

<p>Institution: Birkbeck, University of London</p>
<p>Unit of Assessment: 11 – Computer Science and Informatics</p>
<p>a. Context</p> <p>The Department of Computer Science and Information Systems is one of the four constituent departments of the School of Business, Economics and Informatics (BEI). The Department celebrated in 2007 the 50th anniversary of its foundation, making it one of the oldest academic computing departments in the world. There are two main research groups, of roughly equal size and levels of research activity (see REF5): the Computational Intelligence (CI) and Information Management & Web Technologies (IMWT) groups. We have a joint research collaboration with the Institute of Education – the London Knowledge Lab (LKL) – and four members of the CI and IMWT groups constitute the Department’s Learning Technologies subgroup. There is also cross-group research in bioinformatics and health informatics.</p> <p>Our main non-academic user groups are in IT, the life sciences, healthcare, education, culture, ecology and urban development. Non-academic beneficiaries of our research include private, public and voluntary organisations in these sectors, other business organisations, policy makers, museums, and libraries. The types of impact arising from our research include:</p> <ul style="list-style-type: none"> • mobile applications supporting biodiversity, citizen science, urban development, transportation, home health monitoring, and performance art; with beneficiaries including ecologists, urban developers, business organisations, patients, carers and artists; • data warehouses supporting the management and analysis of life sciences data; with beneficiaries including companies in the healthcare and life sciences sectors; • intelligent software tools used in schools, further education (FE) and higher education (HE) to support students’ learning and teachers in their roles; with beneficiaries including students, teachers, teacher educators and education policy makers; • algorithms used for online recommendation, with beneficiaries social media service providers; • algorithms used for classifying images on the web, with beneficiaries including companies in the electronics and telecommunications sectors; • transfer of our information systems research to small businesses’ use of IT in business transformation; with beneficiaries small firms across a range of sectors.
<p>b. Approach to impact</p> <p>The potential for impact is identified at the outset of all externally and internally funded research projects. Up to 2012 the College’s Business Relations Unit was responsible for advising staff on knowledge transfer and research exploitation. This centralised College strategy is evolving into a targeted School-level strategy, with the appointment of staff who have sector-specific expertise relevant to the School’s research specialisms. Specifically, two full-time staff currently constitute the School’s Business Engagement and Impact Group (BEIG) and additional external experts are contracted for specific activities. There is an Entrepreneur-in-residence in the School who heads the Entrepreneurial Innovation Programme and whose role includes increasing staff and students’ awareness of entrepreneurship opportunities.</p> <p>The Department assesses the exploitation potential of its research in consultation with the BEIG, supported by specialist skills provided by UCL Business through a College partnership agreement. This process has identified several software technologies for IP protection, including a novel method for delivering mobile location analytics (MLA), with applications in areas such as ecology, transportation, healthcare and urban development.</p> <p>Building on our national and international reputation for research excellence, the Department pursues links with industry through our extensive technology transfer networks, including London First, the CBI, the UK Innovation Forum and our Industry Advisory Board, comprising a group of senior IT professionals. The research groups play several key roles in relation to impact: sharing members’ expertise, resources and contacts; raising the profile of early career researchers within target audiences; and expanding our networks of staff and practitioners. We have research links with companies in areas such as IT (e.g. IBM, Lazysoft, Microsoft, SAIL), web search (Google, Yahoo!), micro-electronics (Sintronics - Russia), RFID and automatic identification and data capture (CustommediaSdnBhd - Singapore; FEIG Electronic GmbH - Germany, High Tech Aid - USA, AIM UK, Praxis, Skyetek - USA), system software (TRON - Japan), data warehousing (Benchmark Performance), business development (inmidtown), learning technologies (Testaluna, Whizz), social media (LOCQL), finance (First Capital, BNY Mellon) and art (Proboscis), in</p>

Impact template (REF3a)

partnership with whom we are able to explore and develop exploitation routes for research. Recent examples of this are Maybank's image classification algorithms developed with the National Laboratory of Pattern Recognition, Beijing, that are being used by several electronics and telecoms companies; online recommendation algorithms arising from Zhang's information retrieval research that are being used by a social media provider in their location-based community answering and photo sharing services; and mobile apps arising from Roussos' research in participatory cyber-physical computing that are being used to monitor biodiversity, support Parkinson's patients, improve the well-being of workers in urban spaces, and allow commuters to reduce travel costs.

Much of the Department's research has users or user stakeholders as participants, most notably our research in: (i) learning technologies e.g. students and teachers in schools, FE and HE; public bodies such as UCAS, learndirect, Aimhigher, TeachFirst; (ii) pervasive computing e.g. inmidtown, International Institute of Visual Arts, London Zoo, UCL Museums, Bartlett School of Architecture, Proboscis, Transport for London; (iii) bioinformatics and health informatics e.g. the European Bioinformatics Institute, UCL's School of Life and Medical Sciences, London School of Hygiene and Tropical Medicine; and (iv) text search and text mining e.g. the Southampton's Faculty of Humanities and Cambridge University's Taylor-Schechter Genizah Research Unit.

Staff engage with commercial, educational and policy organisations nationally and internationally in a range of knowledge transfer activities, including: (i) presentations and software demonstrations at professional conferences and CPD events, e.g. the MiGen system for learning algebra was demonstrated at conferences of the National Centre for Excellence in the Teaching of Mathematics; the LDSE system for creating learning designs was demonstrated to the Moodle community (ULCC, Moodlerooms) and at a Learning Design workshop for FE teachers; and the Samtla text search and mining tool at Search Solutions 2012; (ii) exhibitions at museums and festivals, e.g. our mobile public authoring applications were demonstrated at Surface Tension (Science Museum, London 2009), Digital Cities (The Building Centre, London 2009), Mobilefest Festival (Sao Paulo, Brazil 2009), Dislocate08 (Yokohama, Japan 2008), Art and Cartography Exhibition (Wien, Austria 2008); (iii) book co-authorship, e.g. a book on event-based distributed systems published by Springer with contributions from IBM, Oracle, SAP, TIBCO; (iv) training delivered with IT practitioners, e.g. Wood with the British Library, Zhang with Data Science London. The Department's London Knowledge Lab collaboration plays a major role in our engagement with practitioners through the organisation of open days and workshops with participation by teachers, teacher educators, policy makers, learning technology and media companies, and publishers, e.g. *Learning with Technology* in March 2012, the *Education Hackday* in November 2012, and the *Potential of Learning Analytics and Big Data* workshop in March 2013.

There are numerous fora for engagement with the public: the School's annual Business Week, providing an opportunity to showcase all our research through presentations and other activities; public events organised by the LKL featuring our research in learning technologies; media articles and reviews of our research in trade and science blogs, magazines and newspapers; membership of the ACM Public Policy Committee, Smart Identification and IoT Forum (Roussos); participation in the UK Computer Conservation Society (Emeritus Reader Johnson).

In keeping with Birkbeck's mission to provide degrees by flexible part-time study, the majority of the Department's postgraduate students study part-time while working in sectors such as IT, business and finance. These students' workplace experiences inform the research problems that they investigate, and their research findings can, in turn, lead to improved workplace practice. Recent examples of this are projects investigating consumer responses to varied media exposure, evaluation of online recommender systems, and impact of off-shoring on the operation and organisation of multinational IT firms. Some of our postgraduate students become active members of informal Department-Industry networks, disseminating research findings to their professional colleagues, bringing back to the Department issues and topics to inform our research, and delivering guest lectures on postgraduate taught modules of the Department.

Incentivising and recognising the achievement of impact arising from research are part of the normal staff monitoring and line management responsibilities of the Head of Department and Dean of School. Achievement of research impact is recognised by the remuneration and promotion processes of the College as an area in which excellence can be displayed and rewarded. The School established a budget in 2012 to support staff in developing impact from their research: applications are submitted twice a year and are reviewed by a panel of senior academic staff of the School; members of the Department have been awarded funding for seven such projects to date.

Impact template (REF3a)**c. Strategy and plans**

Over the next five years, the Department's plans in relation to impact are to:

- build on and extend our existing areas of research impact in IT, the life sciences, healthcare, education, culture, ecology and urban development sectors;
- increase income arising from commercialisation of research: a review in early 2013 of the commercialisation potential of the Department's research identified several routes for increasing licensing, spin-out companies and consultancy in the areas of data analytics, learning technologies and mobile applications;
- increase impact arising from the IMWT group's research in data integration and text mining for cultural heritage preservation, working with user stakeholders in museums and libraries;
- increase impact arising from the CI group's research in ontology-based data access (OBDA): we have developed a query rewriting engine that is incorporated into the Ontop OBDA system being developed at the Free University of Bolzano; in collaboration with the EU FP7 Optique project team, we will apply Ontop to use cases provided by Siemens and Statoil, with also potential for broader impact in areas such as finance, electronics, energy and transport.

Our view is that a precondition for impact is that staff conduct, publish and disseminate research of the highest quality, thereby building up strong reputations within target communities of users and other beneficiaries. The Department has many mechanisms in place to ensure this, relating to the recruitment, development, training and support of staff and research students (detailed in REF5).

The Department develops its strategy for research and research impact through its Research Committee, informed by discussions in its Senior Staff group and Industry Advisory Board. Our impact strategy informs and is informed by the School's impact strategy, which is developed through discussions in the School's Executive Board (Levene and Poulouvassilis are members). All these are fora in which research impact is reported and reflected on, new opportunities for impact are identified, and new mechanisms for supporting impact are formulated.

Key to the Department's impact strategy is the encouragement of collaborative research carried out by multidisciplinary teams involving users or user stakeholders as full participants. Such research has direct potential for impact due to users' involvement right from the outset, who play a central role in prioritising the research questions, co-designing software and associated materials, evaluating the research outcomes, and engaging with their communities of practice for dissemination and uptake of these outcomes. Equally important to our strategy are promotion of links with industry partners with whom we can develop research exploitation routes; engagement with commercial, educational and policy organisations in knowledge transfer activities; and maintaining Department-Industry networks through our part-time postgraduates and alumni.

For the future, the School's Business Engagement and Impact Group (BEIG), together with UCL Business, will continue to support the Department's impact strategy by assisting staff to develop contacts with external organisations, acting as a first point of contact for commercialisation and partnership proposals, advising staff on protection and commercialisation of IP, and liaising with agents and lawyers. The BEIG will assemble the impact-related experiences of researchers throughout the School and will compile guidance and best practice for achieving impact. It will use this to help existing research projects to enhance their impact and to assist in the preparation of new research proposals. The School will continue to run its annual Business Week, comprising public lectures, discussions and debates, which present the research of all the School's departments to a wide audience, including Birkbeck's community of students, staff and alumni, the general public, and targeted audiences of potential users and beneficiaries of specific research.

d. Relationship to case studies

The case studies draw on long-term research agendas of the Department, established before 2008. Case studies 1 - Roussos, 2 - Martin and 3 - Poulouvassilis all exemplify the Department's strategy (articulated in our RAE 2008 return) of engaging in multidisciplinary research projects with users and user stakeholders as full participants. Case study 1 has informed the development of our strategy of forming sustainable research links with companies with whom we can exploit the outcomes of specific research projects. Case studies 1 and 3 have informed the development of our strategy for knowledge transfer through participation in exhibitions and professional conferences. All three exemplify achieving impact by working on challenging research problems whose solution results in tangible benefits to peoples' personal, cultural and working lives.