Institution: University of Abertay Dundee
Unit of Assessment: 15 General Engineering

a. Context

This Unit integrates research expertise over 4 (of 5) academic departments to deliver engineered solutions to real-world problems. The Unit is underpinned by research in engineering, modelling and simulation, human computer interaction, and materials surface science: Unit groups are **Engineering**; **Interactive Media**; **Security**; **Modelling & Simulation**. This Unit sits in the context of a University research agenda that drives a small number of focused, inter-disciplinary groups:

- SIMBIOS (Scottish Informatics, Mathematics, Biology and Statistics Centre) linking complex behaviour of individual organisms and the bio-physical structure of their environment;
- UWTC (Urban Water Technology Centre) providing research and consultancy services to UK and international water industries;
- CCSB (Centre for Cancer Systems Biology) a partnership with St Andrews and Edinburgh Universities combining complex systems modelling and interactive visualization;
- WhiteSpace, a cross-University research group integrating computer arts, computer science, psychology, sociology and environmental sciences;
- I-SPI (Investigation, Security, Policing and Intelligence) integrating the disciplines of forensics, computer security, psychology, sociology and law to deliver real-world impacts.

Working as part of these University groups provides the Unit with impact pathways to the stakeholders with which these groups interact. For example, UWTC gives us significant reach into City Councils; I-SPI supports links to UK Government agencies; CCSB and WhiteSpace have strong links to commercial industry. Moreover, the mix of disciplines that make up this Unit and these University groups means that we are able to build teams to suit industry demand. We have identified and interacted with the following groups, as detailed in our approach to impact below:

1. UK Government: we have worked with the UK Government in **Security** (in collaboration with the Home Office we have developed novel techniques for recovery of forensic evidence from fabric) and in **Interactive Media** (providing an evidence base to HM Treasury on tax relief);
2. International industry partners: e.g. in **Interactive Media** we have sustained interactions with global technology company NCR Corporation (Impact Case Study) and a new collaboration with 20th Century Fox on technology for film production (see below);
3. National industry/ trust partners: e.g. in **Modelling & Simulation** we worked with NHS Tayside to develop modelling approaches originally conceived for gene flow in plant systems (SIMBIOS) to study hospital acquired infection spread within wards (KTP project);
4. Local planning authorities: in **Engineering/Interactive Media** we work with local councils and other government bodies on sustainable urban planning (see Impact Case Study);
5. Society and Public Understanding: we are very active in dissemination to societal groups including politicians, industry representatives and bodies, lay audiences and schools.

Our work is stimulated by an overlapping interest between our research direction and stakeholder needs. Our commitment to impact is motivated by a desire to contribute to the sustainability of the national environment and economy. We recognise the virtuous circle that undertaking industry-facing activity promotes: research with impact offers a diversified funding portfolio to allow us to:

- Develop core research competencies (with industry problems as exemplar case studies);
- Stimulate new teaching provision, e.g. Security-based KTPs with NCR have underpinned our successful UG and PG provision in Ethical Hacking and Countermeasures;
- Ensure industry involvement in the design and delivery of our taught programmes to help make our programmes vibrant and relevant, which is essential in our operating context.

b. Approach to impact

The Unit is well geared for impact and we adopt a differentiated approach to interacting with stakeholders, mixing long-running partnerships, formation of new relationships, agile responses to new opportunities, marketing of our work and working with well established Abertay RKE groups. In all cases we seek to maximise the impacts and benefits to the stakeholder and ourselves.

Our most impacting work is founded on **long-running partnerships** with stakeholders. E.g., our two impact case studies are founded on ~15 and ~7 years of interactions with NCR and Dundee City Council respectively. In the case of NCR we have in the past provided a steady supply of

graduates, and undertaken several KTP projects (e.g. computer system security, display technologies). This relationship, together with our world-recognised capability in computer games, gave NCR confidence to invest in virtual agent design for self-service checkout (£185K). This Unit has also been a major contributor to an impact case study in UoA5 Biological Sciences, where in partnership with CCSB and Optokem Ltd. / Norton Scientific Inc. – again a ~15 year partnership – we re-engineered a lab bench-sized protein aggregation monitor such that it was a hand-held device which needed only small volume samples: this is now a marketable product.

Importantly, we do not depend on this length of interaction for all our impact, as our reputation to deliver in key areas can attract company interest. For example, a **new partnership** with Macphie, an innovative food and drink company, was stimulated by our recent Food Innovation @ Abertay agenda. This is a KE channel that has helped to develop creative solutions for >140 companies. On a project co-funded by Macphie and Interface Food & Drink (£30K) we have developed an interactive software product to support sensory analysis for testing food products that Abertay will co-license. Again, based on track record, we have recently begun a funded project (£100K, co-funded by Interface Food & Drink) with Agrico, an international potato growing company (2011 turnover of €208M) who are seeking innovative modelling, simulation and interactive visualization to profile aspects of company activity (this work is currently in development).

This latter example serves as an example of our **agility to react to opportunities**. Agrico saw some adjacent work of ours (on cell signalling visualisation) and engaged with us in discussions based on their business needs. We then built a mixed-discipline team to address those needs. In addition to us working with collaborators in, we also push our innovations out. For example, work initially developed by internal pump-priming funding led to a prestigious Royal Society of Edinburgh Scottish Enterprise Fellowship to develop a new kind of interaction device for virtual environments. Through **publicity in digital media channels** (YouTube) we entered into a collaborative agreement with 20th Century Fox to allow them access to the technology developed in the Fellowship. Fox used the technology as part of their production pipeline for a blockbuster film (not yet released). The Unit has also contributed to the **well-established UWTC group** and this gives us impact beyond our size. E.g. UWTC leads the ERDF-funded LoCal-Net network to coordinate R&D and innovation in low carbon activities for SMEs across Scotland. Project staff (to which we contribute) visit SMEs to identify areas where partnership working would progress R&D or innovation projects; To date LoCal-Net has helped 123 SMEs to develop innovative products and services that contribute to reduced greenhouse gas emissions, protecting 4 jobs at SMEs.

This kind of activity, including the RSE Fellowship, a Royal Academy Industrial Secondment to NCR and other Innovation awards, are important to Abertay. Our impact-related research is typically non-FeC and so requires internal investment. Heads of School for this Unit are supportive of industry engagement, recognising the virtuous circle outlined above. Staff are supported by both senior staff and our Research, Enterprise and Innovation Services Office on costing and approvals of applications for external funding and management of IPR. Abertay's staff appraisal system and workload planning model aligns personal objectives with the University's research objectives and impact-generating activities are an important element of Abertay's core business. The Unit recognizes the importance of public understanding and engagement in STEM. In the period Abertay employed 2 STEM outreach coordinators to coordinate outreach activities across the University. Staff in the unit have contributed directly to outreach programmes, including:

- In **Security** we have delivered Scotland-wide Christmas lectures (2012, 2013) in cyber-security to promote awareness of security issues to school children;
- In **Modelling & Simulation** we developed training and teaching materials to enable school teachers to use Raspberry Pi platforms for teaching programming in secondary schools;
- The Tayside Space School targets primarily the P6/7 year audience, delivering a series of events with the support of a NASA astronaut and Educator (approx. 500 pupils selected from 20 schools), supported by staff from **Interactive Media**;
- Café Science: co-organised by Unit staff across institutions in Dundee;
- Research was demonstrated to eminent visitors (incl: Alex Salmond; David Gani; Alistair Darling; John Swinney; David Willets).

c. Strategy and plans

Our impact strategy is integrated into a new 5-year Abertay-wide RKE strategy, founded on 4 cross-Abertay themes (Environment, Security, Society and Creative Industries). These themes recognise our major income streams, which includes a substantial fraction of KE. Our RKE strategy management team includes theme leaders that are very experienced in KE provision. For Abertay the R->KE link is an essential element of this 5-year strategy. We are providing internal pump-priming funds to stimulate KE activity to enable researchers to attract external funds.

In this Unit we will combine Unit-led R->KE with Unit activities that supported impact in our larger research groups. In our Unit group **Security** we will drive development methodologies and toolkits to enable industry to (i) optimize forensic evidence recovery in materials with multiple, diverse types of forensic evidence, in partnership with stakeholders including the Home Office; and (ii) systematically mitigate security risks in computer systems in partnership with current providers of cyber-security services (we have already initiated one such project). In both cases we expect to generate KT income from wider uptake by the industry. For **Interactive Media** and **Modelling & Simulation** our target it to integrate our research-base to construct a combined modelling-simulation-visualisation framework to enable key stakeholders to explore multi-scale complex systems modelling in key stakeholder sectors. We currently anticipate these to be:
- The <u>consumer experience</u>, especially in self-service, and particularly our partnership with NCR;
- <u>Food & drink</u>, where we have an extensive industry network into this sector on which to build;
- **Engineering**, where through strong industry networks we will continue to enhance environmental sustainability;
- <u>Cancer system biology</u>, especially in tools to understand drug action at both cellular and tissue scales in partnership with the Lothian Health University Hospitals Division (REF UoA5).

We will also respond to new developments nationally. SFC are supporting new pathways to stimulate industry-academia partnerships by funding Innovation Centres in the areas (among others) of big data (Data Lab, under negotiation) and healthcare: Digital Health Institute (DHI, £11M) and Stratified Medicine (£20M)). Our modelling-simulation-visualisation framework is well aligned to the Data Lab (creative industry solutions to big data problems) and Stratified Medicine (cancer drug therapy); DHI deals with patient data and we will seek to determine what contributions we can make with our cyber-security expertise.

To further optimise outreach, we have created an Outreach and Public Engagement Network (OPEN) and work with the University's centralised and coordinated Communications Centre. The Centre's strategic objective is to manage and influence Abertay's reputation for excellence and ambition in applied research, as it circulates and evolves among our many different audiences and stakeholders. The aim is to encourage perceptions and attitudes towards the University that accurately, consistently and favourably reflect the reality of Abertay as an institution committed to making a genuine impact across society locally, nationally and internationally. The Centre deploys a range of tactics specifically designed to transmit information and routinely monitors references to (and perceptions of) the University in the external environment. The Unit interacts with the communication Centre through a dedicated officer: this ensures in-depth knowledge of on-going research in the Unit and optimizes the timing of press releases to maximize impact. In partnership articles have been written for local and international newspapers. In addition, research achievements of staff have been covered in radio and TV programmes (approx. 30 p.a.).

d. Relationship to case studies

Our case studies demonstrate our inherently inter-disciplinary approach to impact. Case study 1 combines **Engineering** and **Interactive Media** and has supported the development of our local economy and environment. Case study 2 spans **Interactive Media** combining human factors, software development and computer arts to allow us to work with the global leader in self-service checkouts. Both case studies are founded on long-running partnerships. Both case studies have had significant public exposure: Case study 1 has been used on public signage across Dundee's £1B 30-year development and in stakeholder consultations; Case study 2 was developed into an exhibit at Dundee Science Centre (summer 2012) with thousands of visitors and we used this as an important opportunity for data collection. Both case studies have led to follow-on funding (case study 1 in the same area with different partners; case study 2 in a different area with NCR).