Institution: Leeds Metropolitan University

Unit of Assessment: UoA11 Computer Science and Informatics

a. Context

Research in the Unit is organised through a number of research groups, which are under the auspices of the Leeds New Technology Institute and Digital Research Centre, (NTI-DRC) (http://www.leedsmet.ac.uk/research/northern-technology-institute-digital-research-centre.htm). Its core activities stem from our School of Computing, Creative Technologies, and Engineering (within the Faculty of Arts, Environment, and Technology) which is headed by Professor Colin Pattinson. Note that the boundaries of UoA11; the School and the NTI-DRC are not contiguous. The mission of the research centre is to foster research, development, and inquiry in the realm of digital technology and its applications. It acts as a vehicle for organising and concentrating international quality research activities in the School and beyond. The eight research groups which reflect both the School core research strengths (as demonstrated by strong research leadership and international reputation) and Masters' Degree course provision, are: Virtual Systems (led by Professor R. Behringer); Intelligent Systems (led by Dr E. Guest); Mobile / Ubiquitous Computing, Converging Technologies and Networking (led by Professor C. Pattinson); Green IT (led by Professor C. Pattinson); Assistive Technologies (led by Dr M. Fabri); Software Engineering (Dr M. Ramachandran); Computers And Art/Music (led by Dr N. Stavropoulos); Information Management And Social Informatics (Professor E. Halpin) (Note: the last two groups are outside this UoA). NTI-DRC also works very closely with the University's Leeds Sustainability Institute, http://www.leedsmet.ac.uk/research/leeds-sustainability-institute.htm, a centre which addresses the challenges of creating more sustainable places and at the same time, supports world class sustainability related research (including ICT) involving business leaders, professional associations and community groups.

Research undertaken in the Unit is focused on the provision of computer-based solutions, derived from the application of research findings and knowledge to actual problems. There is a strong connection between our research work, the taught courses we deliver and our consultancy activity. The titles of the research groups indicate the specific application areas: our strengths are in the measurement and management of the performance of systems and networks, especially in respect of energy efficiency; the development of mobile application software; virtual learning and assistive technologies and intelligent systems. We work in partnership with local, national and international bodies and organisations, across the public and private sectors, delivering research of national and international standing. The standing of our work is demonstrated by funding support from EPSRC and JISC within the UK, in addition to EU funding. A further demonstration of our international standing is in the collaborative activities with a broad range of European institutions and industrial organisations – particularly in research capacity building. A specific strength lies in the work we undertake with Small to Medium Enterprises (SMEs) and voluntary organisations within the Yorkshire region, through our Knowledge Transfer work.

The work of this Unit has had an impact on the understanding of the efficiency of IT networks and data centres; the development and delivery of robust mobile application software systems; the creation and deployment of assistive technologies and virtual environments and the implementation and use of intelligent systems to carry out data analysis and pattern recognition for a range of applications, including image scanning. Our work in these areas has contributed to the development of recommendations for the measurement of greenhouse gas emissions within IT; validation of best practice in the deployment of data centre metering; tool and techniques to support efficient and reliable software systems; creation of collaborative virtual environments including the use of assistive technologies to support independent living.

b. Approach to impact

The Unit has sought to foster interaction with users and beneficiaries in order to achieve impacts for its research. Central to this activity is our work in forging strong industrial links through collaborative projects such as Knowledge Transfer Partnerships, Business Enhancement Schemes; guest lectures; joint PhD student supervision; publications and dissemination; engagement of industry as end-users of our research; dialogue with industry, and shared partnerships in externally funded projects. Recently, we have made major efforts to develop our consultancy activity through a focus on Knowledge Transfer Partnerships. The identification of a

KTP "champion" working within the UoA has already delivered 4 successful collaborations.
The Unit's research has included collaborative engagement with a range of national and international partners, allowing us to make valuable contributions to projects with local and European reach, and with both private and public sectors. Our activities have permitted us to generate work which has positively affected the operation of charities; SMEs; large national and international business; the Police; IT users in HE and FE.
The significant contributions of Dixon's work are the development of QSEE-Super Lite (http://www.leedsmet.ac.uk/qsee/complete.htm) and the creation of industry specification software in collaboration with SMEs. QSEE is a software development tool which is available under a low-cost site licence for universities and colleges, and is also available commercially. The result of many years of development work, QSEE incorporates development support methods including entity relationship modelling dataflow diagrams and the Unified Modelling Language (UML). More recently, Dixon has been successful in securing KTP funding to develop data modelling software for the construction industry. Ramachandran's work on the PRISMS project is a further example of the beneficial impact of improved software development methods for SMEs. Collaborating with four SMEs, the focus of this work is to develop reusable software components, and then establishing a methodology by which this reuse can be managed and controlled. This work has been successfully trialled, and is now being extended into larger application domains.
Fabri's work (some of which is described more fully in our first case study) also includes practical applications to permit people with autism to represent and understand emotions, thereby enhancing their interaction with society.
Guest has worked with colleagues on an EPSRC project which developed a scanning technique to assist in the identification of armed criminals without the need to be in close proximity. The technique makes use of electromagnetic scanning, and Guest's contribution lies in the advanced 3D pattern recognition algorithms used in the data analysis stages, these pattern recognition methods have been applied to a variety of other problems, including automated marking and natural language interpretation.
Kor's expert systems work has led to the development of a system which has been used by engineers to diagnose the Flue Gas Desulphurisation process within a power station. This system has two versions: a PDA version for use in the field, and desktop version allowing more detailed and structured analysis. It is currently being use by a local power station.
Pattinson's work on measurement and performance evaluation has generated a greater understanding of the behaviour and performance of computer network management systems, in particular, performance studies of network management protocols, and of the behaviour of human network managers. Other performance measurement work has identified the performance merits of different IT systems, including a comparison of thin and thick client systems, and the range of data centre environmental controls. This is detailed more fully in the second case study is linked to economic (energy savings) and environmental (reduced carbon footprint) impacts of IT systems and networks. The work described includes an independent assessment of an energy management tool for a multinational company; the establishment of best practice for energy metering and infrastructure within a data centre and contributions to the development of recommended practice for GHG assessment. This is largely related to promotion of awareness and dissemination by Pattinson who has delivered lectures, dissemination of research results via the funding agency websites and via mailing lists (note: details are discussed in Section d).
In the first case study, we describe the strong, fruitful, and longstanding public-private collaboration between Leeds Met researchers and national arts charity, Axis, which resulted in the development and exploitation of effective online platforms for local artists to showcase and promote their artwork.

c. Strategy and plans

Our university has a clear mission to be a catalyst for social and economic progress in and for our region, nationally and internationally, through research and enterprise (Theme 3, Strategic plan – see http://www.leedsmet.ac.uk/strategicplan/Leeds-Metropolitan_Strategic-Plan_2010-2015.pdf for full details) and that mission is central to our work in Unit 11.
Working within the University's strategic plan, our school research and enterprise activities combine applied research with real end users. Our school has forged very strong industrial links via the NTI-DRC via invited seminars, discussion groups, and organised conferences.
The Unit's plan is to develop its research base through the identification of a small number of

research groups, in which a number of academic staff and students work together, combine their efforts on a set of connected projects, including the supervision of research students and bidding for and delivery of externally funded research work. In order to support this activity, the Unit has identified a research strategy which calls for*, inter alia* an increase in the number of research active staff, and in the outputs each one generates; a targeted approach to funding bids, with particular emphasis on the exploitation of existing collaborations. In order to deliver these aspirations, the Unit has in place a process of bidding for support (both time and other resources) where specific requests are made against clearly defined deliverables which are expected to align with the Unit's overall objectives. This Unit began from a relatively low base, however the results achieved within the last three years encourage us to plan in the expectation that the momentum already achieved will continue, and that as more academic staff become engaged in research, the overall productivity of the Unit will grow, both in quantity and quality.

The investment made so far has generated £1.7m in research income for the School, of which over £1m is in projects attributable to UoA11.

Involvement with professional and research networks allows us to inform, and be informed by, the work of these groups, and to apply this knowledge to our research, whether independently or in collaboration with others.

In pursuit of our strategy we set ourselves the following strategic objectives: to continue the process of strengthening and improving the quality of the research outputs of individual staff members; to maintain a team of research active staff within each research group and to use the NTI-DRC as a vehicle through which research activity, outputs and impact are transmitted to our research partners, users and beneficiaries; to further develop the value (financial and academic) and range of external research income, with clear plans for dissemination of research projects and their impacts; to establish a strong 'community of researchers' and vibrant research environment; and, to continue to develop research collaborations nationally and internationally exploiting, in particular existing links with institutions and partners across Europe.

d. Relationship to case studies

In selecting our case studies, we have selected the strongest examples from across the Unit. Our case studies demonstrate the differential application and target users of the research undertaken within the Unit. As such, our case studies demonstrate a clear alignment and connection with our work, with their scale and reach ranging from international capacity building and sharing of best practice to the development and deployment of application software to promote the work voluntary sector organisations. What unites them is the application of computer technology to address real life problems, and the development of achievable and appropriate solutions, which offer both cost and energy efficiencies.