Impact template (REF3a)

Institution: Cardiff University

Unit of Assessment: 11

a. Context

The School of Computer Science and Informatics has an ethos of applied research where direct engagement with users is the norm. Our research strategy emphasises seeking to solve challenging computational problems that enable follow-on developments in other disciplines. This way of working is underpinned by a network of collaborations with other disciplines that has been developed over the past 15+ years, which continues to grow. All three of the School's research groups – Distributed and Scientific Computing (DSC), Informatics (INF), Visual Computing (VIS) – routinely engage with end-users. Key long-term beneficiaries are: healthcare practitioners and their patients, researchers and scientists from a wide range of fields (especially the life and earth sciences), data managers, high-performance computing service providers, telecoms system designers and operators, engineers, product designers, government regulators and manufacturers. Major partners include: Airbus, BT, EADS, Ford, IBM, NHS, OFCOM, Ordnance Survey, and the global biodiversity community. The nature of the impact from our work is broad, including health (e.g. patient care practice), economic (e.g. business performance), environment (e.g. management and conservation), and impact on practitioners and services (e.g. processes and training).

b. Approach to impact

Impact has been and continues to be embedded in the School's research ethos as evidenced by a **high proportion of interdisciplinary research outputs leading to a series of significant technology transfers** since the School's inception. For example, in the current period, 30% of our REF2 outputs report computer science and informatics results from interdisciplinary work, and examples of significant transfers are provided in this document and REF3b. The School continues to reinforce this established culture through appointment of new and early-career staff with combined research and impact potential. **All staff in REF1, including ECRs, have conducted research with direct involvement of end-users during the 2008-2013 period.**

At a School level we continue to **promote and support impact-generating activity through a robust group structure** with each group being led by a senior academic with a track record of transferring their research outputs to end-users. For example: Martin's (VIS group) reverse engineering software is covered in Case Study 2; Walker (DSC group) led the Welsh e-Science Centre and developed the RTGrid Portal (www.cs.cf.ac.uk/gridprojects/rtgrid/) used by healthcare practitioners across Europe during 2008-2013; Preece (INF group) is co-academic lead of the US/UK ITA (www.usukita.org) with ongoing technology transfers (2012-13) with US Army Research Laboratory, UK Dstl, and IBM. The group leaders are responsible for running a variety of group activities, including seminars which regularly highlight applied and impact-creating work. They also conduct annual academic staff appraisals where an **individual's impact-generation activity and goals is considered as part of the School's performance framework and workload model**. Thus, impact-related successes are recognised and rewarded in terms of performance, including workload credit (e.g. reduction in teaching), award of seed-corn funding (e.g. to support development of a software prototype), and recognition in promotion cases. Consideration of **potential for impact from an individual's research is factored-into staff recruitment and induction procedures**. We seek to embed new staff into an "impact culture", through mentoring and with the support of their group leader, to forge appropriate contacts among partner schools and our network of contacts in industry and the public sector.

The School has **invested in support for impact through a Marketing and Communications Officer** whose role includes raising awareness of impact both internally and externally, for example by developing events such as speed dating with SMEs, group lab visits, and supporting **long-term and strategic relations with existing and potential future beneficiaries** for the School as a whole, group leaders, and individual staff members. The School's long-term (15+ year) strategic partnerships with external stakeholders and beneficiaries include the NHS, Global Biodiversity Information Forum, BT, IBM, OFCOM, and the Ordnance Survey, many of whom contribute membership to the School's External Advisory Board (the EAB remit includes advising on Research & Impact strategy, including "spotting" early potential impact).

Our strategic relationships with user organisations are a key element of our ongoing approach to

impact. The School's **long-term collaboration with the NHS** includes work on improved information sharing in social care (learning disabilities) and two NISCHR-funded projects on sensor information processing for measuring rehabilitation of stroke patients. The School, in collaboration with the NHS in Wales, delivered the design input for the Canisc cancer information system (www.wales.nhs.uk/nwis/page/52601). Canisc provides an information sharing platform for healthcare practitioners in Wales and **supports the care of 350,000 patients across general practice, hospital and specialist cancer units, and palliative care**. During the period the School employed a clinically-trained lecturer to facilitate translation of research outputs into practice. Transfer of the School's healthcare research towards practice has been supported by a diverse set of funding sources including EPSRC, DTI, Wellcome Trust, PPARC/STFC and industry. For example, the Sintero project on secure collaborations across complex sets of clinical information received £1.1M from Wellcome to prototype their technology in order to demonstrate potential impact on patient care (www.cs.cf.ac.uk/newsandevents/wellcome.html).

The School's leading position in international efforts to manage global biodiversity is founded on strong links with the **Global Biodiversity Information Facility** (GBIF, www.gbif.org). Based on the impact of the School's research in this area, the School is represented on the Board of Directors of Species 2000 (see Case Study 1) and is a member of the UK delegation to GBIF. Through its portfolio of projects (directed by a dedicated project manager whose background is in industrial project management), the School continues to play a key role in on-going international efforts including development of the European Environmental Research Infrastructures (envri.eu).

An effective mechanism for achieving impact from our research has been the **joint training of PGRs** with other schools, including the Medical School, Dentistry, Engineering, Pharmacy, and Geography and Planning (several outputs from these collaborations feature in REF2). As an exemplar of how impact arises from such projects, work with the School of Dentistry modelled crowd behaviour to exploring the relationship between alcohol, crowd dynamics and street violence. This work was **cited by South Wales Police/Cardiff City Council as an influence on their decision to pedestrianise parts of Cardiff city centre**, and the Cabinet Office Emergency Planning College highlighted the work in their strategy document *Understanding Crowd Behaviour*. This research forms part of an ongoing collaboration with EADS, who have embedded the software into their simulation suite (Dr Keith Bolton can corroborate: Keith.Bolton@Cassidian.com).

Knowledge Transfer Partnerships are used where appropriate to channel our research into practice. For example, the School worked with Ford's Engine Plant at Bridgend as part of a University-wide KTP collaboration, to develop their data warehouse-based reporting and data mining capabilities (info.ktponline.org.uk/action/details/partnership.aspx?id=8265). While the application was local to Wales, **Ford see the potential impact as global in terms of transfer of best practice**: Ford plan to roll out one system developed from the project globally, and the KTP associate was retained by Ford US and contracted to the company's US operations. This work won the 2013 Cardiff University Innovation Network *Business Innovation Prize*, at a ceremony attended by the First Minister of Wales. The award celebrates the impact of excellent research and practice across the University. Other examples of knowledge transfer activity in the period included a relatively exploratory KTP data mining project with a local SME (Comtec Europe), leading to 2 associates being retained by the company, and a data mining project with a large chemical engineering company which generated research results (a PhD) in addition to benefits to the company in terms of the results of the data analyses. In the REF period members of the school have also undertaken **consultancy** for a variety of firms including EADS, IBM, and ICAD (Japan).

Members of the School benefit from **High Performance Computing (HPC) infrastructure** provided by the University's ARCCA facility (www.cardiff.ac.uk/arcca/) and the HPC Wales platform (www.hpcwales.co.uk) launched in 2011. Examples of current collaborations with HPC Wales include the Centre for Transport Network Optimisation (ctno.org) and the Collaborative Online Social Media Observatory (www.cs.cf.ac.uk/cosmos/).

The School operates with an **open internal structure to enable us to be agile in pursuing opportunities to create research impact**. There are strong inter-group links (see REF5) allowing information on potential user contacts and opportunities to apply our research to flow freely through a well-connected social network inside the School and between the School and its partners. Individuals and group leaders have devolved responsibility to maintain, develop, and manage

strategic links with partners and to track follow-through impact of the School's research. Group working and staff appraisal also ensures that resulting impact is identified, recognised, and communicated upwards and among colleagues. **To incentivise colleagues, a proportion of overheads generated from impact-related activity is returned to the originators by means of the School's Investigator Return Fund** (annual return typically 20-40% in period), and can be reinvested into activities to support impact and innovation. The School draws upon the support of University's Research, Innovation & Enterprise Services (RIES) that supports and facilitates the commercialisation of University research outputs. RIES works with FUSION IP, a company that signed an exclusive 10-year agreement with Cardiff University in 2007 to commercialise its IP. For example, FUSION IP supported MedaPhor (www.medaphor.com), which commercialises Cardiff-patented technology to provide **innovative computer based ultrasound training in leading hospitals across Europe, the USA and Australasia**, leading to improved training and patient outcomes. MedaPhor has secured over £2 million sales since 2010 and, in June 2013, established a distribution agreement in mainland China.

c. Strategy and plans

The School's strategic plan prioritises the following objectives to enable future impact:

- **Agile group working and intelligence sharing**: group leaders are expected to extend their group's network of active collaborations, share contacts and opportunities strategically with other groups, and track resulting impacts. The University is investing in improved Research Data and Information Management (RDIM) tools for these purposes. Intelligence sharing will also help us identify and foster opportunities for impact as soon as possible.
- **Exploitation of interdisciplinary collaborations to reach end-users**: build on our existing ethos of interdisciplinary work to reach end-users, and encourage and support colleagues to transfer promising work wherever possible. In 2013 the School co-developed a new series of Software Impact Workshops to help colleagues learn about successful technology transfer routes and pursue opportunities for generating impact from their best research (covering areas including commercialisation models, patents, and impact through open access to data).
- **Raising the profile of School research**: achieve greater visibility and uptake of our best research results through channels including the School Marketing and Communications Officer, RIES and FUSION IP (see above), and the forthcoming College Business Gateway (2014). Recognise profile-raising activities to a greater extent in staff performance, and encourage colleagues to "go outside their comfort zones" in terms of impact-creating activities.

Across the School there are several key technologies and approaches (examples given in Section b) that are in the process of becoming transferred and increasingly taken up by users. We will use the University's improved RDIM tools to track these "impact pipelines" and maximise potential follow-through acitivity. In addition, new budgeting processes will enable the School to **increase investment in future impact activities of potential strategic importance**. Recent examples of such investment include the establishment of a School-hosted lab to accommodate collaborative projects with a local SME, funding the deployment of a sensor network prototype to support environmental scientists in the Malaysian rainforest, and supporting the development of a mobile app to showcase our geospatial informatics work (in partnership with Ordnance Survey).

The School has recently launched a portfolio of **Masters-level training programmes with industry placements**, and linked to this we are establishing a network of companies, with particular emphasis on SMEs. As our Masters-level projects typically build on aspects of the School's research, we intend to develop this network of companies to foster future impact-related activity such as KTPs, match-funded studentships, and consultancy.

d. Relationship to case studies

The cases have been selected to exemplify the kinds of impact achieved by the School's applied research ethos:

1. *Enabling the Catalogue of Life to index the world's species* shows how the School commits itself to long-term (14+ years) strategic relationships; here the focus is on improving biodiversity management for scientists, government agencies, industries, and citizens.
2. *Realising the potential of 3D scanners through reverse engineering and digital shape reconstruction* illustrates how elements of the School's fundamental research has transferred into commercial products, with impact in diverse areas of design and manufacturing.