Institution: University of Northumbria at Newcastle

Unit of Assessment: 11 - Computer Science and Informatics

a. Context

Research in this UoA has worked with industrial collaborators and professionals/end users in the key areas of cyber security, situational awareness and database management. The main non-academic user groups, beneficiaries and audiences for the UoA's research are: (i) international agencies (e.g. European Network and Information Security Agency (ENISA), Nigerian Economic and Financial Crimes Commission); (ii) national governments (e.g. Government of Gibraltar); (iii) SMEs and business (e.g. Atlantic Geomatics (UK) Ltd (AGUK), Washington Metalworks, Star Spreads). The main types of impact arising from the UoA's research are: (i) changes in policy and practice at international and national level in relation to cyber security awareness and database management; (ii) economic impacts in SMEs. Research in digital forensics, medical informatics and computational intelligence has also achieved impact through knowledge exchange with local and international law enforcement agencies and hospitals.

b. Approach to impact

To ensure that research in the UoA has maximum beneficial impact we have in place a set of mechanisms to enable the translation of research to effect changes in policy and practice, (exemplified by the impacts made on cyber security in EU directives) and to increase economic competitiveness in SMEs (exemplified by AGUK's additional contracts). To achieve this the UoA has taken the following steps: ensuring all staff have a clear understanding of impact; maintaining an impact database; appointing senior staff to drive impact in the UoA; and putting in place support and resources needed to achieve impact.

Impact understanding - All new staff are required to attend a mandatory "Introduction to Impact" workshop within six months of joining the University, which explains impact, its importance and how to achieve it. Research impact within the UoA is reviewed and evaluated twice per year against measurable targets at Department level to ensure a high level of awareness and engagement.

Impact database - Details of all contacts and networks (including their main areas of interest, a history of previous interactions) are recorded in a database, which is made available to all staff within the UoA (via a shared intranet). The database has been developed substantially during the REF period, and is now our primary catalogue of impact-related data and materials.

Impact drivers - Research impact within the UoA is managed by the Impact Champion (IC), currently Dr Paul Vickers, who has an overview of the impact and research generated within the UoA. This role has many aspects, including (i) acting as a promoter for the impact, (ii) managing and developing the impact database, (iii) running the Introduction to Impact workshop, (iv) working with staff to ascertain the potential benefits of research for non-academic users, and to ensure relevant material/data are recorded for future use, (v) assisting staff to establish initial contacts with end users and audiences, and (vi) providing advice and feedback on effectively communicating research and benefits to all end users and external stakeholders.

Support and resources to achieve impact - Following the initial contact with external stakeholders, the relationship between researchers and end users is developed and driven by the researchers themselves. This process is supported by experienced senior staff members and the IC who plays a supporting role (e.g. providing guidance where appropriate, evidence-logging, etc.). Staff are supported and enabled to achieve impact by institutional resources (e.g. HEIF funding); where the IC identifies that this is appropriate. Success in achieving impact arising from excellent research is an important criterion in the assessment of applications for staff promotion.

This approach has been developed over the REF period and the following examples illustrate its application.

Knowledge Exchange/Economic Impacts - Comprehensive SME Warning Action Reporting Point:- The UoA's research in computer security and digital forensics led us to register (2010) a

community shared service for SMEs, nuWARP (www.nuwarp.org.uk), a comprehensive SME Warning Action Reporting Point, within the UK Government Centre for Protection of the National Infrastructure (http://www.warp.gov.uk/). nuWARP adhered to the Department for Business, Enterprise and Regulatory Reform Public Service Agreements 1 and 7, namely: *"raising the productivity of the UK economy"*, *"improving the economic performance of all English regions and reducing the gap in economic growth rates between the regions"*. This service provides: (i) a Filtered Warning Service; (ii) Trusted Sharing Service; and (iii) an Incident Response Service. The key partners include Northumbria Police, the European Network and Information Security Agency, and the International Association of Accountants, Innovation and Technology Consultants, and key users included Security Risk Management Ltd., and Excelpoint (a software and development consultancy). This has led to the establishment of extensive networks/links with various stakeholders from academia and industry. The results of nuWARP led to an EPSRC-funded project for the establishment of a multi-partner RCUK/GCHQ Cyber Security Research Institute "Choice Architecture for Information Security" (EP/K006568/1) to investigate and develop tools and techniques to form a choice architecture tailored to information security. The latter involves academic partners (e.g. Newcastle University) and SMEs (through nuWARP).

Knowledge Exchange/Economic Impacts - Intelligent Database Migration: As part of a Knowledge Transfer Programme (KTP) project (2010-11) in collaboration with Atlantic Geomatics (UK) (AGUK) Ltd., we have provided the company with expertise in the design and development of intelligent database management tools on behalf of the Government of Gibraltar. The project involved the development of a standard address structure, conversion of existing addresses into a new address structure, linking new addresses to their geographical locations, and an official spatially-based address register for commercial as well as domestic addresses in Gibraltar. The work led to AGUK securing a commercial contract with the Government of Gibraltar (2011).

Other Knowledge Exchange – The UoA has also engaged in knowledge exchange with other partners and end users including: (i) development of automatic scene-of-crime shoemark imagery for forensic science in collaboration with Northumbria Police Scientific Department (2010); (ii) practical solutions for use by local and international law enforcement agencies to improve criminal investigations using digital forensic technologies in collaboration with Qatar Security Office (2009-10); (iii) computational intelligence for medical health investigating toxicity and prediction of cancer growth dynamics for use in decision support systems for optimal cancer treatment in collaboration with Bradford Royal Infirmary, and Royal Victoria Infirmary, Northern Cancer Institute, in Newcastle since 2009; and (iv) mobile application development of mobile telephone-based solutions for detecting crimes with Northumbria Police since 2012.

Public Engagement/Impacts on Society, Culture and Creativity - Staff in the UoA regularly communicate their research to the public. For example, Drs Zhang and Aslam presented a humanoid robot equipped with basic Artificial Intelligent learning capabilities at the Newcastle Science Festival, March 2012 to an audience including children, parents, schoolteachers and professionals. Dr Vickers was selected to provide technical advice on building a sonified orrery to a freelance sound artist at the British Science Festival 2013.

The UoA has put in place evidence-gathering mechanisms and approaches to maximise impact from public engagement activities. The UoA has a policy of collecting evidence and data on research impact and its benefits to the community at large, thus allowing us continuously and systematically to measure and assess the impact of our public engagement activities. This has allowed us to make changes as and when necessary to ensure public engagement is at the heart of what we do.

Impact on Professional Services – In 2012 Drs Vickers and Laing filed a patent application (UK Patent Application No GB1205564.6) resulting from a project funded jointly by EPSRC and the Technology Strategy Board (TSB BK008B) for a system that uses an auditory display for real-time monitoring of low-level statistical properties of network traffic, which could be used by the network service providers and security companies. In 2012, Prof. Bouridane in collaboration with the University of Marseille (France), undertook research relating to multispectral imagery for security applications, which led to a joint PhD project funded for three years by the Anglo-French Defence Research Group (AFDRG: https://www.dstl.gov.uk/ukfrancephdprogramme). Professor Hossain is co-founder of Software, Knowledge, Information, Management and Application, a consortium

leading to an EU Erasmus Mundus funded project (Grant No. 545774) resulting in seminars/workshops and partnership exchange meetings involving Asian countries (Nepal 2011, Bangladesh 2009 etc.) to share knowledge, views and ideas in the area of computer science and digital technology.

Use of institutional facilities, expertise and resources to undertake these activities - The University has a well-articulated strategy for HEIF2011-15 and user-led research and its commercialisation, as well as optimising the impact of research through knowledge exchange and public engagement. HEIF funding is allocated for commercialisation of research and for staff exchange and consultancy with a view to establish new links/networks with industry and practitioners/end users. The UoA has specifically made use of (i) Commercialisation Development Projects – e.g. Intelligent Database Migration project, e.g. Vickers' 2010 patent application; (ii) Networking Fund – to establish Hossain's EU project; and (iii) Engagement Event Funding – e.g. Drs Zhang and Aslam involvement with the Newcastle Science Festival 2012. Training in public engagement and media are offered to all staff; both internal and external (e.g. provided by the Training Group; http://www.thetraininggroup.org.uk/). The UoA uses the University's Research and Business Service's (www.northumbria.ac.uk/business/) resources for advice and experience in cases where our software/techniques are thought to be of potential benefit to companies and industry. The UoA works closely with University Business Development Managers (BDMs) with specific sector portfolios (Health and Wellbeing and Energy and Environment) to identify possible research stakeholders and research commercialisation opportunities.

c. Strategy and plans

To maximise the impact of future research, the Unit has a strategy managed by our Impact Champion. The strategy entails a five-step approach to ensure that impact is a key component of high-calibre research. It will require that all research proposals should consider the following: (i) what is the relevance/benefit/potential of research to the beneficiaries (e.g. security companies, database management, network service providers)?; (ii) potential collaborators/participants in the research and how they will be involved; (iii) sharing and dissemination of research findings, to whom, when and how; (iv) identifying, measuring/assessing impact evidence; and (v) the economic impact of research (and at what levels). To support our future impact, an internal peer review process will ensure the above points are addressed. This strategy ensures that current best practice is embedded in all research. To continue to support our impact strategy in the future, we will commit resources for knowledge-sharing and continuous development of public and professional engagement; exchange knowledge and expertise in dissemination strategies and mechanisms; identify new collaborative partnerships while building on existing ones; and utilise and expand the UoAs impact database. The UoA will continue to work closely with the University's Public Engagement and Impact Manager to organise workshops for research end users and funders of stakeholder-led research.

d. Relationship to case studies

Impacts on Practitioners The KTP project illustrates our engagement with industry (and users of industrial products) by showing how our research has been used by AGUK Ltd which was able to develop a commercial intelligent geographical system and secure funding from the Government of Gibraltar. The company has now grown its activities in Gibraltar considerably through this commercial outcome.

Impacts on Society The setting up of nuWARP in 2010 as part of the UK Government's National Warning, Advice, and Reporting Point network illustrates leveraging of University resources to create a vehicle for transferring our research knowledge to SMEs and other organisations. This provides benefits in terms of improved network security and, hence, increases their resilience and sustainability (thereby addressing the government's public service agreements PSA1 and PSA7 on raising economic performance). Very recently our activities through nuWARP have attracted funding from EPSRC/GCHQ for the establishment of a Cybersecurity Centre (EP/K006568/1).