Institution: Staffordshire University

Unit of Assessment: Computer Science and Informatics (B11)

a. Context
a.1. Applied Research

Applied research is a long-held touchstone of the School of Computing, under which this unit of assessment lies. The unit tackles research challenges linked to real-world applications. Hence, the unit's members have worked with private and public-sector user groups or beneficiaries, including businesses and organisations such as the UK environment agencies, UK police forces, Serco Group plc (detention operations), NHS hospitals, Britvic Soft Drinks, BMW AG, Stormking Ltd, MDTi Ltd, Blackroc Technology Ltd, Peak Pursuits Ltd, etc. The research conducted in the unit has a wide range of uses such as within security, environmental conservation, healthcare, marine, vehicle safety, learning and teaching, and mobile and wireless applications.

The unit is a knowledge transfer crucible for information systems, image and video processing, artificial intelligence (AI), and mobile and wireless solutions which can achieve reduced operational costs, enhanced efficiency and effectiveness of services or products, and better environmental quality, as illustrated below. The knowledge created from applied research has been transferred to companies and public institutions through projects funded from internal or external schemes such as 'Knowledge Transfer Partnerships' (KTPs) and company assists via 'Innovation Vouchers'. In addition, the unit has spun-out companies during the assessment period. For example, AVA Technologies Ltd was registered to commercialise the leading-edge, patented video analytics technology (Spectral-360®) produced by researchers in the unit.

The main types of impacts (with examples of beneficiaries shown within brackets) from the research conducted in the unit are:
(i)   improved quality and efficiency of services (UK police forces);
(ii)   improved business performance (Britvic Soft Drinks);
(iii) enhanced technical standards or protocols (Environment Agency);
(iv) improved management or conservation of natural resources (Environment Agency);
(v)   stimulation of debate about environmental standards, resulting in a change of standards, informed by research from the unit (UK Technical Advisory Group for the Water Framework Directive (UKTAG WFD));
(vi) creation of spin-out companies (AVA Technologies Ltd);
(vii) change of practices or adoption of new or improved technologies or processes in companies or other organisations (UKTAG WFD, Serco Group plc - HMP Dovegate, BMW AG, MDTi Ltd).

a.2. The case studies
Developed with funding totalling £77k from the Higher Education Innovation Fund (by HEFCE) and from the Advantage Proof of Concept Fund (by Advantage West Midlands), tools built on Spectral-360® have been used, for example, to improve the effectiveness and efficiency of police officers investigating crimes recorded in video footage. Spectral 360® was developed as a significant part of doctoral research supervised by Chibelushi and Moniri (who is returned in the General Engineering submission). Commercialisation was embedded into this doctoral work as a key target, at the inception of the research project.

With funding from the UK environment agencies totalling £230k over the assessment period, the unit also made significant contributions in the area of scoring algorithms and AI techniques for biological monitoring and diagnosis of river health in the UK. Walley and co-workers (Trigg and Paisley), collaborated with Hawkes of Aston University to produce the WHPT ('Walley, Hawkes, Paisley & Trigg') river water quality scoring algorithm. WHPT has been selected by the 'United Kingdom Technical Advisory Group for the Water Framework Directive', to be used for measuring the quality of river water by UK environmental agencies. This important measurement method helps the agencies meet the requirements of the European Union's Water Framework Directive. A primary objective of the Directive is that all surface water bodies in the EU will have a "good" or

"high" ecological and chemical status by 2015. Furthermore, using pattern recognition and plausible reasoning, as used by experts when diagnosing ecological health, the unit produced novel intelligent systems for monitoring, classifying and diagnosing river water quality. The research was lauded by the 'million+' university think-tank as an exemplar of research which (among other impacts) adds value to business and meets the needs of society (Ebdon and Tatlow, 2011, p. 25).

Les Ebdon, Pam Tatlow, Research that Matters, million+, May 2011. Available at: http://www.millionplus.ac.uk/documents/reports/RESEARCH_THAT_MATTERS_FINAL.pdf, [Accessed on 16 November 2013]

b. Approach to impact

The University Plan (2007-12) strongly supports business and public sector partnerships with national and international stakeholders, for education and consultancy or research projects. The unit leverages these partnerships and support from an enterprise team, to impact on beneficiaries outside and within academia.

b.1. The enterprise team

The enterprise team comprises support staff from the Faculty and from the 'Enterprise and Commercial Development' service of the University. The team consists of 'Enterprise Readers', 'Innovation and Development Consultants', and administrative and financial support staff. They provide advisory, administrative and partnership brokering support for establishing industrial or academic collaboration, for grant applications, and for commercialising research work. This includes support for developing and managing successful funding bids to engage with users (including companies and the public sector) and thereby create wealth.

Furthermore, the 'Enterprise and Commercial Development' service in the University provides support for securing patents and spinning out companies for the commercial exploitation of intellectual property, such as Spectral-360®, produced by researchers at Staffordshire University. The enterprise team also facilitates knowledge transfer through KTPs. For example, staff in the unit worked with Grenville Engineering Ltd on a KTP project. This work automated and streamlined systems and processes at Grenville Engineering by developing a new management information system which enabled the company to grow its business, improve its customer communications and control its costs. The company estimated that the introduction of the management information system resulted in increased revenue by more than £1.5M over the REF 2014 assessment period.

b.2. Public and private sector partnerships

The unit has close working relationships with a number of public and private sector organisations. Fruitful long-term relationships have often arisen from interactions with beneficiaries initially around small-scale research or consultancy projects, many brokered by the enterprise team. The collaboration involving the unit and Britvic Soft Drinks is a good example, which sprung from an initial invitation to contribute research-led thinking to a business problem. It later developed into further research into information systems and work-based learning programmes for staff at Britvic Soft Drinks. This lead to further research and development of work-based learning programmes; one such spin-off work secured £220k funding from the EU Lifelong Learning Programme (for a project entitled 'An Approach to Qualifications Through Negotiated Work-based Learning for the European Union') (Eardley, Borup). Another example is the technical feasibility study about the introduction of video analytics tools into the operations of prisons managed by the Serco Group plc, as an initial step towards a lasting relationship hinged on custom solutions developed for the company (Sedky, Chibelushi). A further example is the unit's research around Radio Frequency Identification (RFID) and Internet-of-Things (IoT) technology for hospitals (Atkins). A smart hospital theatre management system using RFID technology and IoT was developed in collaboration with Walsall NHS Trust. The system is being used to detect, locate and monitor patients and track assets and equipment. This has grown from an initial project funded through the Higher Education Innovation Fund and Walsall NHS Trust, into further research directed at hospitals as far afield as the Kingdom of Saudi Arabia (the work is funded by the Saudi Government through scholarships for doctoral studies). Another illustration is the training tool for nurses and clinical staff developed for Birmingham Children's Hospital (Mills). This virtual reality system has been used successfully to

inform clinical staff about end-of-life care of patients who are Muslims. A second phase of this on-going work informs in a similar way about Hinduism.

c. Strategy and plans

The Staffordshire University Plan includes a firm steer towards ensuring that the University creates a demonstrable impact on the competitiveness of business and the success of the local economy, by (among other things) supporting the engagement of staff and students with businesses, and enabling collaboration with external partners on the design of courses and the co-development of products and services. The University wants to contribute to the long-term economic growth and prosperity of the UK by creating new businesses, growing the value of its intellectual property and demonstrating economic impact through innovation, and job and wealth creation (University Plan 2007-12).

Staffordshire University considers its engagement with business, industry and employers in the public, private and voluntary sectors to be key to its success. Indeed, the University wants to ensure that the academic portfolio is underpinned by scholarship and research, and to ensure that the applied research and knowledge transfer activities are business and commercially focused, and are delivering impact on society at large.

A key target is for Staffordshire University to be a leading business and employer-facing university by 2017. The University listens to the business voice, as an important mechanism for supporting staff and student engagement with businesses. The Plan recognises that, through their research and enterprise projects, Applied Research Centres (further details are given in the environment template (REF5)) are a key organisational vehicle for creating and exchanging knowledge relevant to stakeholders in the private and public sector, both nationally and internationally, and for delivering the most up-to-date and commercially relevant curriculum both on and off campus.

More strategic statements covering other aspects of the University research strategy are given in the "Research strategy" section of the environment template (REF5).

d. Relationship to case studies

The University's Enterprise Team found commercial opportunities and seed funding for AVA Technologies Ltd, which was spun out from the unit with support from the 'Enterprise and Commercial Development' service. The team also publicised to UK police forces the video analytics tools developed by the unit (Case Study 1 – "Adaptive Video Analytics Software"). For example, Staffordshire Police and Leicestershire Police responded and asked for assistance from the unit on two criminal cases under investigation. Case Study 1 builds upon research which was geared, throughout the project, to producing a commercial outcome, which would be tied to the benefits of enhanced reliability of automated object detection under unwanted changes of scene illumination. This research produced a novel object detection algorithm (Spectral-360®) and a software suite which includes tools built around Spectral 360®, for use in applications which require real-time video analysis under operational conditions that may be afflicted by adverse conditions such as varying illumination.

With regard to Case Study 2 ("Computer-Based Methods for Diagnosing and Predicting River Health"), the unit has conducted many research projects funded by environmental agencies. These projects cemented a long-term relationship with the Environment Agency (EA) and with the user community of environmental technologists working in the area of river water quality. This applied research, begun in the 1990s, has been conducted by the 'Centre for Intelligent Environmental Systems' (CIES) in order to devise AI techniques for use in diagnostic tools which can identify the causes of poor river quality in the UK, focussing on causes which are linked to pollution. The case study demonstrates how the research has now had impact on the implementation of European legislation by UK regulatory authorities.