Institution: Birmingham City University

UOA of Assessment: Computer Science & Informatics (UOA 11)

a. Context

This UOA has an established track record developed over two decades in conducting and exploiting research to solve real world problems with our partners in industry. Partnerships are vital to our strength in achieving impact, from dynamic international collaborations within EU projects to vibrant links with regional and national industry. Our strong institutional emphasis on technology transfer between 2001 and 2007, has facilitated the development of a well-established reputation for close collaboration with industry and businesses to achieve direct impacts. Current partnership activities exploit our research to improve existing product qualities, co-create new products, and transform domain-specific knowledge into automated processes thus achieving economic impacts through increased growth, productivity and enhanced competitiveness.

During this REF period, we have made significant investment to support our existing research capabilities and attracted a fresh and innovative leadership team to initiate research in new subject areas such as cyber security and formal software development methods. This has allowed us to sustain and grow our capabilities to deal with increasingly significant external challenges. This has been demonstrated by our ability to engage and deliver on several challenging EU funded projects.

b. Approach to impact

The three research groups in this UOA: Software Engineering (SE), Digital Media Technology (DMT) and Cyber Security (CS) have a distinctive approach to impact that is focussed on on-going co-production of knowledge between researchers and professionals working in the context of their organizations and sectors. The groups favour an interdisciplinary approach working in partnership with industry having built up a number of very effective long-term collaborations aided by externally facing centres namely the Knowledge Based Engineering (KBE) laboratory and the Centre for Low Carbon Research (CLCR).

During the REF period, this UOA has participated in a range of UK government and industry funded projects that have supported individual organisations through the following schemes: ten Knowledge Transfer Partnerships (KTP), ten Knowledge Innovations Technology Transfer Schemes (KITTS), and three University-sponsored Knowledge and Business Partnerships (KBP).

These partnerships involve the application of knowledge developed during research to support the development of products and services by companies where the impact is measured in terms of tangible benefits to the organisations' finances. The majority of these KTPs were independently assessed as very good/excellent. Monitoring of nine KTPs reveals the following summed differences between the start and the end of these projects: rises in turnover of £15M, in profitability of £1.3M, and in employment of 57 jobs, with greater increases predicted for future years.

Another mechanism for achieving impact has been by direct involvement of end-users in the planning and execution of PhD projects, enabling the solution of substantially complex problems to benefit the sponsoring organisations in the long term. In SE this is exemplified by five PhD projects that are either funded or defined by Rolls-Royce, and four faculty, fully-funded, PhD studentships addressing research topics informed by discussions with SAP and its user base. Whilst within the DMT group the goals for three PhD projects were defined in consultation with Orad, Music Group plc and Mixgenius respectively.

During this REF period, this UOA has also collaborated with groups of larger organisations within international projects as evidenced in the following three application domains:

1. There has been extensive engagement by researchers in this UOA in smart cities development. In addition to other EU partners, this work was in collaboration with Birmingham City Council, with staff from the UOA providing consultancy and being represented on the Birmingham Smart City Commission to facilitate impact on local government strategy. Within the EPIC project receiving €400K of EU funding for BCU, DMT and SE staff have led workpackages contributing to the development of systems that have demonstrated the potential benefits from the integration of a number of municipal services on a scalable ICT

platform to city administrations in Belgium, UK, France and Romania. This is informing and impacting on their future ICT strategies. Currently we are building on this work via the KIC-Transitions project that is engaging with cities in the UK, Switzerland, and the Netherlands.

2. As a partner on two INTERREG IVB projects receiving £1.7M EU funding for BCU, SE has introduced Semantic Web and Linked Data technologies to the algal biomass community. Several datasets, such as CO_2 sources, have been made available as Linked Data and we have worked with biologists to develop knowledge-rich semantic models, so that bioenergy stakeholders will have a more accurate analysis of the potential of biofuels production from algae. These tools have had impact by allowing stakeholders in the bioenergy domain to make better informed decisions regarding their investments in algae markets.
3. CS has contributed to international cooperation on providing suitable technologies to enable effective sharing of cyber threats. This catalyst project has been coordinated by the Telecommunication Management Forum (TMForum) with international partners including RSA, DSTL, TAO, Telstra and AT&T (2012-2013). The CS contribution includes the design of suitable architectures to enable threat sharing among partners to enable better cyber security protection of critical information. Potential beneficiaries include governments, large organizations and supply chains.

An example of the UOA's agile approach to opportunities for impact via co-production of knowledge is provided by the case of work with Nine Tiles Networks, a small company developing specialised computer networking systems for audio/video distribution. Following initial discussions an MSc project in the simulation of the network architecture was proposed. On completion The MSc student was enrolled for a PhD in this topic in 2013 with a further PhD student accepted for 2014. Early results have been presented in the Future Zone at the International Broadcast Convention (IBC) (2013). Impact has arisen in terms of improved capability within the company and through joint contribution, via John Grant, MD of Nine Tiles, to two draft standards being developed by the Working Groups IEC-62379 (Common Control Interface for networked audio and video equipment) and ISO/IEC JTC 1/SC 6/WG 7 (Network, transport and future network) Part 3: Switching and routing.

The university offers support mechanisms for impact activities, through the Research, Innovation and Enterprise (RIE) unit, on IP, legal contracts and targeted dissemination of funding opportunities. In addition there is faculty based support delivered by an experienced team.

The University is also keen to reward staff members who have delivered projects leading to significant impact. Incentives span from providing time allocations, through attainment of performance indicators for career progression, to possibilities of negotiating IP sharing arrangements.

This UOA has a tradition of strong regional engagement and this has been maintained by organising regular networking events for local SMEs such as Creative Networks, a monthly networking event which has been operating for eight years. We also co-sponsor events organised by local Science Parks such as Innovation Birmingham, and the Birmingham Made Me exhibition.

At a national level, this UOA engages with the TSB ICT and Creative Industries KTNs. Engagement with the IT departments of major organisations is also developed through hosting software user groups events, such as those for SAP and SAS applications users giving access to corporates including Atos, CSC, Aurum Holdings, EdenHouse, Capgemini, and Amey.

c. Strategy and plans

During the last REF period, our approach to impact, as described in the previous section, has proved to be highly successful. During the next REF period, we plan to continue with this approach, albeit with some refinements in order to take account of emerging considerations.

1. Our strong and extensive relationship with regional industry and businesses and the high reputation which has grown over a number of years, is a huge asset. We plan to build on this and expand this network to increase our partnerships in volume and in quality. To achieve this, we will intensify our dissemination activities to attract more companies, and mentor early career researchers to engage in our technology transfer partnerships.
2. As a result of continued investments in our research capabilities, we have attracted staff with

extensive international networks. We intend to build on this to enhance our ability to engage in increasingly international collaborative challenges.

3. For the above reason, the new capabilities add stronger theoretical underpinning of our applied research. This creates new opportunities to tackle more challenging problems and, therefore, to achieve wider impacts across whole sectors. This is particularly relevant in the area of cyber security as well as in supporting engineering methods for smart cyber physical components.
4. Due to the increasingly high profile of the impact agenda, particularly in internationally funded projects in which partners are not the main beneficiaries of the research, we plan to gain a deeper understanding in evaluating the nature and extent of impact, identify good practices and embody the knowledge gained in the design and execution of future projects.
5. Current trends point to ever increasing role of multi-disciplinary research. We will build on the experience gained from our collaborations in a number of current multi-disciplinary EU projects, to have a deeper understanding of how to achieve impacts in this type of projects. In addition to national and international cooperation, will harness our inter university cooperation with University research centres in health, engineering, environment, social science and law
6. Our multi-faceted approach to gaining research funding places us in a sustainable position. Our disciplined research capabilities have flexibility to adapt research to serve changing priorities in funding and in contributing to future research challenges during the next REF period.

d. Relationship to case studies

Crash Test Analysis: Based on research carried out within the DMT group, innovative technologies were developed in partnership with industrial partners, namely MIRA and Pixoft, that have revolutionised the professional practice in the global vehicles crash testing industry. As the case study shows, this is an excellent example in which the impact was not just confined to a short period but is long lasting. Its nature was transformational rather than providing small improvements, and its beneficiaries extend well beyond the immediate industrial partners to wider society (links to the design of safer cars and thus better safety for car users and pedestrians) as well as more competitiveness in UK as a whole, with links to diverse UK companies and SMEs that benefit from the systems as a research tool in their domains.

The UOA's approach has been demonstrated by the cultivation of research excellence in specific areas to build sustainable partnerships with key industrial stakeholders based on the provision of technological innovations. After the initial impact had been achieved, further ways were explored to enhance the impact by widening the scope of the beneficiaries and extending its effect for longer period by consolidating the innovations.

Knowledge Based Engineering: The relationship with Rolls-Royce and KBE Lab began with an initial 12-month KBP, which focused on modelling Rolls-Royce's advanced engineering systems, to provide better understanding, knowledge and intelligence of those key systems. The KBE Lab's relationship with Rolls-Royce was further enhanced when it was selected to enter into a research activity built around the £90m, TSB funded Strategic Investment in Low Carbon Engine Technology (SILOET) Project, which continued the initial work of the KBP by investigating further modelling of key systems and developing potential architectures to enhance Rolls-Royce design automation systems. The KBE Lab also embarked on a programme of bespoke training for Rolls-Royce's senior management and key engineering teams. A KBE day was organised in 2012 and yearly afterwards to bring together industrial partners who are interested in KBE and to provide platform for interaction and collaboration. An industry advisory committee will be set up to provide strategic direction to the group and facilitate the development of solutions to solve common problems faced by industry.

The UOA's approach to impact is predicated on solving real-life problems and providing benefits to society as a whole. The initial steps focussed on developing solutions to industry problems within a single company. However, the KBE group has since been developing its research activities with other industrial partners and solving complex problems faced by other sectors, particularly environmental, automotive and construction.