Institution: University of Greenwich (UoG)

Unit of Assessment: (11) Computer Science and Informatics

a. Context

The unifying and guiding theme for much of the research undertaken in this unit within the School of Computing and Mathematical Sciences (CMS) is one that we describe as "Socially Responsible Computing". This term suggests that the research we are undertaking predominantly has a focus on the improvement of services, facilities, and opportunities for individuals and groups who are socially, economically, physically, or personally disadvantaged. This term also covers work that has an impact on public safety, and on the preservation of social infrastructure, environment, culture and heritage. Therefore, much of the work reported through this UoA has had direct societal, economic, public policy, cultural, health, and environmental impacts as evidenced by customer and user feedback, the use of the outputs in industry and public services, and the broad spread of our activities throughout the world.

b. Approach to impact

Here we provide an overview of the approach to impact during the assessment period, in terms of the impact criteria identified above, for the key areas of research reported in this UoA. Impacts are described in general terms, as detailed descriptions of impacts will only be provided for the subject areas selected for the case studies, which are identified later in this statement.

E-learning and Serious Games

A number of projects have been undertaken in this field, and within the university a significant impact of the work has been the development of the eCentre, which has expanded from a single school research group into a university-wide multi-disciplinary vehicle. The centre now hosts research groups in a number of associated areas such as e-Assessment, Personal Development Planning, Social Web for Learning, Mobile Learning, Gaming and Immersive Worlds, Digital Literacies, and Staff and Curriculum Development, with membership drawn from all schools in the university and some of our partner colleges. Recent work in this area has included:

- early warning detection of health issues through analysis of social network traffic;
- the use of games environments to provide learning support mechanisms for a variety of topics;
- personalisation of learning to support disadvantaged students, and
- the more generalised use of e-learning to support students at partner colleges throughout the world, to improve their learning opportunities and access to resources: http://www2.gre.ac.uk/about/schools/cms/study/collaborative

These projects have met a number of the impact criteria and have affected many hundreds of users. One significant area of impact in the serious games area has been the development of a scenario-based games environment for training social workers, with the first scenario being developed on the basis of the 'Baby P' case. This has been endorsed by social worker trainers, who have seen the opportunity to use this immersive environment to provide a more engaging and challenging learning experience for their students. A user forum has been created, and this is already linking in staff from health agencies across the country: http://www2.gre.ac.uk/about/schools/health/research/healthsocial/safeguarding/research-projects

Public Safety, Crisis Management and Security

There is a significant and well-established research group within CMS, the Fire Safety Engineering Group (FSEG), which has developed world-leading research and software products for all aspects of fire safety in enclosed spaces. This group has had a significant impact, both on fire safety professionals and the general public, worldwide. FSEG has developed a range of software tools to support fire safety, including evacuation modelling and fire spread and distribution modelling capabilities. As well as offering the opportunity to design effective fire-safe systems and environments, these tools offer the capability to support crisis managers in dealing with life threatening, fire-based crisis situations such as aircraft fires, tunnel fires, high rise buildings fires and many others. Therefore the use of these tools on a worldwide basis (currently in 35 countries) has directly impacted millions of ordinary people in the design of fire-safe systems, and many thousands who have been directly involved in crisis situations in which these tools were utilised.

Another project developed within this unit is the 'Pandora' crisis management training environment which provides timeline and scenario-based training in crisis management for strategic planners,

known as Gold Commanders. Pandora, developed through an EU FP7 project [www.pandoraproject.eu] and now in the early stages of commercialisation, has already had a significant impact in the crisis management community as a result of the innovative use of affective computing techniques to create realistic stress levels for trainees in addressing the crisis scenario. This approach has resulted in other work being developed in this area, both in crisis management and in AI planning, and the project is contributing to the development of standards for emotional modelling: it has already impacted several hundred people within the crisis community as a result of early user involvement and widespread dissemination.

Additionally, the C-SAFE team has been developing its interests in network security, particularly network protection from attack, and digital forensics. It has recently attracted funding of £80K from the EU for these activities, and its work has had an impact on a significant number of SMEs and individuals working in the security industry in the South of England. Linking to the work being carried out in crisis management, the extended team is now developing skills and knowledge in the areas of cybersecurity and cyberterrorism, and has recently published in these areas.

Healthcare

Several researchers within the unit have long histories of engagement with healthcare research. A number of projects, particularly under the eCentre banner, are looking at the provision of software services and facilities to support vulnerable individuals living independently within the community, particularly those with healthcare problems. In addition, a project called SHREWD has been working with local health authorities, in particular in Kent and Medway, to develop a software system to provide early warning of resilience issues, specifically considering the mechanisms to address individual agency failures in multi-agency managed situations. This planning is vital to ensure that healthcare services can continue to be offered even during periods of significant stress, such as flu pandemics and other abnormal situations. The system as developed has already been picked up and trialled by health agencies across the South East of England and is now being independently commercialised, following the university's sale of the intellectual property to the commercial partner who was involved from the project's outset. This offers the potential for national and international deployment to a significant level, directly impacting the services offered to millions of people.

Support for Advanced Manufacturing, Energy Generation and Smart Systems Technology

There have been a significant number of externally funded projects supporting the development of computational mechanics modelling tools and methodologies for the design of components and smart systems, including their manufacture and reliability. The school has partnered with a number of universities nationally and internationally in this area. This includes the EPSRC Grand Challenge Project: 3D-Mintegration where the team led the design and modelling efforts in this £4m project in collaboration with the Universities of Cambridge, Loughborough, Nottingham, Cranfield and Heriot-Watt and 28 companies. This research involves the development and application of multi-physics modelling, optimisation, and risk analysis models and associated software to investigate the fabrication and technology readiness of micro-nano devices. Recent work includes a Department of Defense (USA) funded project, which is using our multi-physics and optimisation tools to investigate the suitability of commercial off the shelf components for high reliability aerospace applications. These results are providing benefits for our collaborating partners: Rolls Royce, Selex, General Dynamics and EADS. In terms of smart systems we have been developing health usage monitoring systems (HUMS) based on novel sensors and prognostics models that can monitor the health of components and structures aiding future maintenance. Examples include the award winning KTP project with the Cutty Sark Trust where our modelling techniques are being used to help conserve the ship and maintain it for at least the next fifty years. Another example is our work with Nottingham University, Dynex Semiconductors, SMELAB, Arreva, and Converteam which has developed prognostics health monitoring and actuation techniques for power electronics systems which underpin many of the renewable energy systems being proposed: solar, wind, wave and tidal.

c. Strategy and plans

The university is fundamentally committed to the development of high-quality, world-leading research, in particular of a collaborative and multi-disciplinary nature as described above. To this end, staff have been encouraged, through workshops and sandpits, to investigate the potential for collaborative research activity; strategic use of RAE, HEIF and SRIF funds has contributed just under £900K to 35 projects, for groups in this UoA, emerging from such activities. One of the

research centres reported in this UoA, the eCentre, is led from CMS but is actually a university-wide, multi-disciplinary centre, supporting a wide range of projects utilising computing research to support applied research activities in other areas, particularly in eLearning. The university is also strongly committed to bringing on Early Career Researchers, and a number of activities are targeted at these staff, together with pump-priming research funds and a university prize. CMS has a research strategy that complements the university strategy in seeking to develop high-quality, world-leading research and, as can be seen from our case studies and academic outputs, is making good progress in achieving that. However, as identified in the Context section, CMS also has a strong research strategic goal associated with "Socially Responsible Computing" and this has led to strong engagement with the local communities in which the university is based, and with the public, voluntary and statutory bodies, to identify activities and projects in which the resources and skills of the School and our students can offer a significant benefit. This has led to a number of projects, large and small, developing websites, software tools and systems, and computing infrastructure, to support research initiatives and projects with those groups. Longer-term strategy is focused on continuing to develop excellence in current research groups and areas, with some further development of capabilities in spatio-temporal modelling, IOT & Big Data, crisis management, and smart systems. CMS is also incentivising staff to become research active, increasing levels of engagement with research, increasing the percentage of staff with a doctorate, and thereby improving research-informed teaching and the pipeline for new research students/staff.

d. Relationship to case studies

We have selected two case studies to represent the impact of the work in Computing and Informatics at Greenwich. Both of these represent the multi-disciplinary nature of the research environment at UoG, and show strong evidence of high quality academic research from a variety of subject areas (and units of assessment) being applied to solve practical real-world problems, through the development of software modelling tools and approaches involving early engagement of the user community and/or commercial interests. In both cases we can demonstrate substantial current impacts building on world-leading research developed over the last 10-15 years, from research groups that are currently vibrant and strongly engaged within the research strategy and plans of both School and university. All the key researchers identified in these case studies are being returned in the REF but, and this is an important feature of multi-disciplinary applied research, not all will be returned in this UoA.

The first case study is from the areas of Public Safety and Crisis Management, described above, and focuses on the development of software modelling tools, based on Computational Fluid Dynamics, to model fire spread and, in particular, evacuation characteristics, in major public fire situations. This suite of tools, based on the original Smartfire and Exodus software packages, is under continuous development by the Fire Safety Engineering Group (FSEG) and is in use throughout the world. As a result, they have had clear economic and international development impacts, and, by nature of the context in which they are used, they also have significant societal, public policy and services, cultural and quality of life, health and environmental impacts.

The second case study focuses on the Support for Advanced Manufacturing, Energy Generation and Smart Systems Technology area, and the development of software modelling tools to predict reliability in electronic components, which have subsequently been used to develop a digital model for conserving heritage structures. The roots of this development go back nearly 20 years, to the development of the PHYSICA software by the Computational Mechanics and Reliability Group, and through the continuous development of multi-physics software modelling tools to solve industrial problems since then. Most of this work has focused on behaviour prediction of materials in micro-scale manufacturing, particularly electronic components, which led to research work developing prognostics algorithms that aim to predict the remaining useful life of components and structures when subjected to monitored environmental conditions in the field of use. The research team then became involved in the project to save the Cutty Sark, using their modelling expertise to investigate the structure of the ship to aid the dismantling of the ship (fortunately mostly completed before the fire), and then to develop a prognostic structural health monitoring system that will reduce maintenance costs in the future. Clear evidence of societal, economic, cultural and quality of life and environmental impacts have been achieved and are reported through this case study.