Institution: University of Strathclyde

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

a UoA13 - Overview

UoA13 comprises 6 core research groupings (shown in Figure 1), which host a number of themed *Industry Engagement Research Centres* (IERCs). The research groupings are each led by a senior academic "Head of Centre/Institute", have clear engineering and science themes, and are staffed by a critical mass of academics, research staff and research students. Academic and research staff are aligned to one of the research groupings, but may contribute to one or more of the IERCs. There are no barriers to collaboration in UoA13 across research groupings, and indeed the collegiate nature of UoA13 actively promotes both informal and structured collaboration internally and with other UoAs. Research policy is planned and determined by the Heads of Centre/Institute who sit on the Strategic Advisory Board with the Head of the Department of Electronic and Electrical Engineering (EEE). UoA13 has maintained a steady state population of academic staff over REF2014 and is submitting 60 Cat-A staff (59.2 FTE) for consideration. In the REF2014 period UoA13 academic staff have published more than 700 journal papers, enabled 5 new spin-out companies, and graduated over 178 PhD and EngD students. UoA13 research spend over the REF period was almost £44M, with almost 25% of this directly from industry.

b Research Strategy

Over the last five years, UoA13's research activities have been aligned with the University's Strategic Plan and vision as an international technological university. This plan maintains the ethos and vision of our founder John Anderson, whose intention in 1796 was to found "*a place of useful learning*", and to realise the potential of wider access to "*science*". The UoA13 modern interpretation of "*useful learning*" is the sustained delivery of fundamental engineering, scientific and technological advances targeted at societal and industrial challenges, and successful transfer of research outcomes into impact in these areas. Our combined research and knowledge exchange successes have helped shape and form the University's vision for a *Technology and Innovation Centre*. We have also developed sustainable research through ***Industry Engagement Research Centres*** (IERCs) and other initiatives (see Figure 1 for research groupings and

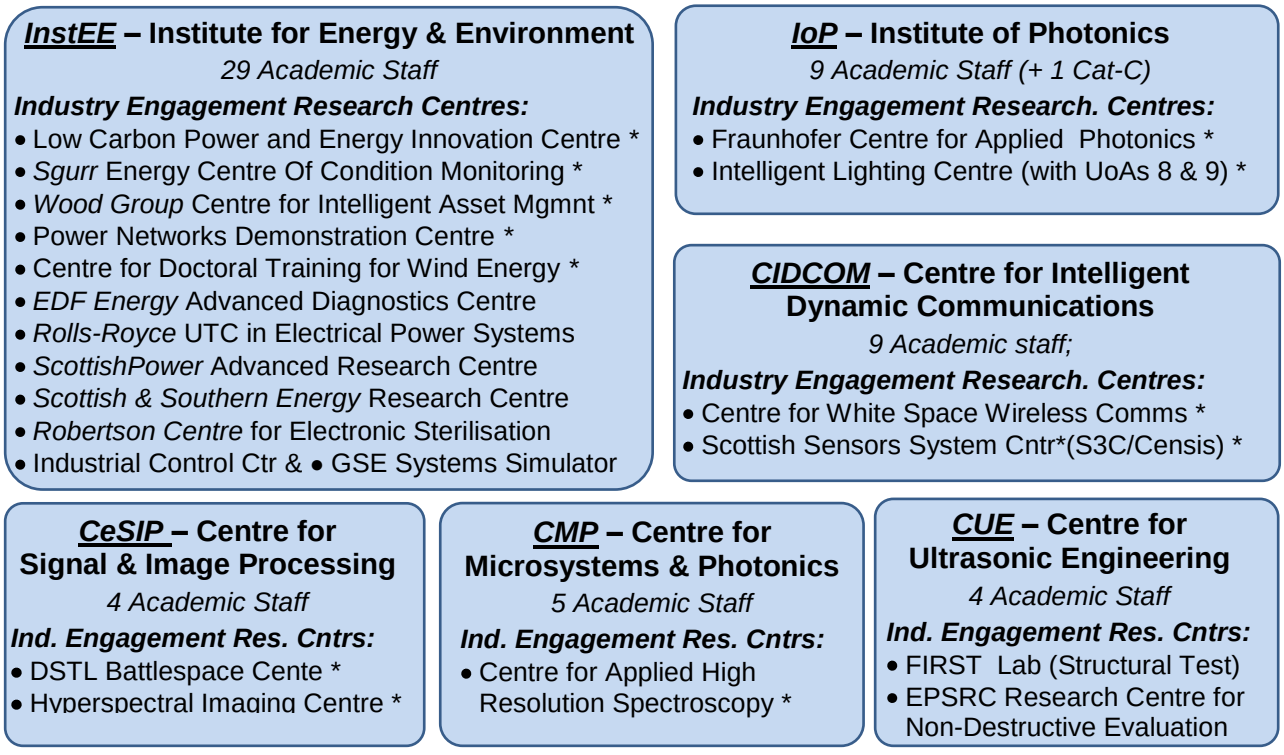

Figure 1: Academic Research Groupings and Industry Engagement Research Centres (IERC)
*' * ' denotes IERC was set up in REF2014 period*.

associated IERCs). This supports Strathclyde's strategic target to be among the top international technological universities, with an enviable research environment, delivering world-class research, developing world-class researchers, and addressing nationally and globally relevant research priorities. The management of UoA13 is designed to enable these ambitions, supporting domain-specific and cross-disciplinary research, and in particular facilitating collaboration with industry.

In accordance with the overall University vision, we have two main strategic aims within UoA13:

(1) **Academic Excellence:** To deliver internationally leading research contributions and innovation via reporting, public engagement, peer reviewed publication, and graduating PhDs/EngDs.
(2) **Impact Excellence:** To evolve, deliver and leverage our research contributions through Knowledge Exchange (KE) - leading to impact in industry, the economy, and society.

UoA13 is committed to fundamental academic research as the platform for its strategy. As new concepts, ideas and topics emerge, PhD level projects are undertaken to deliver novel academic outputs. Our workflow is geared to nurture and expand our academic excellence through the research councils and other appropriate funders to sustain internationally-leading research programmes. To achieve this we lead and form partnerships with UK and international academics to build research teams through grants from the research councils, Government, industry and international agencies. We also influence the international research agenda through leadership within strategy setting bodies, e.g. the *European Energy Research Alliance*. In all of our research and associated activities, the mission of UoA13 is to deliver value in the form of one or more of the following routes (referred to as the *4P model* – see Impact Template for typical *modus operandi*):

- ***Peer reviewed Publications*** (conferences, academic journals and research texts;
- ***Proof of Concept*** (demonstration of new processes, procedures, and prototypes);
- Generation of ***Intellectual Property***; (generation of patents, licencing and know-how delivery);
- ***Development of "People"*** – (from research students through to senior academic staff, to deliver on our ambitions and to provide talent for industry, commerce and society).

b.1 Evolving the IERC - "Industry Engagement Research Centre" - model

UoA13's strategy is to build on our research successes and outcomes through industrial partnerships. This ensures that our research is meaningful, delivers impact and finds routes to knowledge exchange. Within single or multiple industry partner programmes, we leverage funding from the UK research councils (such as *EPSRC*), *European Union* (FP7), and Government derived sources such as *Technology Strategy Board* (TSB), *Scottish Funding Council* (SFC), and *Scottish Enterprise* (SE). The resulting *Industry Engagement Research Centres* (IERCs) ensure that fundamental research is translated into industry impact within a sustainable research environment.

In addition to delivering impact, we use the IERCs to stimulate new fundamental and novel research and to assist in attracting research council, and equivalent, funding streams. (See Section **d** for more IERC information.) An example is the SFC-funded IERC, *Scottish Sensors System Centre* (S3C, est. 2009), organised jointly with Glasgow, & Aberdeen Universities, and over 20 industry partners. S3C established a number of academic - industry projects in environmental sensing which stimulated new PhD projects, such as DSP signature identification of the 240 volt switch-on-cycle of electrical appliances, leading to automatic, grid-level appliance identification. This topic has further stimulated cross-disciplinary efforts; and via InstEE and CIDCOM, led to the creation of a new strategic senior cademic position on *Communications for Smart Grids.*

A recent example of how we have applied the IERC model in RE2014 is the multidisciplinary *Low Carbon Power and Energy Programme* (2013), which resulted from the consolidation of several successful PhD research projects, including UoA13-specific projects, and others undertaken with the departments of *Naval Architecture & Marine Engineering* (UoA12), and *Management Science* (UoA19). In 2013, this IERC programme secured £4.5M (2013-17) of industry funding with *Scottish Power plc*, *Scottish and Southern Energy plc* (SSE), and subsea construction company, *Technip plc*. Another REF2014 example of an IERC established following preliminary research projects is the *Centre for Wireless White Space Communications*, which was stimulated with two successful EPSRC CASE projects from 2008 on rural broadband with *Steepest Ascent Ltd* (a local UoA13 spin-out from 2004; acquired by MathWorks in October 2013). This has now evolved to a 7 industry partner centre co-funded by £0.5M SFC support, £0.5M TSB project support, £0.4M

industry support and engagement on Ofcom white space pilots programmes. Since RAE2008, 12 new IERCs have been formed resulting in the wide-ranging portfolio outlined in Figure 1.

b.2 Vision and Forward Planning

The 5 year vision for UoA13 is to build on our research and academic successes, and to achieve a consistent level of excellence in our areas of focus. We will do this by continuing to grow a portfolio of research that is industry relevant, industry supported, and has the potential to generate industrial, economic and societal impact, particularly in the areas of UK strategic priority. This encompasses research council, international funding and leadership of consortia. For example in 2013, UoA13 secured the leadership of two new *EPSRC Centres for Doctoral Training*: *Future Power Networks and Smart Grids* (with Imperial College) and *Wind and Marine Energy* (with Edinburgh). We will also diversify funding streams to increase grant income and impact. For example, we have made significant recent advances through charity-supported joint research, such as with the *NHS Institute of Hearing Research*, *Beatson Cancer Institute* and the *ROLEST lab HINS Light Electronic (Hospital) Sterilisation* initiative (jointly with UoA3), which have societal outputs in improving health and wellbeing at the point of care, but do not support industry directly.

Specifically, UoA13 aims to further strengthen engagement with a number of top tier industries in each core research grouping area, and grow our formal industry SME collaborations (currently representing around 40% of our industry collaboration) by at least 50% by 2018, i.e., from 35 to 50+ companies. In addition to leveraging schemes such as KTPs and EngDs, the University additionally supports these aspirations with co-funding programmes and pump-prime initiatives to both stimulate new SME engagements and expand on-going relationships, in line with its strategic focus on energy; health; smart cities; and manufacturing.

Our vision includes encompassing all existing and future critical mass IERCs in the University's £89M multidisciplinary *Technology and Innovation Centre* (TIC), which will be completed in 2014. As a core part of a technological University, UoA13 is at the heart of the activities across all of the TIC themes. In particular, the TIC embodies the essence of, and provides an environment to foster, industry-applicable research that has been the cornerstone of UoA13 for many years. The TIC environment will also accelerate our major research outcomes and impact, and allow the IERCs to seed new and grow existing RCUK and internationally funded research centres, with leverage from our industry partner base and provision of direct funding and in-kind support.

b.3 Progress against Plans Outlined in RAE2008

For RAE2008 (UoA24), the research plans were presented in a themed form, and specified for each of the 6 main research groups of Figure 1 (page 1). All the top level research groupings are largely sustained since RAE2008, apart from the "Institute of Comms and Signal Processing (ICSP)", which was restructured as two centres: CeSIP (focussing on signal processing: imaging, biomedical, algorithms), and CIDCOM (focussing on wired, wireless and fibre optics for communications and sensing). Below we review core plans from 2008 and the delivery:

InstEE stated a core plan in RAE2008 to "*grow the industrial partnership model of long-term programme-based Research Centres (and it) will be extended to other power utilities and equipment manufacturers*". Plans were actioned over the REF2014 period with 5 new IERCs now established (centres denoted '*' in Figure 1) along with leadership roles in two TSB-supported Catapult Centres: *Offshore Renewable Energy Catapult Centre;* and the *City Observatory* within the *Future Cities Catapult Centre*. **InstEE** has responded to national and international priorities over the REF period via the creation of major programmes in energy, such as the £9.4M *Power Networks Demonstration Centre*; *Low Carbon Power and Energy Programme* in the TIC (£4.5M, 2013-18, industrial supporters); the *Centre for Doctoral Training in Wind Energy Systems* [EPSRC, EP/G037728/1, 2009-18, £5.8M] ; leadership of the *Grand Challenge in Energy Networks* consortium programme "*The Autonomic Power System*" [EPSRC EP/I031650/1, 2011-16, £3.4M, 7 academic, 9 industrial partners]; and leadership of the smart grid theme in the *Energy Networks Hub* (HubNet). [EPSRC, EP/I013636/1, 2011-16, £4.7M, 5 academic partners].

CIDCOM (returned as part of ICSP in RAE2008) planned "*to open an industry Centre for Software Defined Radio*", which was achieved in 2011 via the creation of the *SFC (Scottish Funding Council) Centre for Wireless White Space Communications*, with a £1M portfolio and multiple industry partners including *British Telecom, BBC, Microsoft, MathWorks* and a number of SMEs. **CeSIP**

(also returned to RAE2008 as part of ICSP) planned further "*biomedical signal and image research*", which has been achieved with a range of REF2014 outputs and funded *NHS* partnerships on hearing research (*Glasgow Royal Infirmary*) and cancer imaging (*Beatson Institute*). **CeSIP** plans for "*further algorithm development in radar*" have been achieved via strong published outputs on MIMO radar [Weiss] and, in 2013, through new projects as part of the *Defence Science and Technology Lab (MoD/UDRC) Battlespace Network Centre in Signal Processing* [EPSRC, EP/K014307/1, 2013-18, £3.4M, 4 academic, 6 industrial partners] .

CMP presented plans in RAE2008 for "*extending the wavelength modulation optical spectroscopy technique to high temperature fuel cells",* and research on this topic has been extensively progressed through new academic recruitment [Lengden – ECR] and publication in the REF2014 period [Johnstone et al. – 20 Journal articles] with specific industry engagement from *Rolls-Royce Fuel Cells Ltd*., *BAEsystems*, *AWE Ltd*, *M Squared Lasers Ltd* and *OptoSci Ltd*. The CMP team lead the spectroscopy research in the *Fibre Laser Imaging of gas Turbine Exhaust Species Programme* (*FLITES*) which also involves Southampton and Manchester universities [EPSRC EP/J002178/1, £1.7M ,(£0.5M to Strathclyde), 2012-16] with *Roll-Royce*, *Shell Global Solutions plc* and four SMEs. The aim of FLITES is to measure gaseous and particulate species in aero engine exhaust plumes for engine, emissions and fuels diagnostics. Other **CMP** plans on "*integrating the technologies of microfluidics, optical MEMS and optical spectroscopy for research on bio-sensing"* came to fruition through new academic recruitment in the microfluidics/Lab-on-Chip research area [Zagnoni - ECR cross-disciplinary researcher returned on UoA3] generating new collaborations with Strathclyde's Pharmacy and Biomedical Sciences research community.

As reported in RAE2008, **CUE** established the second phase of the IERC "*UK Research Centre for Non-Destructive Evaluation (RCNDE)"* jointly with Imperial, Nottingham, Warwick, Bristol and Bath universities [EPSRC, EP/F017332/1, £2.7M, 2008-14] , and also in 2008 planned the IERC "*Facility for Innovation and Research in Structural Testing* (*FIRST*)". **CUE** planned to build on these activities and this was achieved during the REF2014 period through important grant successes (£1M of NDE-related equipment installed through an Equipment Grant [EPSRC, EP/G038627/1, £1M, 2009-13], and a Platform Grant [EPSRC EP/F017421/1, £0.9M]), building new research activities in the areas of wideband ultrasonic sensor design and novel signal processing modalities, and establishing new collaborations with University of Southern California and Krakow University.

IoP presented RAE2008 plans for "*capacity-building programmes*" to "*support new staff through to investigator status, expand already extensive international linkages and maintain the interdisciplinarity of the research*". Five major EPSRC awards were achieved during the REF2014 period [EP/K00042X/1 2012-16; EP/I029141/1, 2011-15; EP/I022791/1, 2011-16; EP/G042446/1, 2009-13; EP/F05999X/1, 2008-12] that have underpinned this plan, allowing five staff members to be brought through to Category A academic staff status, three via competitively-won fellowships. All of these posts are at strategic interfaces: three with life-sciences (working for example with Stanford and UC Santa Cruz), and two at the interface with Physics and Chemistry. This interdisciplinarity and internationalisation is further reflected in the setting up of two IERCs: the *Intelligent Lighting Centre* (jointly with Physics (UoA9) and Chemistry (UoA8)) and the UK's first '*Fraunhofer'– the Centre for Applied Photonics,* (both integrated with the *TIC* programme).

c People

UoA13 appoints new academic research staff with a strong research profile consistent with the University's strategic vision and excellence agenda, often supported by specific initiatives from SFC, EPSRC, and industrial funders who endorse this strategy. Careful consideration is given to identifying new opportunities in emerging areas, to building capacity, and to underpinning success. Since 2008, 18 academics have departed (7 retired, 8 left, and 3 to spinouts), with 17 recruited. Additionally, over REF 2014, 4 academic staff have reduced their research activities and focused on teaching and knowledge exchange. Salaried research staff are key contributors to our strategy, supporting the REF returned academic staff in their fundamental and applied research. At the REF census date UoA13 had 95 full time research staff employed supporting academics and 186 research students. UoA13 has a strong commitment to cross disciplinary research and, whilst most staff appointments are aligned with a specific research unit, appointments are also made across research units. For example, a recent Senior Lectureship appointment was made in the

area of the end-use of energy, spanning UoA13 and UoA12 (Aeronautical, Mechanical, Chemical, Manufacturing).

c.1 Staff Strategy, Staff Development and Funding / Recruitment

New Academic Staff Appointed since RAE2008: New lecturer positions are created on the basis of potential opportunities, and departing staff are not automatically replaced. Factors considered are alignment with major initiatives including RCUK calls/priorities, support from industrial partners, maintenance of core competencies in key areas, imminent opportunities for KE-enabling activities, and potential for inter-disciplinary growth. The post for *Catterson* [InstEE, 2012, National Grid] was created with industrial support, whilst *Mathieson* [IoP, 2011]**,** *Gunning***,** [IoP, 2011] and *Laurand* [IoP, 2010] were appointed as part of a package with the Scottish Universities Physics Alliance (SUPA) to develop critical mass at the life science interface. Other examples of strategic capacity building via new academic appointments are: *A. MacDonald* [InstEE, 2012, Wind Energy CDT]; *Roscoe* [InstEE, 2012, microgrids]; *Ren* [CeSIP, 2010, Hyperspectral Imaging]; *Wang* [InstEE, 2010, High Voltage]; Xu [InstEE, 2013, Power electronics]; *Lengden, Flockart* [CMP, 2012]; *Lubeigt* [CMP, 2010, Lasers]; *Windmill* [CUE, 2008, Bio inspired]; *O'Leary* [CUE, 2008, Ultrasonics]; *Zagnoni* [CMP, 2010, micro-systems for healthcare]; and *Strain* [IoP, 2013, Integrated Optics].

New Academic Staff Research Support: New academic staff appointed at Lecturer or Senior Lecturer level are assigned academic *Mentors* to support their development in research, KE, and teaching. New staff complete a period of probation, usually 3 years, during which they have a reduced teaching and admin load, and are given priority in allocation of PhD studentships in order to advance their research (see below). Academic staff appointed at Reader or Professorial level are also supported in their integration into Strathclyde over the first 3 years. Deputy HoD [*Marshall*] is responsible for staff development, induction of new staff, and monitoring progress.

c.2 Postdoctoral Researchers and Research Fellowships

UoA13 has a census date population of 25 postdoctoral Research Fellows, representing more than 25% of the total research assistant staff (95). These positions are all externally supported by research councils and/or industrial funding/endowments, and provide a bridge between research assistants / associates (RAs) and PhD students, and the academic staff leading the key research activities. UoA13 staff have been awarded prestigious fellowships that often allow the University to appoint an RF in a strategic area for 2 years or more, leading to academic status in time. During the REF2014 period, submitted staff have held awards from the *Royal Academy of Engineering* (2), *Royal Society of Edinburgh* (2), *European Research Council*, *EPSRC*, the *Scottish Universities Physics Alliance*, and the Stanford (USA)-Scotland *SU2P-RCUK* Science Bridges Programme.

Postdoctoral Researcher to Lecturer Career Path UoA13 has succeeded in nurturing aspiring researchers from within the University through to lectureship, and creating industry funded/co-funded academic positions. This strategy has been applied and evolved over 20 years, and in the REF 2014 period, 5 senior research fellows and UoA13 PhD graduates have been career managed into academic positions (*Catterson*, *Roscoe, Lubeigt, Lengden, Flockhart*). Currently five researchers are on the lecturer career path (*Crockett,* since 2009; *McMillan, since 2011; Murray*, since 2011; *Norman, since 2010;* and *West, since 2009)*. The model of structured growth and retention of key staff has been a strategy that has been carefully managed and supported for more than 25 years and is one of the key factors in achieving a sustainable and vibrant research environment in UoA13.

PhD studentships are made available as part of an overall strategy to continually grow the PhD population. There are a number of tranches: (i) support for a new and timely research project; (ii) support for an individual named star student; (iii) leveraging funding with external industrial support; (iv) support for high quality international research students; (v) the launch of new strategic directions and industrial relationships. These studentships are competitive at Faculty level, rank ordered at Department level, with new staff prioritised. On average UoA13 adds 22 PhD students per annum to the population through this mechanism. UoA13 studentships are supported by our EPSRC DTG funds, Departmental and Faculty finance and specifically leveraged industry financial support; more than 40% of our PhD studentships have industry support and engagement. Early career researchers and new strategic directions are all prioritised. UoA13 invests on average £350k per annum of Departmental funds to co-invest in and secure the studentships. Full support

is given to Industry CASE studentship and voucher schemes, and other initiatives to generate full PhD research studentships. The University has a Scottish Funding Council Outcome Agreement target of 1600 PhD students by 2015/16, and UoA13 will grow its PhD population by at least 12%.

Industry Funded/Co-Funded Posts: One key factor of UoA13's research is the strength, diversity and longevity of established industry links. Long-term research partnerships have resulted in the creation of posts fully or partly supported and endowed by industry, including: *Texas Instruments* [*Soraghan*, 2005-present]; *Xilinx Inc*. [Stewart, 2006-present]; *Raytheon-Systems* [Williams*,* 2011-present]; *National Grid* [Catterson, 2012-present]; *Rolls-Royce* [Ault, 2008]; *Scottish Power* [Judd, 2006, and Bell 2013]; and *British/EDF Energy* [Niewczas, 2006]. This interaction with industry has engendered an active, enthusiastic research culture where staff address research challenges of strategic relevance to partners, and acts as a gateway to further IERC engagement. For instance, *Texas Instruments* support the *Battlespace Network Centre for Signal Processing*, *Xilinx* support the *Centre for Wireless White Space Communications*, *Rolls-Royce* support the *Rolls-Royce UTC*, and *ScottishPower* are Tier 1 members of the innovative multi-partner *Power Networks Demonstration Centre* (PNDC), support the *ScottishPower Advanced Research Centre*, and are partners in the *CDT on Wind Energy Systems*. These industrial partnerships not only improve the research environment through ensuring the key challenges are understood and by increasing the number of researchers/facilities, but they have also allowed UoA13 to create a stable and sustainable research activity in key topics. For example, *Rolls-Royce* has continually funded the UTC for 16 years and EDF Energy has supported their *Advanced Diagnostics Centre* for 13 years.

c.3 Staff Development Schemes and Policies

Career development within UoA13 is underpinned by a number of Institutional, Faculty and Department based initiatives. Strathclyde's *Researcher Development Programme* (RDP) is delivered by our Faculties, Professional Services and external partners to offer academic and research staff (and including postgraduate research students a range of opportunities to continue their personal, professional and career management skills development. Established through utilisation of Research Council's '*Roberts'* funding, and now institutionally supported, provision is designed to help researchers enhance their generic skills, attributes and competencies for future employability both inside and outside of academia. New academics complete a PG Certificate in *Academic Practice and Researcher Development*, and the *Strathclyde Programme in Research and Leadership* provides development training and the *Research Induction Framework* supports colleagues in their early career. For example, Catterson and Roscoe took advantage of this as researchers to support their ambition of a transition to academic roles, and other researchers are currently being supported in the same way. The *Accountability and Development Review* (ADR) is an annual process for all academic and research staff, reviewing achievements and setting objectives in research, KE, and citizenship. The *University Equality and Diversity Policy* ensures that all staff are assessed and rewarded on the basis of merit, ability and potential, based on transparent criteria. All staff must abide by the University's *Dignity & Respect Guidelines*. Within UoA13 new academics and ECR staff are directly targeted by the Deputy Head of Department (Staff Development) [*Marshall*] for support sessions and mentoring on specific training and development opportunities. The success of the recruitment and career development strategy has led to formal external recognition of the processes and procedures during the REF2014 period: (i) the *European Commission* presented the University with the HR Excellence in Research award for its commitment to supporting researchers' personal, professional and career development; (ii) the University has been commended by *Athena Swan* for *Employment Practices* that specifically further and support the careers of women and holds an institutional Bronze Award; (iii) the University holds the **'***Double Tick*' award for employers who have committed to employ, retain and develop the abilities of disabled staff; (iv) the University was shortlisted for the *Times Higher Education* (THE) Award in 2011 and 2012 for 'Outstanding Support for Early Career Researchers.

c.4 Academic Staff Research "Loading":

The University has a general policy that no member of academic staff should be first supervisor for any more than 6 PhD students at any one time, although they may be second supervisor for more, but within reason. Early Career Academics benefit from a reduced and managed teaching load to ensure that they have sufficient time to develop their research portfolio, and would have at least a

50% reduced load. (For reference the average academic teaching load for research active staff within UoA13 is 1.5 x one semester classes (30 teaching credits), equivalent to around 36 lectures + tutorial, lab, and admin support per year per academic staff member.)

c.5 Doctoral Students

PhD/EngD Recruitment Process: The recruitment process for PhD scholarships across UoA13 is based on academic qualifications, but also on industry experience and notable successes. The competitive process means that most new UK graduate recruits have recently obtained a 1st Class Honours or MEng with Distinction; albeit a number of PhD students have some years of industry experience (some over 20 years). Overseas applicants may apply for study via the University's on-line application portal, providing a short précis of their intended research. Subject to acceptable qualifications and experience, the overseas applicant has then the opportunity to discuss their project outline through an interview with relevant academic staff. UoA13 has around 25% of PhD students from overseas, recently including China, France, Belgium, Germany, Colombia, Egypt, Spain, Malaysia, India, Pakistan, Mexico, Singapore, Nigeria, Iraq, Libya, Greece. The REF2013 census date registered PhD population is 186 within UoA13, and while modest growth of academic staff is planned (5-10% over the next 5 years), the aim is to grow the PhD population to 220 by 2016, and postdoctoral research fellow staff from 29 to 50 stimulated via the IERCs and the TIC environment in tandem. Further, with the appointment of directors and technology translator staff within IERCs, more senior and experienced staff will be in place to support the additional PhDs.

Academic Supervisors and PGR Assessment of Progress: 1st and 2nd supervisors are allocated to each postgraduate researcher (PGR) at the start of study. All supervisors are obligated to attend the relevant training module or have demonstrated previous PhD supervision at an appropriate level. For probationary staff, the second supervisor is a senior member of staff. New PGRs are provided with a comprehensive Postgraduate Handbook summarising expectations, generic objectives, and pragmatic aspects of management and day-to-day progress. PGRs are required to complete a 6 month progress review, and a panel of staff interview each student annually to assess academic and research progress based on a technical report and presentation.

Training and Facilities: All new PhD students attend a credit bearing Research Induction Course. The course outlines the University's research objectives, PhD progress procedures, presents exemplars of good research practice, the institution's publication and KE agendas, and ensures all PhD students clearly understand and embrace the University research environment, ethics and expectations. PGRs must also secure at least 15 taught credits (150 hours) as a formal requirement of their PhD degree (increasing to 60 credits in 2013/14 in line with EPSRC guidelines). The Engineering Faculty offers support courses for researchers, covering topics such as publishing a first paper, writing a thesis, time management etc. All research staff and students are allocated a dedicated office and/or laboratory space, and access to the facilities of the extended research group, including administration and IT support.

Engagement, Presentation Skills and Teaching Experience: In addition to the formal credit requirements, an annual Faculty Research Presentation Day (FRPD) is organised by a team of PhD students providing early stage students experience of presenting in the mode of a conference (i.e. via a poster or oral presentation). PGRs are required to formally present at Departmental seminars in the 2nd and/or 3rd years of study. Further (optional) opportunities exist for postgraduate students to learn teaching skills for Teaching Assistant (TA) positions (laboratories, demonstrations and grading) and undergraduate tutorial supervision opportunities. Involvement in IERCs also exposes the students to project management, presentations and formal reporting.

d Income, Infrastructure and Facilities

UoA13 supports all academic staff in funding their research from various sources: (i) *UK funding councils*, particularly EPSRC, SFC (Scottish Funding Council); (ii) *Industry and Government Agencies* – e.g. TSB, SE (Scottish Enterprise), MoD; (iii) *International Agencies* – e.g. EU; (iv) *University funds*; (v) *Societies and Charities* **–** e.g. the Royal Society of Edinburgh (RSE), NHS Trust. At the REF census date, UoA13 has 16 EPSRC active grants, worth >£22M. Total research spend over the REF period was £42M, with more than £10M of this being direct funding from industry, and £24M from research councils. A further £2M of in-kind support was also procured.

Research proposals are managed by our *Research and Knowledge Exchanges Service* (RKES)

directorate. Where necessary, RKES will draw up a custom contract – including IP arrangements – based on *fair and reasonable* terms. A clear process for IP is particularly important in multi-company IERCs, and Strathclyde's RKES has very successfully developed a portfolio of models and IP agreements applicable to various industries and research partners.

d.1 Knowledge Transfer and Impact Acceleration Projects

UoA13 was awarded a £2.6M Knowledge Transfer (KT) Account [EPSRC, EP/H50009X/1, 2009-12] - the *Strathclyde KT Escalator* - to advance research outputs to the next level of industry engagement. The programme successfully strengthened the culture of research exploitation by providing targeted internal training, venturing opportunities, and industry-academic joint funding. The activities included the Uo13 areas of power, energy, electronics and communications, and also cross-disciplinary activities in chemical engineering, biotechnology, advanced manufacturing, healthcare, and management science. Within UoA13 the project engaged with 9 SMEs and large companies/enterprise (including *British Telecom*, *David Brown Gear Systems*, *Smarter Grid Solutions*), and unlocked significant additional funding and support for spin-out companies and IERCs. As a follow-on to this grant, in October 2012 EPSRC awarded the university a 3 year grant of £1.8M for an "*Impact Acceleration Account*" [Management Science, EP/K503861/1, 2012-2015], to work on a cross disiplinary approach with UoA13 and others, and to engage with partners to generate impact from industry driven research. To date there are 4 UoA13 projects funded from this grant via a secondment to *Rolls-Royce*, research engagement with *Silverwing (UK)* and *Spirit Aerospace*, and work with Microsoft for an OfCom wireless pilot project in Glasgow.

d.2 Investment/Funding in Infrastructure & Facilities

Infrastructure and facilities investment has benefitted a wide range of research activity within the 6 themed academic research groupings and specifically for many IERCs (see Figure 1):

InstEE - Power Networks Demonstration Centre (PNDC): The *PNDC* facility is a purpose built research centre opened in 2013. The *PNDC*, the first of its kind in Europe, was established in response to growing demands for secure, reliable and low carbon electricity via advanced technologies. On top of the £9.4M (2011-13) construction phase funded by SE and SFC, the Phase 1 research and development programme (£4.5M, 2013-18) is being funded by SSE, Scottish Power, S&C Electric, Alstom and Omicron. The planned research staff population is 20 by 2015, plus additional PhD and EngD student engagements.

InstEE - GSE Systems Simulator: The *GSE Systems Power Station Simulator* is a £2M facility providing high-fidelity simulation of the control room within a generating station. Configurable to cover a wide range of technologies, including combined cycle gas turbine and nuclear generation, it gives users an immersive experience of operating a power station. The facility provides a research platform for advanced decision support technologies, real-time simulation, and control, operation and condition monitoring of electrical plant.

InstEE – Rolls Royce UTC in Electrical Power Systems: This University Technology Centre (UTC) is responsible for providing Rolls-Royce with strategic and applied research to support aero, marine energy, and electrical activities. Rolls-Royce invests approximately £290k per annum in the centre, in addition to financial and in-kind support of a range of projects (EPSRC, EU, and TSB) and wider initiatives, including the UoA12 IERC, the *Advanced Forming Research Centre* (AFRC). This centre represents the very essence of a successful UoA13 industry engagement research centre model - it has been in existence now for 16 years, with a sustained staff of research fellows, academic staff and PhD students.

InstEE - Centre for Doctoral Training (CDT) in Wind Energy Systems: This centre was established in 2009 with a £5.8M grant [EPSRC, EP/G037728/1, 2009-18], and now supports over 40 PhDs working on cross disciplinary areas of wind energy including economics, gearing, control systems, distributed power, and data processing. The Centre engages with utilities, manufacturers and SME companies on managed research projects. It has been awarded further funding (2013) as a *CDT in Wind and Marine Energy Systems* (with Edinburgh University) from 2014.

InstEE - Robertson Laboratories for Electronic Sterilisation Technologies (ROLEST): Established in 2004, *ROLEST* is a unique research facility, a collaboration between EEE, Biomedical Eng, and Institute of Pharmacy and Biomedical Sciences returned in UoA3 (*MacLean*, *Anderson*) for REF2014 and engages with the NHS, and food and drink companies. Its core

facilities include a unique £2M 'Category A' interdisciplinary lab with pulsed-power sterilisation and microbiological equipment. (The ROLEST HINS-light project to kill pathogens such as MRSA in clinical environments received *The Times Higher Education Research Project of the Year 2011*.)

InstEE – D-NAP: The £1M experimental facility "*Distribution Network and Protection Laboratory*", D-NAP, comprises a 100 kVA microgrid that can operate grid-connected or variously islanded, integrated with a real-time digital network simulator and protection injection laboratory. The facility offers hardware-in-the-loop capability, and incorporates induction machines, programmable load banks and various 1/3 phase inverters. The facility supports a range of international academic and industrial programmes and has been expanded to incorporate a communications system simulator for testing of smart grid technologies. It supports basic research, Rolls-Royce UTC activities, and engagement with European research organisations via the EU *Distributed Energy Research Infrastracture* (DERri) and *Distributed Energy Resources Laboratories* (DERLab) programmes. Strathclyde is the most accessed lab in the DERLab transnational access programme (which features academic/national labs from partner counties). *Burt* is a board member of the 23 member international DERLab association, ensuring influence in European strategy in this field.

InstEE – David Brown Gear Systems/Sgurr Energy Centre for Condition Monitoring. The *Centre for Advanced Condition Monitoring* is a partnership between the University, *Sgurr Energy*, *David Brown Gear Systems*, and *Scottish Enterprise (SE)* to develop innovative techniques to improve the availability of offshore wind farms and to reduce the need for expensive reactive, offshore maintenance. SE funding has underpinned the development of a unique gearbox and rotating machinery laboratory for testing sensors and condition monitoring systems.

CIDCOM/CeSIP - Wireless White Space Communications Centre: The industry-driven Centre is supported by SFC (£480k) with £500k matched funding from industry, EPSRC and TSB grants. White space refers to the available spectrum in the former analogue TV bands to be licensed by Ofcom for communications services in 2014. The Centre currently supports 6 PhD students, each with 40% funding support from an industrial sponsor and has run TSB/industry co-funded projects with partners including *British Telecom*, *BBC*, *Xilinx*, *Motorola*, and *Microsoft*. The Centre is overseen by an industry advisory panel (chaired by a senior *Microsoft* consultant with representatives from Ofcom, industrial collaborators, and SFC). The Centre has a high profile and widely recognised White Space network on the Isle of Bute, and a demonstrator network in Kenya.

CIDCOM – Scottish Sensors Systems Centre (S3C): This £1.2M centre, set up in 2011 jointly by Strathclyde, Glasgow and Aberdeen Universities, is supported by SFC and industrial partners. The research utilises artificial intelligence based models, supported by a wireless communications platform, enabling applications within many industry sectors. Companies actively engaging with the Centre include *BP, Freescale, IBM, Network Rail, SSE, Thales, SELEX* and *Scottish Water*. In 2013, the S3C project was extended into a new centre – CENSIS – a new SFC flagship IERC, *Centre for Sensor and Imaging Systems* working with Scottish Universities and local industry.

CeSIP – Hyper-spectral Imaging (HI) Centre: This centre, set up in 2009, is the first of its kind in the UK. It delivers interpretation and turnkey solutions for industry and the public sector, working jointly with industrial partners *Gilden Photonics*, *Hamamatsu* and *Specim.* Hyperspectral imaging can measure multiple variables including temperature, chemical composition, and levels of moisture, fat and sugar. This has led to a highly multidisciplinary IERC working with meat producers, food and drink companies, and health services. Recent projects include classification of Chinese tea samples, food/beef quality, polymer identification, and ocean remote sensing.

CeSIP - DSTL/EPSRC Signal Processing Solutions for the Networked Battlespace: The 5 year IERC, established in March 2013, is a unique consortium of four Universities (Loughborough (managing partner), Surrey, Strathclyde and Cardiff) and six industrial partners (QinetiQ plc, Selex-Galileo plc, Thales plc, Texas Instruments Ltd, PrismTech Ltd and Steepest Ascent Ltd). The Centre has £3.6M of grant funding derived from DSTL/MoD [via *EPSRC, EP/K014307/1*) and £1M cash and in-kind support from industrial partners. The aim is to develop transformational signal processing solutions to the benefit of DSTL, the MoD, and the UK in general. A key aspect of the Centre's operations is secondment of research staff and students to the labs of partners.

CUE - Research Centre in Non-Destructive Evaluation (RCNDE): Strathclyde is a core member of the *RCNDE* (with Imperial, Nottingham, Warwick, Bristol and Bath, originally set up in 2003, with

a second £15M phase that commenced in 2008). The group works with a broad spectrum of industries including aerospace, power generation, nuclear, oil and gas, manufacturing and instrumentation. It encompasses 16 full industrial members and >30 associate members (75% SMEs) from NDE service providers. The Centre is industry driven and, in addition to the core EPSRC research funding, provides industrial collaboration through targeted EPSRC/RCNDE and EngD projects. RCNDE has a Strategic Partnership with EPSRC and manages the IDC in NDE.

CUE – Bio-Inspired Transduction/Signal Processing: An EPSRC Platform Grant (2008-2012) was instrumental in developing new bio-inspired transduction and signal processing technologies and led to further grants totalling £7.7M (of which direct CUE funds were £3.6M) secured from EPSRC, BBSRC, EU, TSB, Royal Society and industry. A number of new international collaborations have been established including exchange visits with the universities of Krakow, , UC Berkeley, Toronto, Paris, and also the Fraunhofer Institute and Los Alamos Labs.

CUE - Facility for Innovation and Research in Structural Testing (FIRST): FIRST was opened in 2009 through a University investment of £300k in infrastructure and £1M from EPSRC for NDE-related equipment [EP/G038627/1]. This has provided additional capability for NDE research and is central to the strategic plans for both research and KE within this important industrial sector.

IOP – Intelligent Lighting Centre: This cross-disciplinary IERC (IOP-led with CIDCOM (also UoA13), Physics (UoA9), and Chemistry (UoA8)) researches new technologies such as visible light communications, working closely with industry in the strategically vital solid-state lighting sector. UoA13 underpinning comes from major EPSRC Programme [EP/K00042X/1] and EPSRC Platform [EP/I029141/1] Grants (£5.6M in total for all partners).

IOP – Fraunhofer Centre for Applied Photonics (CAP): The UK's first Fraunhofer centre was established at Strathclyde in 2012. Following the successful model that has made Fraunhofer the largest applied research organisation in Europe, CAP is independent but led by a UoA13 Professor [*Dawson*] and closely aligned to the research of the partner University. CAP provides industry-driven photonics R&D in sectors such as security, healthcare and energy. In less than a year it has secured competitively won funding of £1.6M and grown to 12 staff, with plans to expand to 80 staff and doctoral students by 2016. This is underpinned by £9M of investment over 5 years from the Scottish Government, the Fraunhofer Gesellschaft, and the University, and has led to the co-location at Strathclyde of *Fraunhofer Research UK Ltd*, the umbrella body for Fraunhofer in the UK.

d.3 Endowments, Research Consulting Projects, and Professional Services

UoA 13 has received support from a number of endowed academic and research positions over the REF period: *SSE plc* endowed a research fellowship; *Xilinx Inc* has endowed Professorial Chair [Stewart] in Digital Signal Processing; *Texas Instruments Inc* endowed the TI Chair in Signal Processing [Soraghan], *Raytheon Systems* endowed academic research [Williams] and Rolls-Royce endowed an academic researcher post. More than £1M of endowed funds were received over the REF period. Also in 2013 *Scottish Power* set up a Professorial Chair in Smart Grids [Bell].

ITI Techmedia – Livestock Wireless Sensor Condition Monitoring: CIDCOM received funding (2006 to 2010) of £700k from *Techmedia* (an office of Scottish Enterprise) on condition monitoring of livestock via wireless sensor based asset tracking. The output of these projects consisted of patents, and led to the formation of the Strathclyde spin-out company [Andonovic, Michie], *Embedded Technology Solutions (ETS) Ltd* (2009). ETS then structured a multidisciplinary £1.3M TSB project with Strathclyde (CIDCOM) and partners (*Morrisons, Scottish Agricultural College, Harbo, Well Cow*) on animal health services platform and transponders to replace cattle passports.

Energy Technology Partnership (ETP): InstEE led the establishment of an innovative alliance of the 12 Scottish universities, whose purpose is to stimulate increased capacity and capability in energy R&D. ETP is structured via pooling of resources and equipment, sharing of major facilities, competitive dispersion of a £3M European Regional Development Fund (ERDF), and the provision of a single "shop window" for the research outputs of the universities. It is an excellent exemplar of the Strathclyde and UoA13 endeavour to support academic-industry engagement, particularly with SMEs. At the REF census date 6 companies have engaged with UoA13. The ETP also supports Strathclyde UoA13 research through co-funding of 3.5 year PhD studentships (currently 7, and equal funding split between ETP, industry partner and a Faculty/UoA13 contribution).

General Consultancy and Professional Services: UoA13 research staff have provided over

£2.6M of consultancy and services rendered for industry and government offices in the REF2014 period. This ranges from more than 30 (typically sub-£10k) industry consultancies with SMEs including *WFS*, *Touch Bionics, Encompass* and *Helia Photonics*, as well as larger organisations such as *Freescale, MBDA*, BAeSystems, *Samsung*, *Envirotec*, *Wolfson Microelectronics*, *Brookes-Bell, GE*, *Scottish Power*, *Kema*, *Clyde Union*, *Doosan Babcock, Element6, M-Squared Lasers, Singapore Power Grid, DMS Ltd, Gamesa, Mitsubishi, Mott-Macdonald, AWE, National Grid, RES, Hammerfest-Strom, Raytheon* and *Alstom*. Many of the SME engagements are often co-funded by *Scottish Enterprise*, the *Energy Technology Partnership*, and the *Scottish Sensor Systems Centre*. The funding received for these activities is re-invested to support expansion of UoA 13 research.

e Collaboration and Contribution to the Discipline or Research Base

Notably, Strathclyde was named the Times Higher Education (THE) University of the Year, 2012, with the citation lauding ***"..its close links with business and industry and its commitment to making an impact on the global economy…".*** Judges summarised the University as a "*bold, imaginative and innovative institution*". UoA13 is an exemplar of a bold and innovative academic unit, driving forward a strong and consistent strategy of underpinning research activities, aiming to evolve and manage world class IERCs, led by academic staff empowered to progress core research and fully engaged with both the academic and industrial communities. The Strathclyde *Technology and Innovation Centre* project will be the physical embodiment of this strategy with 35 IERCs from across the university located in the 25000m^2 custom-designed building.

e.1 Research Collaborations

This document has detailed our extensive collaborations. UoA13 uses collaboration strategically to ensure that the research environment is vibrant, sustainable and internationally leading, and to develop new directions. Industry collaboration ensures that the knowledge base is current and the key challenges are understood, offers routes to fully/co-funded research growth and sustainability, while providing career-shaping training for students and researchers. UK wide academic collaboration ensures that our scholarship is recognised by our peers and that we influence national policy and directions. In addition, international collaboration is a priority to ensure that our scholarship influences, and is influenced by, the best researchers globally. As an example, the international partnership between InstEE and Rolls-Royce (Indianapolis) on novel aero-electrical architectures has led to their involvement in the NASA RTAPS 2013-14 project.

e.2 Visiting Professors, Scholars

UoA13 External Visiting Professor Appointments: Several UoA13 academic staff hold active visiting professor or research/KE exchange positions in external institutions including: *Infield* (North China Electric Power 2011-16); *Judd* (Huazhong Univ, China 2012-15); *Williams* (ZheJiang Univ China, China 2013); *Siew* (Shandong Univ 2007-10); *Andonovic* (Princeton Univ, USA, 2008); *Anaya-Lara* (DNV Visiting Professor in Wind Energy / Senior Scientist with SINTEF, Trondheim, Norway, 2010-11); *Stewart* (University of California, Los Angeles, 1996-13); and *Gu* (Wuhan Univ. of Technology, China 2007-2016, Peking Univ., China 2013-2016). These engagements allow periods of sustained collaboration to evolve research topics, and are supported variously by the respective Universities, the *Royal Society*, *EPSRC Science Bridges* and other sources.

UoA13 Visiting Professors (VPs): There are currently 20 esteemed and pragmatic individuals from senior positions in industry and other institutions who have been appointed to UoA 13 as Visiting Professors (VPs). VPs visit regularly, deliver seminars, mentor/advise early career researchers, enthuse young research staff and support specific research endeavours, applications for funding, and generally the promotion of Strathclyde UoA13's activities. Many VPs also have a steering group role on our various IERCs. Appointments during the REF audit period include: *Dr Ken Stewart* (Chief Wireless Technologist at Intel Inc, 2010-); *Dr Sanjay Jha* (CEO Motorola Mobility, 2008-12); *Dr Gene Frantz* (Texas Instruments Inc, 2008-13); *Dr Malcolm MacLeod* (Chief Scientist, Qinetiq plc (2007-); *Frankie Garcia* (Principal Managing Engineer, Agilent Ltd, 2006-); *Prof Moshe Kam* (IEEE President, 2012 & Drexel University, 2013-); *Jennifer Cooper* (National Grid, 2004-); Prof *Ed Dougherty* (Texas A&M University, USA, 2008-); *John Gilchrist* (Gilden Photonics, 2010-); *Ignacio Galan* (Chair and CEO, Iberdrola, 2011-); *Dr Chris Scruby* (Imperial College, 2004-); *Francisco Montero De Espinosa Freijo* (Spanish National Research Council, 2004-); Prof *John Hossack* (Univ. of Virginia, 2004); *Mike Graham* (Imperial College, 2013-); *Ian*

Irvine (SgurrEnergy, 2013-); *Duncan Botting* (Parsons Brinckerhoff, 2008-); *Dr Oscar Lazaro* (Innovalia, Spain, 2013-); Prof *Kevin Warwick* (Univ of Reading 2006-); *Andrew Mill* (National Renewable Energy, 2012-); *Gerry Docherty* (Innovation Centres Scotland, 2012-); *Natasha Maurits* (Univ Medical Center Groningen, 2013-); *Dr David Clark*, (Thales Optronics); *Dr Chris Dorman* (Coherent Scotland); *Dr Graeme Malcolm* (M Squared Lasers); *Dr Frank Turnbull* (Honeywell); *Dr John Nicolls* (TMRI Ltd); *Prof Erwin Bente* (TU Eindhoven) and *Dr Tom Baer* (Stanford).

UoA13- Visiting Scholars: UoA13 has hosted a number of visiting scholars on funded programmes who have spent extended periods at the University. These include *Dr Dejan Vukobratovic* (University of Novi Sad, 2009-10) through a Marie Curie Fellowship grant; *Prof Mike Hoffman* (University of Nebraska, 2008), on Software Defined Radio; *Prof Guo Peng* (2011, North China Electric Power); *Prof. Subhas Mukhopadyay* (2012, Massey University); *Prof. Takashi Matsuyama* (Kyoto University, Japan, 2012); *Prof Andrea Tonello* (Udine University, Italy) on a Royal Academy of Engineering Distinguished Visiting Fellowship Scheme.

e.3 **Listing of Selected Key Academic Leadership Roles, Contributions and Recognitions**

InstEE*:* *J. McDonald*: Chair of Scottish Research Partnership in Engineering, Scottish Energy Technology Partnership, Glasgow Science Centre, and Independent Glasgow Economic Leadership Board; member of SE Board and UKTI Energy Excellence Board. Co-chair (with the First Minister) of the Energy Advisory Board in Scotland. Vice-President of the UK IET. Knighted in 2012; FREng, FRSE. *MacGregor*: IEEE Peter Haas Award, IEEE Nuclear & Plasma Sciences Society, 2013; Times Higher Education University Research Project of the Year, 2011. *Galloway*: Deputy Editor IET Electrical Systems in Transportation; *Infield:* EPSRC Engineering College (2000); member of RCUK Energy Research Advisory Board; Editor in Chief of IET Renewable Power Generation (2006-); member of EU Wind Technology Platform (2006-); *Burt:* UK lead for European Energy Research Alliance Joint Programme on Smart Grids, with *Leithead* UK lead for Joint Programme on Wind Energy. *Judd:* Member of Steering Board, EPSRC Energy Harvesting Network, 2010-13; Chair, Universities High Voltage Network, 2012-14. *A. McDonald:* Assoc. Editor, IET Renewable Power Generation, 2012; *Niewczas:* Distinguished Lecturer, IEEE Instrumentation and Measurement Society, 2009-10; *Finney*: 1st prize for paper IEEE Trans. on Industry Applications; *Katebi*: Chair of IEEE Rolling Processes Committee; Chair of IEEE Metal Processing; *Bell:* Deputy Chair, Technical Programme for Power Systems Computation Conference (2011-).

IoP: *Dawson:* Fellow IEEE; Head of Centre, Fraunhofer Centre for Applied Photonics; Strategic Advisory Committee for EPSRC ICT; Fellowships Committee of the RSE; Aron Kressel Award Committee IEEE Photonics Society; Programme Chair, IEEE Photonics Conference, 2013. *Gunning:* Royal Academy of Engineering Research Fellowship 2011-16; *Mathieson,* (SU2P-RCUK-funded Visiting Research Fellow at Stanford 2009-11); *Hastie*: (EPSRC Challenging Engineering Fellowship, 2011-16); *Kemp*: (European Research Council Starting Grant 2011-2016); *Laurand*: (Scottish Universities Physics Alliance PaLS Research Fellowship 2010-13).

CIDCOM: *Andonovic*: Director Glasgow Research Partnership; Editor Optical Devices and Networks of the IEEE Transactions in Communications; IEEE Photonics Conference; Topic Chair;. *Glesk:* Editorial/Advisory Board Journal of Optics, Optica Applicata*;* *Stankovic:* Editorships: IEEE Trans on Communications; IEEE Trans on Image Processing, IEEE Comms Letters (2006-12); TPC Chair of Eusipco-2012; Symposium Chair of IEEE SmartGridComm-2013; Executive Team Member of IET Image & Vision TPN (2010-13); Guest Editor of EURASIP Journal on Advances in Signal Processing Special Issue. *Stewart:* General Chair and Organiser, EUSIPCO 2009.

CUE: *Windmill:* Managing Editor for the Journal of Remanufacturing; Conference chair, Invertebrate Sound and Vibration (ISV 2013); Fellow of the Royal Microscopical Society.

CMP: *Uttamchandani:* Editor-in-Chief, IET Micro and Nano Letters; Programme Committee, IEEE MEMS 2013; Optical MEMS and Nanophotonics conference series 2010-13; Editorial Board Member, IEEE E-Learning Library.

CeSIP: *Marshall*, Editor of EURASIP Journal on Advances in Signal Processing; *Weiss*, Technical Programme Chair EUSIPCO 2009 & European DSP in Education and Research conferences (EDERC) 2010, 2012; Associate Editor for Elsevier Signal Processing (2005-8); IEEE Transactions on Mobile Computing (2006-9), and the International Journal for Communications.