltd, JDSU, Megger Ltd, National Instruments, Ocean Signal Ltd, Procon Engineering Ltd, R & D Design Services Ltd,

Rohde & Schwarz, Royal Air Force, Texcel Technology and Wurth Elektronik. SIP members ensure the unit is industry-aware, externally responsive and focused on maximising industrial impact.

Dissemination and Publicity is a key facet of our impact strategy and administrative support to this important activity has been significantly strengthened during the REF period within the UOA. Staff organized and attended a range of events to enhance interactions with non-academic users and audiences throughout the period. For instance, we organized two Summer Schools in 2008 and 2010, both supported by RCUK and attended by engineers from the UK, France and China. We have hosted, throughout the assessment period, the annual Engineering Education Scheme sponsored by the Royal Academy of Engineering whereby the unit interacts not only with children and teachers but also with engineers from industrial companies. We participated in the national 'Big Bang' exhibition (http://www.thebigbangfair.co.uk/) in 2012 and 2013 to promote our design and engineering work. Senior staff were invited to give presentations at more than 40 industrial organisations and industry-focused conferences (e.g. the 9th European Conference on Industrial Furnaces and Boilers in 2011). Some staff appeared in television and radio interviews on topical issues (e.g. Batchelor: BBC Radio Kent in 2011; Deravi: ITV Meridian in 2011 and BBC Radio 4 in 2013; Fairhurst: BBC Radio 4 in 2008 and 2010). Many staff are members of expert panels and committees of professional bodies and organisations. For example, Spurgeon is a member of the Defence Scientific Advisory Council (DSAC) providing independent advice to the Secretary of State for Defence and Lee is an active member of the Electronics Technology Network (ETN), formally known as the EKTN, and acts as an academic representative on the current Board of Directors. Such dissemination activities create opportunities to interact with targeted industrial sectors and the wider community and have been an important component in the strategy of promoting engagement with industrial and end user partners.

c. Strategy and plans

The SEC in collaboration with the School Research Committee will continue to refine our already successful impact strategy to maximise impact with established beneficiaries whilst extending the reach of our impact agenda. An impact officer was appointed in 2013 to assist the School Director of Enterprise and lead and coordinate our impact activities. The three Research Groups and individual academic staff will continue to annually review their impact achievements and formulate plans for maximising impact in the following year. We will continue to pursue collaborative funding opportunities such as TSB and KTP programmes to ensure our research impacts directly on the commercial environment. Meanwhile, we will enhance our commercialisation and consultancy activities through staff development and with the support of KIE. The proven structures of the SEC and SIP will continue. We will maintain our long term links with established user groups such as power generation and security. We seek to strengthen our impact in areas relating to defence and healthcare, exploiting institutional initiatives such as the partnership with DSTL and the establishment of Kent Health (http://www.kent.ac.uk/health/about/index.html) and are committed to supporting the impact agenda of the cross-institutional Centre for Molecular Processing by focussing the impact agenda of our control and modelling researchers in the area of biotechnology.

d. Relationship to case studies

Three case studies are submitted, one from each research group, each of which exemplifies our approach to developing strong and enduring relationships in all areas with our end user community:

1. Radio-frequency engineering for antenna systems
2. Combustion instrumentation for power plant optimisation
3. Biometrics: supporting technology, policy and professional developments

All three case studies resulted primarily from externally funded projects in partnership with key industrial and end-user partners. Dissemination and publicity are a contributing factor in all three cases. Both SEC and KIE made significant contributions to case studies 1 and 3, which included the identification of industrial and end-user partners and the arrangement of TSB, KTP, CASE and consultancy projects. The experience of these case studies is informing our annual planning and enhancement of our approach to impact (Section b) and the impact plans (Section c).