Impact template (REF3a)

Institution: Newcastle University

Unit of Assessment: UoA 11 Computer Science and Informatics

a. Context

The UoA's research on middleware, asynchronous systems and software dependability has had a significant economic impact, including contributions to employment, investment and product development. Its reach has extended internationally and has been maximised by a deliberate emphasis on practical embodiments of research including toolsets, open source implementations, contributions to standards and standard reference implementations, thereby allowing results to be readily exploited by industry. This is illustrated in the UoA case studies, for which the main beneficiaries have been global corporations involved in software design and development (Hewlett-Packard, Microsoft, IBM, Red Hat [ICS1,2]), microprocessors (Intel, Sony [ICS2, 4]) and firmware (NTT DoCoMo, FeliCa [ICS2]); and major users of these resulting products (including Siemens, SAP, NASDAQ, Brazil's Ministry of Health [ICS1,2,4]) and in pharmaceuticals (e-Therapeutics [ICS3]). More recently the UoA has widened the scope of its pathways to impact to encompass health, society, culture and creativity through engagement in multi- and interdisciplinary research addressing societal challenges.

b. Approach to impact

The Unit's approach to our engagement with users in order to create impact has four main characteristics: user-centric, open, collaborative, and agile.

User-Centric: developing close and deep relationships with key users
By forging close relationships with users and key industrial beneficiaries the UoA has been able to identify major challenges faced by the potential users of its research, to develop new methods to understand their needs, to address those challenges through fundamental and applied research, and to put in place appropriate pathways to impact, including partnering with users and key stakeholders as appropriate. Examples are:
- Collaborating closely with industry in major research projects (e.g. BAE, Bosch, HP, Intel, IBM, Red Hat, SAP, Siemens, Sony) has delivered insights into user needs and needs-driven research problems, see [ICS1,2,4]. The Unit routinely exploits KTP funding, CASE and industry scholarships, staff and PhD student secondments (e.g. with Arjuna, BBC, Microsoft, Phillips, GCHQ, Siemens, HP) as routes to impact (e.g. a KTP contributed to [ICS3]).
- Crafting a deep relationship over many years with Red Hat, the world's largest open source company, led in 2010 to the Red Hat Research Centre @ Newcastle University. Red Hat currently employs 25 software engineers in Newcastle, mostly Newcastle graduates and it continues to sponsor collaborative needs-based research [ICS1].
- Appointment of carefully selected Visiting Professors (currently SAP, Microsoft, Red Hat, DSTL, IBM, HP) and guest/visiting staff provides knowledge transfer opportunities and has been instrumental in the case studies [ICS1, 2, 4]. Leveraging deep expertise (e.g. appointing a former Detective Chief Inspector for cybercrime research) creates new impact pathways (e.g. supporting victims of domestic violence and protection of children on-line).
- Participatory approaches to understanding user needs such as the development and application of new co-design methods for people with dementia and their carers, and victims of domestic violence, shape our future research and impact agendas in interaction design and privacy. Our commitment to long-term engagement with users is exemplified by the establishment (under the RCUK Digital Economy (DE) programme's Social inclusion for the Digital Economy (SiDE) project, led by the UoA) of a user pool of 2,000 users providing ready access to research participants and allowing researchers to position their research for impact.

Open: commitment to open systems, platforms, tool development and standards.
Much of the economic impact of the UoA [ICS1,2,3,4] relies on open source software, publicly available tools and engagement in standards. This open approach aims at maximising the uptake of research outputs and broadening the opportunities for entrepreneurial activities, e.g.:

- Development of OpenMovement, an open source hardware and software platform that has been adopted by UK Biobank (2,500 devices for seven-day activity monitoring of 50,000 subjects), and academic and commercial health researchers internationally (e.g. Georgia Tech, Phillips Research, McClaren consulting). Spin-out Axivity resulted from this development.
- The UoA led in the development of PROV, a W3C standard for provenance information which is very influential and used by Oracle for monitoring very large audit trails; described by their VP for Development as a vital tool and "at least as important to us as OWL".
- The UoA led the development of User Managed Access (UMA), now submitted to the Internet Engineering Task Force (IETF), resulting in spin-out CloudIdentity.
- Development of open source platform e-Science Central (supported by spin-out Inkspot), a data analytics platform scalable through cloud technologies underpinning various research pilots and adopted by Unilever to support product related market research.

Collaborative: using institutional vehicles to foster multidisciplinary research
The Unit and the University as a whole strongly believe that societal as well as economic impact increasingly relies on multidisciplinary research. Therefore, institutional vehicles have been created to foster multidisciplinary working and help establish pathways to impact that are effective in a complex setting. The following are the main examples:
- The Digital Institute collaborates with many disciplines to address major social challenges. Early stage health impacts include a pilot for 'movement as medicine' using physical activity monitoring and novel methods for stroke rehabilitation using bespoke games development in collaboration with Paediatric Neuroscience in the award-winning Limbs Alive project.
- Innovative use of Digital Economy research funding (through SIDE) has enabled the Unit to work on practical applications addressing the needs of charities and similar organisations previously unable to access standard research funding. Early society, culture and creativity impacts include 'Craft Cube', a national Craft Council sponsored public exhibition of user centred technologies to benefit people suffering from dementia.
- At Culture Lab, the University's centre for interaction design and digital media research, the Unit's Digital Interaction group leads the Newcastle arm of the Creative Exchange, one of four £4 million Arts and Humanities Research Council (AHRC) Knowledge Exchange hubs for digital technologies and the creative industries (e.g. links through SAGE, Baltic, Microsoft, BBC R&D)
- The UoA's Research Centres have an outreach function and impact purpose. For example, the Centre for Software Reliability (CSR) organised 50 events during the REF period with over 3,500 participants from the safety community; the Centre for Computer Security and Cybercrime (CCCS) has engaged with charities for victims of domestic violence and has developed Internet safety solutions for them. The recently established (2013) Centre for Synthetic Biology and Bioexploitation (CSBB) has 14 industrial partners signed up to its translational activities and has already established joint collaborations with five funded through the Technology Strategy Board (TSB) and by CASE studentships.

Agile: flexibility in pursuing opportunities for impact.
Opportunities for impact cannot always be foreseen and if needed the UoA's investigators are able to respond in a manner appropriate for the opportunity at hand. Where IP protection (as opposed to our typical 'open' approach) is likely to facilitate impact, University support is deployed in a timely manner. For example, patents related to CAPTCHAs and sensor technologies have been initiated. Staff members have established start-ups, including Reflective Thinking, Axivity, Cloud Identity, Inkspot, ISafely and Rodin Tools and eTherapeutics [ICS2, 4], encouraged by the University's newly introduced base share of 25% instead of the traditional 50%.

c. Strategy and plans

The Unit is establishing and implementing an impact strategy that is based on strengthening the synergy between research and impact by systematically integrating impact and research considerations in all stages of research. Our plans have the same core characteristics as mentioned in Section b (user-centric, open, collaborative and agile), with concrete goals and planned activities with respect to people, physical environment and processes:

People. To establish and exploit the synergy between research and impact requires team-based solutions, in which students, researchers, academics and support people come together, playing different roles in different stages of the pathway to impact. Our initiatives aim to set incentives to maximise reach and significance of our impact:
- providing sponsorship for PhD students and postdocs to pursue entrepreneurial activities related to their research (based on a University funding initiative associated with Science Central)
- considering impact activities as a first-class element (alongside teaching and research) in staff personal development reviews and as a recognised activity incorporated in the UoA workload model

Environment. We aim to innovate in our physical space to best seed, grow and exploit synergy between world-class research and impact. The Unit has a unique opportunity to make a step change in achieving this goal because all its researchers will move to a new building for the School of Computing Science, to open in 2017. This is part of a large initiative called Science Central, which is a multi-million pound investment by the University and Newcastle City Council. The new building allows the Unit to implement the following:
- co-location space for companies we have developed or will develop deep relationships with (Red Hat) to intensify the needs-based research collaborations
- co-location with early stage spin-outs (by researchers and students) based on the Unit's research
- public research facilities as enablers and accelerators for societal impact, for instance through maker spaces for co-design with researchers
- flexible interdisciplinary research spaces for cutting edge research in societal challenges
Science Central will also host the Unit's new Cloud Innovation Centre, a dedicated joint business engagement initiative with Newcastle City Council which aims to use the research base on cloud technologies and big data to address real commercial needs through direct collaboration with industry. The Centre's aim is to develop deep relationships with users, supporting collaborations through closer-to-market funders such as TSB.

Processes. Economic impact requires "first to market" and "fail fast" thinking, and impact on society requires engagement with, and a deep understanding of, users. To achieve this, we aim to innovate in the processes in collaboration with the University. Our activity plan includes:
- faster turn-around for spin-outs approval
- creation of an umbrella spin-out for the UoA to enable participation in smaller value commercial activities and consultancy
- the University will appoint dedicated staff to support inward investment and business development for the new building at Science Central and the Unit will focus on leveraging this resource
- the Unit will leverage the University's investment in support for impact monitoring

d. Relationship to case studies

The case studies illustrate in detail how the UoA approach has been converted to measurable impacts. The Middleware case study [ICS1] demonstrates how building a portfolio of industrial research collaborators through user driven requirements (industry standards) can lead to "first to market" opportunities for SME/Micro organisations, in this case resulting in a $13.5M software sale for a UoA spin-out, major relationships with HP, JBoss and Red Hat and wider reach and significance through advancing the $20BN global middleware market. The case studies in Asynchronous Synthesis Tools [ICS4] and Formal Verification Tools [ICS2] demonstrate that the synergetic emphasis on fundamental problems and the creation of generic software tools results in impact that has wide reach across a variety of application areas, from chip design to business process modelling, and rail safety to planetary exploration. The e-Therapeutics case study [ICS3] demonstrates the value of collaboration with other disciplines (psychology, neuroscience) to reposition a commercial problem and use a new combination of skill sets to expose and exploit a commercial opportunity.