Environment template (REF5)

Institution: UNIVERSITY of WEST LONDON

Unit of Assessment: 11 | COMPUTER SCIENCE and INFORMATICS

a. Overview

This unit of assessment submits 10 FTE staff based in the School of Computing and Technology (SoCaT) and in the University's Institute for Practice, Interdisciplinary Research and Enterprise (INSPIRE). Growth of research, enterprise, and scholarship in Computer Science and Informatics from RAE 2008 has been supported by a robust and developmental research and scholarship strategy of the University (2008 – 2013 and updated in October 2010) guided by the strategic plans of the University (2008 - 2013 and 2013 - 2018).

INSPIRE was established in 2011 in order to facilitate and grow an interdisciplinary research culture across the University and enhance its PhD infrastructure. The unequivocal aim of the Institute is to support directly the University's Research Scholarship and Enterprise Strategy by providing interdisciplinary research leadership across its academic disciplines including Computer Science and Informatics. The Institute comprises research-focused senior academics (Professors and Readers) that conduct and promote research University-wide. Professor Dimitrios Rigas, and Dr José Abdelnour-Nocera (Reader), have expertise in Computer Science and Informatics. Additionally, the Institute provides a research office infrastructure (formerly undertaken by the Graduate School) and fosters an environment supportive to of all doctoral students and research-active staff.

Through this infrastructure, the SoCaT contributes to the research and strategic direction of the University. The School delivers research support through the leadership of Professor Thomas Roth-Berghofer and enterprise through Professor Peter Komisarczuk. Since RAE2008, the School has grown as planned in: research capacity; volume of published and other outputs; the number of research students; and has integrated research-led teaching into its PG provision. A research cluster with two overarching research groupings: Model-driven Software Engineering, and the Sociotechnical Centre for Internationalisation and User Experience (SCIUX) comprise the backbone of research and enterprise development. Recent appoints through INSPIRE provide additional thematic research areas that enhance the breadth, capacity and impact in this submission.

b. Research strategy

Across the REF2014 assessment period, strategy has been, and continues to be, directed by the University's successive Strategic Plans (2008-2013 and 2013-2018) and by the University Research, Scholarship and Enterprise Strategy (2008-2013, updated October 2010). Both INSTIL (*The Institute for Teaching, Innovation and Learning*: est. 2009) and INSPIRE have been created specifically to support and implement actions embedded within these strategies. The key aims are:

- Create and sustain a growing research and enterprise culture across the University that all academic staff can engage;

- accelerate the development of research capacity and capability and scholarly activity at the University;

- increase the attractiveness of the University to potential students, staff, employers, funding bodies, and other potential stakeholders as an institution known for its pursuit of excellence in applied, pedagogic and practice-based research;

- maximise the potential for knowledge generated within the University to be translated into solutions addressing contemporary issues regionally, nationally and internationally.

After RAE2008, the dissolution of a faculty structure and its replacement with a devolved School structure led to a period of consolidation. INSPIRE undertakes roles formerly played by faculties, (principally those functions relating to research). It now manages the University's Research Degrees Sub-Committee (URDSC), with a panel for Computing and Technology reporting to it on matters specific relating to research within the School. Research funding is also now administered centrally by INSPIRE, with the School panel acting in an advisory capacity where required. Time, funding and other resources are allocated commensurate with the University Research and Scholarship Strategy and act as a significant catalyst for an evolving research-base that is core to the recently-launched *Ambition: 2018* (University Strategy 2013-2018). This makes explicit, *inter alia,* the University's commitment to producing 'impactful research which can benefit people, society and the economy'. Specifically, through Theme 3 of the strategy (Create and disseminate useful knowledge), the University will:

- Actively encourage and pursue research and scholarly collaboration; facilitate and support inter-disciplinary and collaborative approaches to research through INSPIRE, and ensure academic schools are connected to the Institute;

- expand and increase the funding sources for our research, focussing upon promoting collaboration;

- extend the opportunity for research by increasing the volume and breadth of expertise in a supervisory capacity through high calibre internal and external appointments;

- encourage current staff to complete doctorates and make it an essential criterion for new appointments in key areas.

Early career researchers receive training, attend workshops, and receive advice on how to further-develop their research. For example, INSTIL runs a series of 12 seminars and workshops on such matters as writing abstracts, presenting papers and framing a research question. The University established INSPIRE with the ambition, *inter alia*, of developing a synergistic approach to the generation of research projects, funding bids, external and internal collaborations, connections with industry and the wider community. In addition a mentoring structure for early career researchers has been established. In this respect the creation of the Institute was the culmination of plans laid by the University in 2008 to develop the research infrastructure, research services, and a research-active staff base across the university. The INSPIRE team is currently engaged in the furthering of a series of major bids for research funding to (for example) HEFCE, the NHS and EU as well as for KTPs.

Research is an integral part of the submitting unit's activities. Research outputs address issues such as: effective software engineering, culturally aware human-computer interaction and empirical studies of interactive systems, mobile and intelligent computing, and networks and distributed systems. PGT courses are tightly linked to research, and research in the submitting unit spans several thematic areas:

- **Intelligent Computing** supported by the Centre for Intelligent Computing (CIC): This theme researches the way in which software designers develop computing systems that are smarter in their interaction with users. "Explanation-aware" software design is a new approach to the design and development of these applications. This research extends from knowledge-modelling foundations through context and "explanation-aware" computing to applied sound engineering. Furthermore, it addresses issues of personalised learning support, from knowledge acquisition, through experience, to reasoning with this knowledge in context. This research is informing part of the curriculum of MSc Intelligent Computer Systems.

- **Model-driven Software Engineering**: Work here investigates techniques of model-based software engineering to build software systems. Researchers were partners in several UK Joint Information Systems Committee (JISC) funded projects and four Knowledge Transfer Partnerships (KTP) relating to data-mining and mobile applications. The research involves

software product lines and domain specific languages, context aware mobile applications through to Enterprise Architecture. Their work adds real-world currency to the curriculum of MSc Software Engineering.

- **Mobile Computing**: This encompasses applied research in pervasive and embedded computer science by focusing on communication systems that operate in constrained environments. Techniques developed include the use of data compression and lightweight messaging to provide a highly portable and scalable data-sharing infrastructure. The software is being developed for a number of mobile and embedded operating systems ranging from embedded Linux distributions to proprietary platforms (e.g. QNX). Researchers have established links with companies in the mobile industry (e.g. Blackberry Ltd).

- **Networks and Distributed Systems** supported by the Centre for Networks and Distributed Systems: This focuses on applied research in network protocols, architecture and modelling, Grid and cloud computing, and mobile-educational tools. Researchers have been involved in several JISC funded projects and an EPSRC CEReS project that started September 2013. Research projects are linked to industry and often involve system security. This research is feeding part of the curriculum of MSc Network and Mobile Computing.

- **Human-Computer Interaction** supported by the Sociotechnical Centre for Internationalisation and User Experience (SCIUX): This research theme supports the design and development of systems that meet the needs of end users globally. It investigates the cultural differences in the process and the product of design and development of interactive systems. Researchers have been successful in EPSRC and EU funded projects, a Leverhulme fellowship and a KTP with Siemens. This research informs the curriculum of MSc Computing Interaction Design.

Enterprise and applied research in the above themes include: product and service creation; delivery of Continuous Professional Development courses; consultancy; Knowledge Transfer; and research funding. Engagement has been primarily through academic and industry consortia networks and business engagement, either directly with industry or with the West London Chamber of Commerce. SoCaT is committed to the interface with INSPIRE and cross-disciplinary engagement by developing networks (e.g. industry groups, professional forums and bodies, Universities, EU).

The submitting unit's engagement with the research and enterprise strategy has delivered at international events such as:

- Smart University 2013, A workshop at the Eighth International and Interdisciplinary Conference on Modelling and Using Context (CONTEXT'13) in Annecy, France;

- 10th International Workshop on Internationalisation of Products and Systems, (IWIPS 2010);

- Fourth and Fifth Annual Doctoral Consortium at the 20th (Lyon 2012) and 21st (Saratoga Springs 2013) International Conference on Case-Based Reasoning (ICCBR). UK workshops on CBR at the Annual International Conference of the British Computer Society's Specialist Group on AI, co-organised since 2010 in Cambridge, UK;

- BCS Symposium on Knowledge Discovery and Data mining (UKKDD) 2013, London;

- Tutorials on myCBR at recent conferences, including AI 2012, ICCBR 2012, and UKCBR 2012.

Planned future engagement centres on: continuation of research funding bids (EPSRC and EU); dissemination of research findings through high quality open access contributions to journals; international conference contribution and cross-fertilisation of research directions; knowledge transfer activities (KTP), and consultancy to industry.

c. People, including:

i.   Staffing strategy and staff development

The University adopted a new *Academic Employment Framework* in August 2013. The Framework clarifies staff roles and responsibilities in relation to teaching, academic leadership and research. Its 'career family' approach to academic contracts enables all academic staff to have support 'balancing their outputs according to their development, duties and responsibilities for each academic year' (p.23). The introduction of the new Framework supports the key performance indicators outlined in *Ambition: 2018*. Fundamental to supporting the development of a culture supportive of research is the integration of local (School) and University-wide (INSTIL/INSPIRE) knowledge, expertise and resource.

Over the assessment period, the University has rationalised to ensure all activities and staff appointed to support this, meet with a whole University approach. A significant advantage of creating INSTIL and INSPIRE has been the accessibility of a central resource to support all academic areas. For example the 22+ permanent academic and support staff, including seven professors within INSTIL and INSPIRE (all new appointments since 2008), also hold embedded roles within each of the academic schools (e.g. Professor Rigas for Computing) whilst *vice versa* all members of University academic staff hold affiliate positions aligned to a research interest in INSTIL and/or INSPIRE. This Computer Science and Informatics submission has, over the period of assessment, benefitted from the addition of new research-active staff.

Senior staff providing research leadership within the submitting unit are: Professor Peter Komisarczuk with research expertise on networks, security and cybercrime; Professor Thomas Roth-Berghofer with expertise in Artificial Intelligence and case-based reasoning; Professor Rigas with expertise in human-computer interaction, and Dr Abdelnour-Nocera with expertise User Interface Design.

Other new researchers, with doctoral qualifications, were also recruited based on their potential to grow research capacity. They complement existing research themes such as predicting maintenance of heritage artefacts and assessment calibration in technology-enhanced learning. These staff receive research mentoring from senior academics in the School and INSPIRE in order to balance their duties and progress their research development. This early career research development is supported by the Academic Employment Framework and INSPIRE.

Research expectations and systematic research engagement, with peer-reviewed article contributions to reputable journals, are at the core of their academic duties. The University also supports attendance at conferences, workshops and seminars as part of on going staff development and to foster networks with other active researchers in their fields. The recent streaming by the University of staff into three categories: Research Academic, Teaching Academic, and Academic Practitioner – acknowledges the need to sustain the research profiles of those in the research stream. These members of staff now teach significantly fewer hours than hitherto. The University's promotion scheme, and a slate of staff development opportunities, support and encourage the aspirations of staff currently streamed in the other two categories. The university also supports staff undertaking PhDs through a 100-hour reduction in their teaching load. Five members of staff from the School are currently supported by the University to undertake doctoral studies; two are pursuing PhDs at other institutions (supported by contributions to fees and teaching remission), and three undertaking their studies in-house.

ii.   Research students

SoCaT and INSPIRE ensure the quality of training and supervision of postgraduate research students through adherence to the University's *Code of Practice for Research Students and Supervisors* (approved by the University Research Degrees Sub-Committee, October 2011). The *Code of Practice* is intended to 'provide a framework for research in an atmosphere of scholarship and collegiality enabling students to complete their degrees successfully within the time limits' (p.

1). It makes explicit the responsibilities of students and supervisors and provides examples of good supervisory practice. More formal requirements are provided by the University's Research Degree regulations.

Postgraduate research students are supported academically through the appointment of two supervisors including at least one subject specialist. The appointment of additional external supervision is possible. Pastoral support is provided through the University's central student support services. Students and supervisory staff are supported administratively through the Research Office which is part of INSPIRE. The University has made significant progress in enhancing research training that is now aligned with the *VITAE Researcher Development Framework* thus affording support to students and staff with the development of postgraduate research and employability skills.

During the period covered by this assessment the University has sought to support research activity and provide opportunity to aspiring PhD students through the award of Vice Chancellor's and Graduate Scholarships. The School has benefited from the award of 14 Graduate Scholarships to MPhil/PhD students. Postgraduate students are fully integrated into the research culture through presenting their work to colleagues in research seminars and at the UWL Annual MPhil/PhD Research Conference held each Spring. The University now offers 15 funded PhDs per annum across the institution. It is the ambition of the unit to continue to strengthen supervision capacity and to target applicants to work under the supervision of specific members of staff within their research expertise.

Currently, the submitting unit has 30 registered research students working towards a PhD. 24 research students are in Computing and 6 in Technology. This represents a significant growth of research students (from 9 research students for the period assessed in RAE 2008). During the period of assessment, they were 4 successful PhD completions, in addition to 1 who already submitted the thesis before the census date and 4 others close to submission.

d. Income, infrastructure and facilities

The school has been successful in EPSRC, EU, Leverhulme, JISC and TSB (KTP) as well as internal research and knowledge transfer bids over the RAE 2008 and REF 2014 periods. The school supports staff to engage directly or in networks and currently has several EU and Leverhulme bids in process and one KTP application.

Source	Income (£)	Description
EPSRC	46,155	BGDD network project: identifying and developing suitable ICTs for groups of rural farmers in Kenya.
HEFCE	57,386	Programme specification domain map for HE.
JISC	30,617	Open source business process management solutions as a viable approach for supporting common administrative processes in HE.
HEFCE	190,413	Mobile software toolkits to support work-based learning and assessment for social worker students.
KTP	100,000	Applied user centred design methods in a medical imaging applications development company (Siemens)
JISC	240,000	Use of Data Mining to support student learning by detecting situations where early intervention can help retain students.
JISC	40,000	A model driven approach to co-operative document development.
JISC	40,000	Special Interest Group in Intelligent Decision Support in HE.
JISC	13,000	Promoting results of MCMS to other HE institutions.
JISC	140,000	Project with aim to provide UWL course data in XCRI format.
JISC	15,000	Project to build an internship or work experience at a school level.
Mammoth Graphics	10,000	iPhone application development for the Tour de France.
WhizzBike	10,000	Model development of the information structures and processes for an SME and implementation using a CMS.

Connect	10,000	Model-based approach to leaning workflows for a company that supplies foreign language tuition.
TSB	113,983	Development of a set of portals to ARC records systems.
TSB	125,472	Development of a domain-specific language, to help a company implement a business plan for mobile media applications.
TSB	108,582	Project to build and market a system for managing student attendance and associated reporting within an HE environment.
TSB	108,582	Project to build a software system that helps build 3D models from point cloud data.
Leverhulme	39,420	Visiting Fellowship
Total:	1,438,610	

A weekly research seminar series provides a focus for staff and research students. Speakers are mainly from other universities, research institutes, or practitioners in the field. As part of the School's research culture, research students are also scheduled regularly to provide a seminar on their research in order to receive feedback and practice their research presentation skills. This Unit has benefited from the presence of international visiting scholars who have contributed to the further development of a research culture. These include:

- Professor David C. Wilson, from the University of North Carolina, USA. A research sabbatical (2012-2013).

- Dr Barbara Rita Barricelli, from the University degli Studi di Milano, Italy. Awarded a Leverhulme Trust Visiting Fellowship (January - December 2013).

- Mrs Lotta Rintala, from Aalto University, Finland. Research student visit (March - June 2013).

- Dr Martin Atzmüller, from the University of Kassel, Germany. Initially an Invited speaker for a BCS event (UK KDD 2013), later a visiting research scholar (April 2013).

- Mr Eduardo Lupiani, from the University of Murcia, Spain. Research student visit (August - December 2013).

e. Collaboration or contribution to the discipline or research base

- A 3-year EPSRC CEReS project commenced in September 2013 addressing cyber-crime. Project partners include the Universities of Cardiff, City, Plymouth, and Durham. Professor Komisarczuk is leading and there are plans to grow research students in this area and continuing working with the international Honeynet project.

- The Centre for Networks and Distributed Systems is working with local start-up Ecode on Software Defined Networking (SDN) and is developing co-operation with others in this field.

- The CIC is active in the German Informatics Society and the BCS, where Professor Roth-Berghofer is a member of the BCS Specialist Group Artificial Intelligence (SGAI), which organises the annual AI conference in Cambridge.

- SCIUX is an active member of IFIP TC13. SCIUX Head, Dr Abdelnour-Nocera, is vice-chair of TC13.6, the special interest group in Work Analysis and Interaction Design, and co-chair of the BCS Sociotechnical Specialist Group. He is editor in chief of the *International Journal of Sociotechnology and Knowledge Development*. SCIUX is part of an international research network looking at issues related to cultural and sociotechnical aspects of user experience. Its members have been invited speakers and panelists in key conferences in HCI such as IFIP Interact.

- Dr. Abdelnour-Nocera has been a guest Professor delivering PhD courses in work analysis and inter-action design at Roskilde University in Denmark. As part of the SCIUX research in HCI Education and Culture, Dr. Abdelnour-Nocera was invited by the ACM SIGCHI Academy to a steering group meeting at the ACM 2013 Conference in Paris to discuss issues related to development of a new international curriculum in HCI.