Institution: Liverpool John Moores University

Unit of Assessment: UOA4

a. Context

Impact has been achieved via knowledge transfer in two areas, the design of technological systems and the promotion of health and wellbeing. The main external users of this unit's research include industry (Philips Research Laboratories, Pfizer, Kelloggs, GlaxoSmithKline), international bodies (European Space Agency), public sector organisations (e.g. MerseyCare NHS Trust) and cultural institutions (e.g. Foundation for Art and Digital Technology (FACT)). The unit has incorporated psychological expertise into the design cycle of emerging technology and applied a human factors perspective to operator performance in safety-critical environments. Impact on health and wellbeing was accomplished by the development and evaluation of psychological and pharmacological interventions conducted by the unit.

The unit is composed of three main research groupings: neuroscience, health psychology and human factors/human-computer interaction (HCI). Research on human factors psychology is concerned with the measurement and prediction of human performance in safety-critical environments, such as aviation. This work is supported by a sustained collaboration with the European Space Agency. The human factors strand is complimented by HCI investigations into physiological computing as a nascent category of technology. The impact of this research has been achieved via collaboration with industrial partners, such as Philips Research Laboratories and Ferrari. The neuroscience research group have a specific interest in somatosensory systems and were recently awarded a CASE studentship with GlaxoSmithKline, the same group have been funded by the NHS to explore neuropsychological changes due to mindfulness meditation. The topics covered by the health psychology group includes pain and eating behaviour, research on health psychology has been funded by industry (Pfizer, Kelloggs) and local government (Sefton Council).

b. Approach to impact

The main mechanisms employed by the unit to achieve impact from our research are: (a) direct collaboration/funding by external partners, (b) collaboration with external partner on research projects funded by third party, (c) dissemination of main research findings via websites and media sources, and (d) presentation of our research at non-academic forums and other forms of engagement with end-users. The types of impact achieved via mechanisms (a) and (b) are best illustrated by the following examples:

- Pfizer have funded a project worth £50,000 on patient perceptions of neuropathic pain via an investigator-led grant that began in 2011 and is ongoing. Research within the unit produced a clinical scale (NePIQoL) designed to assess quality of life for patients with neuropathic pain. The goal of the project is to assess the sensitivity of this scale and incorporate its use into clinical trials.
- Mersey Care (an NHS Mental Health Trust) funded a project (£14,000) to explore the impact of an intervention based upon mindfulness meditation on psychological features (e.g. impulsivity) associated with eating disorders. This project ran from 2010-2011 and was conducted in collaboration with the local NHS Eating Disorders Service in Liverpool. Findings suggested that mindfulness-based interventions successfully target psychological mechanisms related to emotion regulation and represent an innovative therapy for the treatment of eating disorders.
- The REECH project is funded by Sefton Council and is worth £30,000 to the unit; this research began in 2012 and is ongoing. The goal of this research is to assess the impact of retrofitting housing for energy efficiency on relevant behaviours (i.e. energy saving) and mental health/wellbeing. The Council wishes to establish whether retrofitting houses has positive impact on behaviour and wellbeing in order to inform their policies on the improvement of energy efficiency in the borough.
- The REFLECT project funded by the EU was worth £195,000 to the unit and ran from 2008-2011. Staff from the unit worked with Philips Research Laboratories in Eindhoven and Ferrari in Maranello. The partnership with Philips contributed to the development of a Mood Music Player (an mp3 player which responds to psychophysiological responses from the user) and led to collaborative studies and a number of co-authored publications. Philips produced several prototype devices related to this concept but none have been marketed to date.

In addition to the projects listed above, engagement and interaction with potential beneficiaries (b) occurred in a variety of forms. Our involvement in EU-funded projects, such as REFLECT and ARTSENSE, allowed staff to collaborate directly with industry and arts organisations on a number of experimental pieces of work. The REFLECT project involved 'exchange visits' of two PhD students between an industrial partner and LJMU, which strengthened our contact and collaboration. The unit also provided expertise in the form of consultancy for clinical trials on Complex Regional Pain Syndrome (CRPS) sponsored by CSL Behring and developing a care pathway for Breakthrough Cancer Pain funded by Flynn Pharmaceuticals. Kelloggs funded a consultancy project on the relationship between mood and eating behaviour from 2011-12, where trials were conducted in our Appetite Laboratory. The partnership between LJMU and Liverpool Community NHS Health Trust (LCH) is an example of knowledge transfer between the unit and the public sector. The success of a project on perceptions of community dental services led to further collaborative work funded by the North West Regional Innovation Fund on perceptions of mobile technology for Speech and Language Therapy (worth £5,000); this project recently won an award for innovation from LCH.

The research conducted by the unit is disseminated via academic means (journals, conferences, workshops) and to other parties via a website associated with our Research Centre (Research Centre for Brain and Behaviour - RCBB) and social media (RCBB Twitter account) (c). Research on self-efficacy and self-examination for testicular cancer was adopted from a research output by Men's Health Initiative (a US-based charity concerned with raising awareness of male health issues) who incorporated our recommendations directly into their literature. Staff in the unit have regular contact with the Corporate Communications department of the University in order to publicise our research achievements with potential beneficiaries via media outlets, e.g. McGlone's appearance on BBC1 programme "Britain's Favourite Supermarket Food" broadcast at 20:00 on Thursday 18th July 2013.

With respect to formal presentations to end-users at non-academic forums (d), research from the unit has been presented at a NESTA workshop in London (Hack Yourself: Measuring Wellbeing) on 3/5/12 (approx. 100 people in attendance), an event on the Internet Of Things organised by the BBC R&D in Manchester (7/11/12) with 15 people in attendance and a symposium on Big Data held at Google Campus in London (6/6/13) with an audience of approximately 120. Research on mindfulness meditation has been presented at a number of Cafe Scientifique events at Leeds (7/6/10) (attendance: 60), Liverpool (13/12/11) (attendance: 60) and Cockermouth (20/11/12) (attendance: 45); this research was also the focus of a symposium at the 2008 British Association Festival of Science in Liverpool (attendance: 200). Two members of the unit also presented their research at consecutive symposia organised by Philips Research Laboratories for approximately 200 of their own staff - Sensing Emotions (1/10/08) and Neurovation (26/5/11).

In order to broaden the reach of our engagement with relevant beneficiaries, specifically regional SMEs, we have developed a close working relationship with part of LJMU called Open Labs. This group is part of the institutional infrastructure dedicated to the development of partnerships between the University's research community and the region's technology companies. The unit organised a one-day workshop via Open Labs in February 2012 to present research on physiological computing to representatives from local organisations, including 10 SMEs. This event led to two grant applications to TSB (Technology Strategy Board) and SBRI (Small Business Research Initiatives), where research expertise from the unit was utilised to support the R&D activities of local SMEs. In addition, the unit funded a small contract for a local technology company (d3t based in Runcorn) to produce bespoke software to support our research activity. Through these events and projects, we have constructed a network of potential collaborators from the local economy and demonstrated a bidirectional engagement with local business.

The unit recognizes the importance of collaboration with industrial partners as it not only enhances impact, but also serves as a learning opportunity for academic staff to identify impact opportunities. The institution provides important support to maximise impact and reward engagement with external parties. Staff from the unit make use of institutional resources whenever possible and appropriate. This includes the development of collaborative agreements with industrial partners to cover IP issues, which is supported by LJMU's Research and Innovation Services. The University has signed up to the Manifesto for Public Engagement (National Coordinating Centre for Public Engagement) as part of the University's strategic intent to share its knowledge, resources and

skills with relevant parties and to learn from non-academic collaborators. It should also be noted that staff are rewarded for the achievement of impact via the promotional pathways at LJMU. Engagement with industry, government and public sector bodies are recognised components of academic activity within the conferment criteria for Professors and Readers in the University. When interviewing potential new staff, the unit seeks candidates who can evidence the impact of their work or have relevant experience in a non-academic environment; three new staff were recruited to the unit directly from industry (Unilever R&D) and the public sector (NHS) over the last three years.

c. Strategy and plans

The unit has recognised the important contribution of partnership with external partners to the long-term viability and vitality of its research. The strategy for achieving impact in the future is based on the following initiatives:

- Ensure the relevance of research with respect to impact by strengthening and extending our existing network of external partners and actively soliciting the involvement of industry and public sector bodies as part of developing projects and funding applications
- Be proactive with respect to the identification of high impact research areas by closely following priority areas as identified by industry, government and the public sector in order to seek out new opportunities for funding application and collaborative work
- Acquire apparatus to facilitate research with high impact, e.g. the unit has identified 'mobile neuroscience' as an area with enormous potential to facilitate impact. The unit has spent approximately £20K on ambulatory EEG facilities to bring our research from the laboratory to accommodate testing in the field with real-world behaviour
- Capitalise on available opportunities to disseminate our research via specific forums that include stakeholders and develop a profile in local and national media outlets
- Use impact as an essential criterion when selecting new research projects and allocating resources to allow staff to develop impact from research via LJMU's Research and Innovation Services
- Support the local economy by working with SMEs and public sector organisations in our area and enhancing their R&D activities via collaborative projects

The primary goal of the unit is to develop research that encompasses both high academic quality and relevance for external partners. The unit has developed a number of our relationships with industry and public sector bodies, as illustrated by the examples listed in section (b), and we intend to supplement our existing network with new contacts. We will continue to develop relationships with industry, local government, SMEs and the NHS to design research projects of mutual benefit to both parties. Specifically we will engage in collaborative projects funded through industry-led initiatives (such as CASE studentships and TSB initiatives) and public sector funding (e.g. Health Foundation) where the scope of the project is shaped by an external partner

d. Relationship to case studies

Two case studies were selected to exemplify the unit's approach to impact on a national and international basis. The first represents a collaboration with the European Space Agency (ESA) where expertise on the limitations of operator performance were used to shape the human factors agenda of the European Space Programme, specifically with respect to long-duration missions to Mars. This work represented the culmination of expertise developed in the unit on operator functional state and the relevance of this concept for safety-critical performance in complex environments.

The second illustrates a direct collaboration with an arts organisation and a group of professional artists. The world of digital art is dependent on technological innovation to supply the tools necessary for the creation of new work. A collaborative project enabled the creation of a novel form of digital art whereby objects created in augmented reality were controlled real-time from psychophysiological changes in the viewer. This work was presented to the public as part of a major show at FACT, which enabled the unit to shape the policy of a major arts organisation as well as providing an opportunity for public engagement with our research.