Institution: University of Surrey

Unit of Assessment: UOA 11 Computing

a. Context

The Unit has developed a strong track record of industry-facing research which has led to the establishment of links with an extensive range of non-academic user groups and beneficiaries, benefitting from the research of all four of its research groups: (i) Digital Ecosystems, (ii) Formal Methods and Security, (iii) Multimedia Forensics and Security, and (iv) Nature Inspired Computing and Engineering. These include the following (by no means exhaustive):

Business and Industry: Airbus; Amazon; AWE Aldermaston; Bosch (UK); Consult Hyperion; Honda Research Institute; IBM; Jaguar Land Rover; Qinetiq; Thales Research & Technology Ltd.

Government agencies: DEFRA, Royal College of GPs, Royal Surrey County Hospital**;** Moorfields Eye Hospital**;** Surrey Police and Home Office**;** Metropolitan Police**;** Pirbright Institute (formerly Institute of Animal Health)**;** Victorian Electoral Commission, Australia; Royal Botanic Gardens, Kew.

Charities and voluntary organisations: Born Free Foundation; Surrey Wildlife Trust; Tiger Nation; Zoological Society of London.

The main types of impact include:

Economic impacts: e.g. creating new businesses and products, for example through spin-out companies Rulemotion, Technotomy and Thoughtified.

Impacts on Health: e.g. developing techniques such as automated screening for diabetic retinopathy and tool tracking for measuring skill levels in eye surgery directly benefiting patients.

Impacts on public policy and services; e.g. the introduction of new secure electronic voting systems, specifically in Victoria, Australia, and new tools to support policy formulation.

Impacts on practitioners and professional services: e.g. the provision of enhanced specification techniques leading to improved system safety at AWE Aldermaston, and business intelligence tools for the Surrey Wildlife Trust.

Public engagement: Citizen Science projects with Tiger Nation and Zoological Society of London

b. Approach to impact

The Unit has various approaches to realising impact such as delivery of research commissioned by a non-academic partner to address a specific need, transfer of a research output to one or more existing non-academic user groups for exploitation, or the setting up of a start-up for the specific purpose of exploiting a research output. Relationships with industry are often established for collaborative research, with impact being kept in mind as the relationship matures. The nature of the impact is aligned with the research objectives of the four groups in the Unit. Examples include:

- Creation of three new businesses: *Rulemotion*, *Technotomy* and *Thoughtified*.
- Enhanced public engagement through development of the social web for citizen science.
- Direct economic benefits through applying understanding of the end-to-end service and technology chains of the Internet and World-wide web.
- Development of new tools to support policy formulation through Agent Based Simulations to model a range of governance models.
- Development of software, in conjunction with the Victorian Electoral Commission, to realise the design for verifiably processing the votes in the forthcoming state election.
- Development of a new product in collaboration with Moorfields Eye Hospital for automating screening for diabetic retinopathy; this also led to the commissioning of research to develop

a tracking tool for measuring skill levels in eye surgery.

- Improvement in safety for systems under development at AWE Aldermaston (arising from a long-term relationship).
- Use of forensic vehicle convoy analysis for investigating organised crime, leading to economic benefits through reductions in the workload of forensic operators within the Metropolitan Police (arising from a long-term relationship).
- Establishment of SULFA (Surrey University Library for Forensic Analysis) to provide a widely accessed benchmark library for video forensics.
- Creation of two new products involving the mining of imbalanced data sets that are characteristic of the web of data: Machine learning product for toxicological risk prediction (Lhasa Ltd) and rule generation for financial fraud detection (AI Corporation).

These examples have arisen through different pathways, but in many cases the group concerned was contacted by industry due to reputation and we responded positively. All staff are proactive in establishing relationships with non-academic partners to realise impact and a variety of approaches are used to facilitate this:

- Initiating relationships through Knowledge Transfer Partnerships and CASE studentships.
- Active engagement with Knowledge Transfer Networks (the ICT KTN in particular).
- Creation of an Industrial Advisory Board, with all its members being users of knowledge and technologies generated by the Unit.
- Appointment of Visiting Professors (7) and Senior Visiting Fellows (4) from industry as a way of consolidating relationships with the user community.
- Interaction with University's Research and Enterprise Support unit which provides project management for the key partnerships and commercial, legal and IP expertise to help enable the creation of impact through licensing and spin-outs.
- Access to the University's Incubation Centre on the research park for early stage companies including business planning, mentoring and help raising finance from business angels and Venture Capitals via the Surrey 100 Club and the University Seed Fund.
- Training for non-academic users to build awareness of the Unit's capabilities, such as the provision of Web training materials for Professional Development and the running of several two-day workshops delivered in Singapore.
- Running student projects and CASE PhDs in conjunction with industrial collaborators, providing a 'foot in the door' access to real industrial problems while providing our partners with a low-risk way of evaluating the applicability of our research and the potential for a more formal collaboration.

Although the initial route to impact may be mediated through one non-academic partner, we always take the next step of extending the network of participants to ensure the impact is sustainable in the face of a dynamic socio-economic landscape, and the emerging ecosystem feeds back further research questions that can be used to ensure the relevance of our work.

c. Strategy and plans

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

Staffing related initiatives:

- Appoint a Director of Enterprise from September 2013 (Krause) who will act as an 'Impact Champion' to increase exposure and dissemination of impact activity within the Department and the University and to identify routes to impact of key research findings.
- Update annual staff appraisals to recognise and reward achievements in impact, and recognise excellent impact at University level through annual impact awards.
- Refine the Department sabbatical scheme to encourage staff to seek opportunities in technology transfer and commercialisation of their research.
- Strengthen our alumni programme to ensure that our graduates remain advocates for the Department's research and technical capabilities throughout their careers.

Specific initiatives:

- Maintain and build on long-standing relationships with industrial partners through periodic updates, aiming to understand business needs and outlining our research plans to end users at an early stage.
- Strengthen the resilience and sustainability of the 'ecosystems' we have built up around our core research themes to support the transitioning of research outcomes into mature software products suitable for commercialisation.
- Support staff and students in establishing start-ups and external consultancy to companies through the mechanisms of research day and flexibility in time off, and through providing manpower resources to support start-ups via placement and PhD students
- Continue to build a portfolio of advanced training and professional development material in order to build the reputation of the unit in the wider technology community.
- Pro-actively use the Department marketing officer and wider Faculty marketing team to generate a much more widespread awareness of successes and capabilities through the use of research blogs, web video content and social media, as well as develop an independent public engagement pathway.
- Grow our outreach activities to raise awareness amongst the general public of the socio-economic benefits that are accruing from our research outputs.

d. Relationship to case studies

The three case studies exemplify the approaches to realising impact in section b. All relate to a common approach of building up "ecosystems" around specific research themes and the particular mechanisms are described below:

Case Study 1: Introducing a secure electronic voting system to the State of Victoria, Australia

At a point where the technology was mature enough to take into practice and we were seeking a partner for trials, our reputation led to an approach by the *Victorian Electoral Commission*, and we were in a position to respond positively. The results of this demonstration will be used to trigger wider usage of the technology with other partners.

Case Study 2: Adaptive Information Systems

We took the path of starting up a business entity, *Rulemotion*, to ensure we had full control over the realisation of both the technology and the method that was founded in our research outcomes. This has provided an agile business entity that can adapt as further market opportunities arise.

Case Study 3: Financial Fraud Detection

Based on knowledge of our research, we were commissioned by a leading figure in the financial fraud industry to develop techniques that would lead to improvements in the accuracy and accountability of automated detection of fraudulent transactions.