Institution: London South Bank University

Unit of Assessment: General Engineering

a. Context

The UoA encompasses 5 groups covering a wide range of research interests: Chemical & Process Engineering (CPE); Environmental & Energy Engineering (EEE); Health, Acoustics & Communications Engineering (HACE); Materials Engineering (ME); and Refrigeration & Air Conditioning (RAC). During the assessment period, the Unit's research has had an impact on a wide range of beneficiaries, notably industry, the natural and built environment, and local and national government. Examples of the different types of impact are given below.

Impact on health and welfare

Research by the HACE group led to the development and commercialisation, through spin-out company Biox, of instrumentation to measure skin barrier characteristics. Since 2008 Biox has sold 200 major products worldwide to medical suppliers and leading teaching hospitals. Other research has had an impact on the health, safety and comfort of passengers and staff on the London Underground. The RAC group has developed a sustainable, natural method of cooling stations, which is now used in several stations in London as well as metros in Europe. It is also currently being investigated for use on Crossrail, as well as other metros in North America and China. The HACE group has developed new methodologies and guidelines for improving speech intelligibility of underground voice alarm systems, which has led to the design of new loudspeaker systems for 74 stations on the London Underground.

Impact on the natural and built environment

Research by the CPE group into hydrogen safety led to the Hydrogen Technical Guide which is used across all Sellafield sites to reduce the risk of hydrogen explosion. The group has also worked with Uptown Oil to improve the quality of biodiesel produced from waste cooking oil. Uptown Oil now supplies fuel to Richmond Council, cutting its CO_2 emissions by 1,170 tonnes pa; to PwC (EN 14214 standard) to power its London HQ; and to Hackney Council's taxi fleet. Research by the HACE group on acoustics in schools has developed guidelines for open plan schools, which are incorporated in the (2013) revised legislation and guidance on school acoustics. Further research, with Arup Global Healthcare, into the acoustic design of in-patient hospital wards has influenced the design of a new ward at Great Ormond Street Hospital (2011).

Economic impact

Much of the Unit's research has had an impact upon both established and start-up companies. For example, the hydrogen research by the CPE group has saved Sellafield over £500M in installation/ operating costs, plus £50M due to reduced engineering requirements. Solion, a spin-out company, now sells its photovoltaic products worldwide and has an income of £2 million pa. Biox, which has generated revenue of £1.37M through world-wide sales, established a sales and support agency network in the USA and Asia, and has employed 7 new staff. Research with Telent on VA (vocal alarm) systems for London Underground Ltd (LUL) led to 3 new professional engineer posts; generated £500K net profit; saved LUL around £70K pa in electricity costs; and enabled Telent to gain the maintenance contract with LUL, worth £1.5M. The EEE group's patented upflow multi-layer bio-reactor/oxic process for treating high-strength wastewater has been commercialized and is currently producing a turnover of £3.2M pa for Ecodigm Ltd. The ME group has enabled a Spanish company, Tekniker, to design, construct and market a new physical vapour deposition machine that has lower costs, higher throughputs and more flexibility than conventional machines.

Impact on government policy and legislation

Staff have provided advice on policy to the Department of Energy and Climate Change (DECC) (on leakage of refrigerants from heat pumps); Department for Education (DfE) (on the acoustic design of schools); and Department of Health (DoH) (on effects of noise on health). Research by HACE on school acoustics was used to persuade the Government to retain and revise legislation on acoustic design of schools and has led to new criteria and guidance on open plan schools. Research results were also presented to the Welsh Assembly in 2009, and led to representation on the DoH Ad-Hoc Committee on environmental noise. The RAC group is influencing international policy through an International Working Group on refrigerant containment, and advised the former London Development Agency on mitigation of carbon emissions from air conditioning systems.

Public engagement

Research by the ME group on the development of climbing and swimming robots for non-destructive testing and inspection was used by the Royal Society (2010 Summer Science

exhibition) and the Royal Academy of Engineering (2011 Big Bang Engineering Fair) to promote science and engineering to school pupils and the general public.

b. Approach to impact

A major strength of the UoA, enabling wider impact of its research, is its strong relationships with multinational, national and local industries and businesses. This enables us to respond to research needs and challenges posed by industry. The UoA provides strong collaborative pathways for impact of research between fundamental, applied, knowledge transfer and enterprise activities. The Unit seeks to strategically stimulate and support the impact of its research through:

1) Collaborative research with business, industry and academic institutions. In the past 5 years, we have collaborated with over 100 companies and many UK and overseas non-commercial organisations, including through EPSRC and EU funded projects, and matched funded industry-led PhD schemes. Interdisciplinary research (e.g. with psychology, music, physics, architecture, IT) is also encouraged which widens the impact of the research. We also have a very successful record of delivering impact through Knowledge Transfer Partnerships (KTP), which lead to immediate benefits (Case Studies 1 and 3). During the assessment period, 43 KTP projects were funded and/or running. In establishing and maintaining our links with industry and applying for funding, the Unit is supported by the University's Enterprise, Marketing, and Central Research Departments.

2) Pump priming funding, used to exploit new innovation. Staff are encouraged to take advantage of funding opportunities to exploit their research, particularly in London. In the past five years, we have benefitted from the London Development Agency proof of concept Emerald awards and the Greater London Authority Knowledge Connect scheme which links small businesses with local universities e.g. An Emerald award led to the application of acoustics research to the development of a sound absorbent mirror for the Royal Academy of Music. These awards have been supplemented by University Enterprise Awards which reward staff who have had a significant impact. The Enterprise Department encourages and supports patent applications for innovations; staff in the Unit currently hold 27 patents; 8 applications have been filed since 2008.

3) Leadership through professional institutions and government departments. The Unit provides leadership of our professional institutions which include the IET, IOR, IOA, IOP and IChemE. Two staff are Presidents of their institutions: Prof Shield - Institute of Acoustics (2012-14) and Prof Maidment - Institute of Refrigeration (2013-16). These enable impact driven research and innovation, by raising awareness of issues requiring research, providing contacts with potential partners, and channels of dissemination to academic colleagues, industry and end users. Many staff are members of influential committees: Prof Nolan - Hydrogen Forum, Sellafield Hydrogen Working Party, HSE and BSI committees; Prof Maidment - International Working Group on Refrigerant Containment, Director of the Air Conditioning and Refrigeration Industry Board; Prof Shield - Chair of the Acoustics Committee advising the DfE on the revision of the Building Regulations on schools, member of the DoH Ad Hoc Committee advising on the effects of environmental noise on health (2004-10).

4) Dissemination to the general public via the media. In the past 5 years our research has featured on TV and radio, for example research on noise in schools on BBC2 (2009) and BBC Worldwide website (2013); refrigeration research on BBC4 (2013) and Radio 4 (2008, 2010). We also run exhibitions and public presentations and staff are encouraged and financially supported to present at various local, national and international conferences.

c. Strategy and plans

Our research inherently delivers impact as it tackles practical problems in society, business, the economy and the environment meeting future demands. Key aims are to build on our research strengths; to continue and expand our applied research activities and their impact; to increase our collaboration with industry, for example by expanding KTP and industry-funded PhD programmes; and to seek funding for research into issues of topical importance. To achieve these aims we will:

1) Make use of recent Faculty and University initiatives to support and underpin our research and its dissemination: In 2012 the UoA was involved in the setting up of the Nat Puri Institute (NPI), following a donation of £1M. The NPI is embedding an enterprise culture into the UoA. It will provide relevant projects that relate to current and new research themes, enabling us to a) widen our impact in industry and business b) provide PhD students with necessary skills needed for impact. The NPI will also exploit commercial ideas from research, generating income to be reinvested in research, and enabling the UoA to widen the reach of its impact. University support for research impact has been further strengthened by the new £13 million Clarence Centre for

Enterprise and Innovation (September 2013), which hosts the University's Enterprise Department. The Centre has dedicated support for the exploitation of engineering activities. It also has many links with the local community and provides networking opportunities with local businesses at which research outputs feature. Indeed, 40 local businesses currently use the innovation incubation facility. An example of engagement with local businesses is with Vanguardia, who operate from the incubator, and provide specialist sound systems for major events including the 2012 Olympics. They regularly engage with the acoustics team; a recent example is using our research labs for a study of the acoustics of tennis balls for Wimbledon. The Clarence Centre will lead the expansion of the University's KTP programme, in line with the aims of the Unit and will be a major mechanism in delivering impact.

2) Encourage staff, through seminars and workshops, to engage in relevant and topical research and widen the impact and dissemination of their work: We will continue and further develop a programme of workshops and seminars to encourage staff to engage in research and its exploitation. This will include exploitation of new and existing industrial links and applied and relevant research, which will have immediate impact in the commercial world. Staff will have the opportunity to apply for pump priming funding and follow-on research funding. The Research Concordat in the Faculty will place an increased emphasis on the importance of impact and its measurement. Seminars will be arranged on methods of dissemination and impact, including media training and publication beyond the traditional academic channels, e.g. in trade and professional magazines. We will continue to financially support staff who present at conferences.

3) Stimulating new internal and external collaborations: Cross faculty research meetings will be arranged within the University to disseminate research findings and encourage exploration of possible interdisciplinary research partnerships. We will continue to arrange external events at which we will publicise our research strengths and seek industrial and other external collaborators, with the aim of applying for funding for joint projects. We will increase the number of studentships funded by external organisations through CASE awards, and exploit collaborative funding opportunities including KTPs and Research Tax Credits.

4) Raise and record the profile of impact: We will develop mechanisms for capturing and monitoring areas of impact resulting from our research activities. A report will be produced to monitor the progress of this activity which will be presented annually to the Faculty's Executive.

5) Staff Development and Reward: We will encourage staff through the annual appraisal process to engage in enterprise activities and we will recognise and reward significant achievements relating to impact, through annual awards and an academic development funding mechanism.

d. Relationship to case studies

The impact case studies illustrate the potential for achieving impact when working with industrial partners, and through the setting up of spin-out companies. Three of the case studies illustrate how many years' experience of research in different areas - acoustic modelling of sound fields (Case Study 1), research into hydrogen generation and explosion (Case Study 2), and modelling of geothermal cooling (Case Study 3) - has been exploited through collaboration with industrial partners who approached the Unit because of their expertise. In all 3 cases the impact was underpinned by 15-20 years of previous research, culminating in collaborative projects which delivered impact during the assessment period. These 3 case studies also demonstrate different funding mechanisms that are used by the Unit. Case Study 1 (Vocal Alarm systems for underground stations) was funded via a KTP with funding provided equally by the company Telent and by the Technology Strategy Board. Case Study 2 (Hydrogen mapping and mitigation) was funded through contract research by the industry, Sellafield, who have also provided 5 years of funding (£500,000) for a Centre for Expertise in Flammable Gases at LSBU. The research in Case Study 3 (cooling underground railways) has been funded from a variety of sources including industrial, charity (the Carbon Trust), EPSRC and a KTP. Case Study 4 (Commercialisation of technology for water vapour flux density measurements) demonstrates the impact that can be achieved by the setting up of a spin-out company to commercialise a product developed after many years of research supported by EPSRC and the Royal Society, in collaboration with industrial partners. All 4 case studies have had a significant economic impact for the companies involved, plus impacts on comfort, safety and health. Throughout the projects, staff have been fully supported by the University's Enterprise and Research offices who liaised with the industrial partners, and advised on the best approach to obtaining funding and exploitation of results.