Institution: University of Aberdeen

Unit of Assessment: 11 (Computer Science & Informatics)

a. Context

Our research strategy is key to providing an environment that allows us to maximise the reach and significance of research impact, enabling our research to have impact on a wide variety of non-academic beneficiaries. We have established strategic partnerships and conduct joint research with industrial partners in the IT sector, both large corporate and SMEs. Commercialisation of our research through spinouts is another means by which we develop economic impacts. We also influence this sector through standardisation bodies, e.g. through researchers in the Agents, Reasoning & Knowledge (ARK) theme engaging with W3C. Collaboration with partners in government provides us with a route to influence both policy and practice in areas as disparate as security/defence and the environment. We have developed a tradition for impact on society, culture and creativity. Our approach includes promoting understanding of computing and its societal implications through national events (British Science Festival, National Science & Engineering Week), exhibits in science education centres, popular science books, etc. Further, we engage with the public in the conduct of our research to maximise its relevance and impact, including collaboration with cultural heritage groups, and with patients and their families. Our culture of interdisciplinary work is important in enabling this wide variety of routes to non-academic impact, opening up routes to impact in non-IT industry sectors with charities and other partners who would not normally see the benefits of working with CS researchers. Academic and research staff and students from across our research themes contribute to routes to non-academic impact via industry and government partners, and public engagement activities.

b. Approach to impact

Our approach to impact is to work closely with partners throughout the research process. In the RCUK dot.rural Digital Economy Research Hub (EP/G066051/1), for example, we: (i) worked closely with key user partners to scope the original proposal to RCUK; (ii) organised agenda-setting workshops with a wider range of stakeholders to help identify key research challenges; (iii) using the outputs from these workshops, produced project proposals involving multiple disciplines and clearly identified user partners; (iv) established user panels with the specific remit to review projects and their non-academic impact. To facilitate follow-through, dot.rural employs an impact PDRA, whose remit includes working with project teams as a consultant to support the identification of potential impacts and advise on strategies to exploit them. The user panel chairs work with the Hub directors in an impact review group that meets quarterly to monitor impact from projects. This process, and in particular the role of the impact PDRA, was highlighted in the 2012 Digital Economy impact review as an example of best-practice.

The International Technology Alliance in Network and Information Sciences (ITA, usukita.org), led by DSTL and the US Army Research Lab (ARL) is also a good example of our approach to the process of engagement through effective relationships with partners. Since 2006, research projects in ITA have been driven by research challenges set by government leaders in the US and UK, proposals developed by project teams involving both academic and industrial partners, and assessed both in terms of the scientific content and routes to impact. Annual international peer review emphasises impact through technology transition. A specific example is research conducted at Aberdeen, Cardiff and IBM on decision support for sensor selection and deployment. ARL partners were actively involved in the basic research (including joint publications), software was demonstrated to senior government stakeholders in both countries, and an Aberdeen RA spent 3 months as an intern at IBM and ARL (this RA is now a member of staff at IBM Research in NY).

Both these examples illustrate how our approach to impact in research projects has a positive influence on researcher development: in ITA through internships and involvement of research staff in the follow-through on impact; and in dot.rural the role of the impact PDRA in working closely with researchers in project teams in helping them to identify and exploit opportunities for impact. The University's Researcher Development Unit (RDU, abdn.ac.uk/develop) further supports this through high-quality impact-oriented training opportunities, such as the 'Achieving Impact from your Research' workshop series with speakers that included John Baird (RCUK DE Programme Leader) and members of the Public Engagement in Research Unit (PERU, abdn.ac.uk/engage). To supplement this, within the unit we provide training focussed on achieving impact from interdisciplinary research, and, in conjunction with PERU staff, support for outreach activities. For

example, the Training and Outreach Officer in dot.rural supported 3 PDRAs and 5 PhD students from the unit in delivering a 'Countryside, Digital, Life' workshop, initially at four primary schools during National Science & Engineering Week 2013, followed by two further events due to demand. Over 150 pupils attended, and the workshops received 5* reviews from pupils and teachers.

In addition to engaging the public by communicating the relevance of our research to society and culture, we also engage with the public in the process of our research. For example, in the CURIOS (CUltural Repositories and InfOrmation Systems) project (dot.rural) we are working with historical societies to develop an open source cultural heritage 'toolkit' (built upon our Natural Language Generation and Semantic Web research) that will allow communities to preserve and communicate cultural heritage and local knowledge that might otherwise be lost (featured in the RCUK 'Big Ideas for the Future' report, p.72). Donnie Morrison of Hebridean Connections, one of our community partners, said "The CURIOS project will enable us to establish a more joined-up network of heritage groups[…] The open source development using linked data will assist with the long term sustainability of our cultural heritage repositories, creating a new model of resilience and a means of future proofing for the heritage sector" (2012 RCUK Impact Review).

One of the important effects of the culture of interdisciplinary research within the unit is that this opens up new avenues for research from the unit to have non-academic impact *in collaboration with* partners in other disciplines. This increases the potential for impact due to the breadth of application and contextualisation of our research. For example, collaboration with colleagues in the Centre for Transport Research has enabled us to engage with First Group, a major international but non-IT company. Through this partnership, we have access to buses, and other infrastructure to run live software trials to explore the impact of novel technologies that exploit crowd-sourced data to support passengers and influence public transport use. Work with Ecologists has facilitated collaboration with Charities (RSPB, Bumblebee Conservation Trust) and government bodies (Scottish Environment Protection Agency, SEPA). We are exploring the impact of Data Mining and Natural Language Generation technologies to enable public engagement in nature conservation (featured on national television: BBC, May 2013), and, with SEPA, to improve the analysis and presentation of river data for government decision makers and the public.

Enabling economic impact through commercialisation is strongly supported by the unit and by the institution, and commercialisation activities are fully recognised within the institution via annual promotions exercises. In the 2013 PraxisUnico Spinouts UK Survey, the University of Aberdeen was listed as 6th in the UK as most active in the creation of spinouts in the three years 2010-12. Support for commercialisation (including legal services) is provided by Research and Innovation (abdn.ac.uk/research-innovation). A good example of how the unit and institution has enabled staff to effectively develop commercialisation opportunities is the Data2Text spinout. Early in the development of this spinout company, both Reiter and Sripada were given additional support in delivering on teaching, and reduced administrative loads. Subsequently, their time to pursue this commercialisation was bought-out by the company in a more formal arrangement. Additional space was made available to Data2Text within the footprint of Computing Science, which was extended with the support of the institution as their needs grew which ensured that academic staff involved could better balance the variable demands of a new company and their continued engagement in research. Further, the presence of Data2Text within the same building as the unit helps to foster a culture of non-academic impact through this route.

c. Strategy and plans

The strategy of the unit aligns well with that of the institution, where emphasis is placed on knowledge exchange, commercialisation and public engagement. Our strategy extends this, however, by exploiting interdisciplinary research strengths to broaden our capacity for non-academic impact. In further developing our strategy in the REF period, we have: (i) employed an approach to impact in which engagement with partners that pervades the research process from the development of ideas to the delivery of impact; (ii) supported public engagement, entrepreneurism and other routes to impact in research for all students and staff through staff development; (iii) significantly broadened the range of partners we engage with including those from industry, government, charities and the public, both directly and in collaboration with other disciplines; (iv) developed deeper engagement with industry through increased numbers of student internships, staff exchanges and consultancy; and (v) responded flexibly and rapidly to the entrepreneurism of researchers to help bootstrap commercialisation activities.

To engage all research staff and students in the unit in impact activities, training is key. The dedicated Training and Outreach Officer, funded by dot.rural, has enabled us to establish training for all research students and staff, complementing that provided by the institution. This has helped us to develop a culture of both public and user engagement across the unit. In 2012, for example, 6 members of academic staff, 11 research staff and 6 students were involved in various public and industry-focussed events including 'Speed Science' (one such event attracting over 50 members of the public), public lectures and industry/government-focussed events. Having developed this culture, an important aspect of our future strategy is to integrate public engagement, entrepreneurism and other routes to impact in expectations for research student and staff development and monitoring (already the norm for CS students working within dot.rural).

We have established a number of key partnerships with companies by engaging with them across a range of research activities, and developing routes to impact through internships, consultancy and other knowledge exchange activities; links to IBM, and the Arria NLG Research Centre established in May 2012 (arria.com/research-centre-A420.php) being good examples. Developing deeper, longer-term and cross-project relationships with industrial partners has been, and will continue to be an important aspect of our strategy. Further developing staff secondments (academia to industry and vice versa) and student placements is important in maintaining such partnerships. Industry secondments are actively encouraged with the support of the University's sabbatical scheme, and the University operates flexibly to respond to opportunities outside the norm. We plan to develop further partnerships in this way as routes to future research impact.

We intend to establish additional mechanisms to enable us to respond to opportunities to generate research impact. To this end, we are working closely with the University's knowledge transfer office, the North of Scotland Knowledge Transfer Partnerships (KTP) Centre, and the Technology Strategy Board to put in place mechanisms to allow us to initiate a range of KTP activities. In March 2012, a Memorandum of Understanding was signed between the University, the Technology Strategy Board and dot.rural to allow it to co-fund a portfolio of activities under the KTP umbrella. Further, through the Scottish Informatics and Computer Science Alliance (SICSA) we are engaged with a new industry-led Innovation Centre 'The Data Lab' current in final stages of negotiation with the Scottish Funding Council. This centre will provide a Scotland-wide focus for demand-driven, collaborative knowledge exchange and research in data science.

Our experience has demonstrated that developing non-academic impact through collaboration with other disciplines is an effective strategy for broadening the pathways to impact. Key challenges for 2014 onwards are to further develop established relationships with government and third sector partners, to sustain the breadth of routes to impact we have built, and to follow through on the potential we continue to develop across these routes.

d. Relationship to case studies

Our case studies represent examples of *economic* impacts, impacts on *practitioners and professional services* and impacts on *society and culture* through: commercialisation inspired by interdisciplinary collaborations and user-led research (case study 1); public engagement and promoting public understanding of science (case study 3); and collaboration with industry partners directly and via standards organisations (case study 2).

Case study 1 is a good example of how our approach has led to important non-academic impact through commercialisation: the spinout *Data2Text*. The underpinning research was strongly user-led and interdisciplinary, including authors from different disciplines in many cases. The research benefitted from collaboration with users throughout the research process and effective follow-through on impact which has led to an important strategic partnership (with Arria NLG).

Our culture of public engagement that has developed within the REF period is exemplified by case study 2. In fact, the work presented in this case study (particularly the computational humour element) has informed our strategy for public engagement, and demonstrated the real benefits of these activities for research across the unit.

Case study 3 demonstrates how we utilise multiple means to develop non-academic impact, both through direct collaboration with industry partners and via standards organisations. Our engagement in the development and verification (through implemented systems) of important industry standards serves to maximise the reach of our impact on practice.