Institution: Oxford Brookes University

Unit of Assessment: 11 - Computer Science and Informatics

a. Context

Research within the UoA positively impacts the producers of IT based products, systems and services, and the associated users and consumers. Impact typically arises from the application of the tools, methodologies, techniques, open source software, products, standards and patents that are generated, and which map onto three strategic research themes: Intelligent Interaction (T1), Reliable Systems (T2) and Smart Networking (T3).

Beneficiaries include international corporations (e.g. Sony), SMEs (e.g. Wildknowledge, Clearview Traffic), standardisation bodies (e.g. Open Group), service providers and end users (e.g. Nominet), the science community (e.g. Culham Laboratories, Diamond Light Source), the entertainment industry and their user base (e.g. through OMG), and users of mobile devices (e.g. through the MONICA project and Wildknowledge). Relationships with these companies include research and knowledge exchange collaborations in the areas of product development, standards and open source software and use of schemes such as Knowledge Transfer Partnerships (KTPs).

b. Approach to impact

The UoA's two research centres have encouraged staff to include within their research plans appropriate knowledge exchange mechanisms to develop impact through three strategic research themes: Intelligent Interaction (T1), Reliable Systems (T2) and Smart Networking (T3).

There is an established track record of delivering high quality concepts and innovation based on the intellectual capital arising from research activities. This can be evidenced through examples of research relating to tools and technologies including chaotic neural networks (T1), GfXpressTM (T2) and heterogeneous networks (T3). A major impact of the Intelligent Interaction theme (T1) arose from the development of new conditional random fields techniques in computer vision resulting in novel technologies for the entertainment industry. Research in Intelligent Interaction (T1) and Smart Networking (T3) has contributed to open source software (for example robotic operating systems, wireless network drivers and network simulators). The development of skin detection technology in collaboration with Sony under the Intelligent Interaction theme (T1) has resulted in the Wonderbook Book of Spells product. Work in the Reliable Systems theme (T2) has contributed to impact relating to standards (for example for enterprise architecture frameworks and software quality assurance for architect certification). Both the Intelligent Interaction (T1) and the Reliable Systems (T2) theme have filed four patent applications (for work on 'A Method Of Controlling A Dynamic Physical System That Exhibits A Chaotic Behaviour', 'Cross Parity Based Error Tolerant Circuit Design', 'BCH Code Based Dynamically Error Correctable Electronic Circuit Design', and 'An Efficient Approach to Synthesise and Optimization of GF(2m) Polynomials in Hardware').

The UoA has a number of formal mechanisms to support impact generation from 'inception', through 'development' to 'mobilisation':

At the *inception* phase (where research ideas are formulated), mechanisms include:

- An active 'Industry Advisory Board' that provides strategic advice and industrial/user-based perspective on research priorities and directions.
- Personal networking and participation in networking events (e.g. Venturefest for which Oxford Brookes University is a silver partner) and regional IT fora.
- Other industrial and user based interactions that provide a means of inspiring and focusing the research agenda toward areas of key technical and/or commercial significance. These include the interchange of staff and research students with major firms such as Microsoft Research (e.g. Torr and Kholi) and other organisations such as STFC Rutherford Appleton Laboratory (i.e. **Duce**, Matthews and postgraduate students).
- Collaboration with other parts of the University including the Department of Sport and Health Sciences (olde Scheper and **Cuzzolin** are collaborating with Dawes), the

Department of Biological and Medical Sciences (**Duce** has collaborated with Thompson which led to a KTP with Wildknowledge) and the Department of Real Estate and Construction (**Duce** with Tah on the TSB funded project 'Integrated Carbon Waste and Cost Modelling for the Design of Low Impact Buildings'). Also **Harrison** has collaborated with Gellatly of the Department of Psychology in the area of mobile app design.

At the *development* phase (where research ideas are transformed into research outputs), mechanisms include:

- The University's Central Research Fund, which has an annual call for proposals. This fund is particularly targeted at research with potential exploitable outcomes. The UoA typically has several projects per annum supported by this fund to an annual value of approximately £30K. For example, a project to exploit the combination of NLP and Computer Vision research was funded to support a PDRA.
- QR funding that is devolved to the UoA to support selected research areas and the exploitation of research. Throughout the census period this has accounted for 60% of total QR income to the UoA. Uses have included support of PDRA's in Applied Software Engineering and Cognitive Robotics.
- External funding from the Leverhume Trust (e.g. Torr), TSB (e.g. **Duce**/Tah), EPSRC (e.g. **Cuzzolin** and Torr), EU programmes (e.g. **Ou** and **Zhu**), ERC (e.g. Torr) and from industry (e.g. Technicolor, Sony, the Open Group).
- The Faculty 'Next 10' scheme that seeks to accelerate staff development for outstanding mid-career researchers through increased research hours and allocation of a fully-funded PhD studentship (e.g. **Cuzzolin**). Agenda based leadership and applied outcome-based impact are core to the selection process.

At the *impact generation* phase (where impact is realised), mechanisms include:

- Supportive strategic planning processes at University, Faculty and Department levels. Impact is considered in the development of personal research plans (agreed annually). It is also a feature of staff development processes and addressed when considering the appointment and progression of research staff to higher grades. It is a particularly relevant consideration in the appointment of professors and research leaders.
- The University's Research and Business Development Office supports academics throughout all stages of research and knowledge exchange activity (e.g. KTPs and patent applications).
- A well-resourced University HEIF programme (resulting from upper quartile performance in relation to commercial interactions) is available to support impact generating activities. The programme is designed to foster 'third stream' and knowledge based activities that have positive economic and social impacts. Academics can bid for up to £50K. Several projects have been supported within the UoA (e.g. Torr, **Jabir** and olde Scheper).
- KTPs are used to foster project based industrial collaboration. The quality of UoA/industry collaborations through the scheme has been exceptional. For example, in 2013 a second KTP with Sony was awarded a Grade A, 'Outstanding' (only circa 10% of KTPs are graded at this level). More recently the UoA has been awarded a KTP with Clearview Traffic, a company based in Bicester specialising on products that improve driving safety and automated traffic counting.
- A number of instruments, such as revenue sharing agreements for inventions and professorial promotions, are used to reward and recognise, *inter alia,* successful impact.

c. Strategy and plans

The primary instruments to drive future impact generation will be the two research centres: Intelligent Systems Engineering (ISERC) and Dependable Systems Engineering (DSERC). The research centres provide vision and leadership, determine research agenda and manage the overall research portfolio in the UoA. Research will continue to be addressed through the themes of: intelligent interaction, reliable systems, and smart networking. Both centres will operate from within new purpose built laboratories intended to facilitate synergistic interactions between

postgraduate students, postdoctoral research assistants and members of academic staff, as well as industrialists and collaborators. A further key motivation for setting up these centres was to enable synergistic interactions between staff engaged in impact generation and those engaged in the generation of new ideas.

Through the areas of focussed engagement reflected by the centres, research within the UoA is implicitly directed towards the requirements of industry and needs of users. The UoA will continue to invest in the growth of collaborative networks. For example, the strategic appointments of both **Steil** and **Hartley** are enhancing the reach of networks in the areas of robotics and computer vision. Similarly, the EU funded MONICA project, led by Oxford Brookes University, was a strategic investment in Euro-Sino collaboration in the area of mobile cloud computing.

Mechanisms supporting impact generation will continue to include incorporation of research results into standards (e.g. W3C recommendations, ISO/IEC standards), embodiment of algorithms and techniques in open source software (e.g. OpenWRT, NS3), incorporation of techniques directly into products (e.g. the Sony Wonderbook), exploitation of patents (e.g. MOD error tolerant electronic circuit design).

d. Relationship to case studies

Sony's Wonderbook: theoretical mathematics contributes to enriching the gaming experience

The research that facilitated the development of the Sony Wonderbook™ was underpinned by work funded through EPSRC projects. In particular the Automatic Generation of Content for 3D Displays (EP/C006631/1(P)), and Markov Random Field Methods for Segmentation projects contributed to the theoretical advancements that enabled the skin segmentation algorithm to be developed for the Wonderbook. These advancements included the ability to perform skin segmentation with varying skin colours and lighting conditions within a 30th of a second per video frame. This work was taken to market through a successful KTP with Sony Computer Entertainment (2010-2012).

Reducing fraud: Using research to help one of the world's leading internet registry companies to understand typosquatting and improve abuse detection..

The research, which led to the impact case study on Typosquatting, was initiated through a KTP project with Nominet, the internet registry for UK domain names. The methodology that was developed for anomaly detection and characterisation has delivered benefits both to Nominet and to the wider industry as a whole. Research in web-based visualization and data mining within the department underpinned this project. In part this emerged from the two EPSRC-funded collaborative projects: Visualization Middleware for e-Science (GR/R96224/01) and Open Overlays (GR/S68514/01).