**Institution: Nottingham Trent University**

**Unit of Assessment: C16 Architecture, Built Environment and Planning**

## a. Context

NTU has traditionally emphasised research that is orientated towards real-world problems, aiming to make sustained contributions to the environment, society, culture and the public interest. Our approach to research into the built environment is aligned with NTU's Mission Statement to conduct research that is relevant. Research with impact is what this UoA has been undertaking and plans to continue to engage with in future. The Unit's story of impact is built on both established and evolving strands of research.

This submission contains two case studies in the area of (1) managing heritage, designing futures (in the Arab Gulf countries); and (2) development of sustainable technologies in the built environment. Other examples of impactful research that demonstrate our longstanding and on-going commitment and contribution to this agenda include: authoring the RICS Procurement Black Book; developing real estate investment models; researching into process improvement; establishing a centre for smart cities; and, developing strategic energy alternatives for Nottingham.

## b. Approach to impact

Impact has always been part of NTU's heritage and ethos. Initially more *ad hoc* in nature, the focus of the Unit is now strategic. Now working within a supportive University, college and school structure (NTU Strategic Plan 2012-15), the Unit has since 2009/10 developed a coherent framework to enhance individual and group impact activities. Key approaches to impact in this Unit include:

- *More emphasis on higher Technology Readiness Levels (TRL)* - Our funded research projects embed impact more formally. Whereas in the past we would develop most technologies to TRL level 3, more recently we are getting better engaged in TRL levels 4-6. For example, our work in LED lighting is being taken as far as developing manufacturing prototypes. The research in Managing Heritage is working closely with Omani government ministries (Heritage and Culture; Tourism) to explore implementation of proposed heritage management schemes.
- *Designing impactful research projects* - We engage in extensive peer consultation (through research surgeries) and industrial discussions (through targeted workshops with industry partners), to identify research areas which will lead to economic and socio-cultural regeneration and a market pull. We reflect these in our research proposals.

QR funding is available for: (i) developing demonstrators; (ii) equipment purchase to assist achieving higher TRL levels (e.g. eco-lighting testing facilities); (iii) developing public engagement material; and (iv) PhD student support for evidence collection – a mechanism to capture the impact to help the development of improved strategy. The research groups now competitively bid for QR funds on the basis of their impact targets and resource requirements.

QR funds are also available for stakeholder engagement and the dissemination of impact. We have supported hosting the Lean Task Force of the European Construction Institute meeting, a workshop for the development of a lean maturity assessment tool. An exhibition on impact projects in Oman and associated workshop in July 2013 was attended by Omani government representatives and other stakeholders and professionals. QR funding has supported travel for meetings and workshops in the UK, USA, China, Oman and Peru, as well as, the organisation of workshops and consultancy to identify impact areas for district heating.

Additional areas of QR support are:

- *Providing time*: The Study Leave provision funds short-term replacement teaching to allow staff to focus on discrete impact-driven projects, such as community participation workshops in Romania (Hughes). Short-term appointment of project staff (RAs and support staff) has enabled impact projects to materialise on time (Managing Heritage).
- *Rewarding impact*: Impact is a key area for consideration in academic progression across NTU from Senior Lecturer to Reader and Professor.

Examples of areas in addition to the Impact Case Studies where our approaches to impact have been successful are:

- *Authoring the RICS Procurement Black Book*: This book is the Royal Institution of Chartered Surveyors (RICS) single point of reference for good practice advice in procurement. The body of work has influenced the development of procurement approaches in an international arena and the direction and content of undergraduate and postgraduate studies in the UK. Morledge authored this book in 1996 for RICS in response to the Laitham Report (1994). The book has since been revised and republished several times, with the newest edition published in 2013. RICS confirm that Morledge has made a significant contribution in their work in procurement.
- *Real estate investment models*: Real Estate investment strategies of financial institutions have a major influence on pension funds and regional investment/growth. Currently most property investment strategies are London centric and follow the Investment Property Databank (IPD) benchmark. The research conducted by White at NTU has begun to change the geographical weighting in real estate investment portfolios across the UK. The mathematical models developed have been adopted by Scottish Widows Investment Partnership with a £10 billion real estate portfolio, pursuing more regional investment. The objective of this portfolio rebalancing that has begun in Scottish Widows Investment Partnership is to increase return performance. By doing so it is encouraging greater regional investment. However Scottish Widows Investment Partnership are keen to maintain commercial confidentiality.
- *Process improvement research*: Due to the recruitment of a new professor (Pasquire), the process improvement research has had national and international influence and is operating through the Centre for Lean Projects. This Centre is supported by an advisory board of committed industrialists from a variety of major organisations. This centre provides cross-disciplinary research and learning across a wide range of construction sector projects and organisations. It boasts partnership with major academic institutions such as UC Berkeley. Pasquire, who has brought 19 years of research experience in process improvement, leads the Lean Task Force of the European Construction Institute (ECI) and is a trustee and board member for the Lean Construction Institute UK. She is currently working with companies undergoing a lean transformation across their organisations in Australia, France and the UK.

**c. Strategy and plans**

Our strategies for impact include:

- *Valuing impact at institutional level*:

The university is developing a more institutional and systematic approach to impact. NTU has selected four cross-university research themes – health and wellbeing; low carbon; materials; and the creative economy – which are resourced and driven centrally by the PVC for Research and the three NTU Associate Deans for Research (ADRs). NTU organises various cross-disciplinary activities, for example: (i) high level meetings with major organisations (e.g. NHS, Boots, Local Enterprise Partnership - LEP) to discuss long term partnerships, introducing the organisations to our core research base; (ii) cross-university bidding workshop (e.g. on low carbon), preparing for future EU calls; (iii) use of cross-university platforms, such as HIVE (for new business development) and Future Factory (a €1,000,000 EU funded project for supporting SMEs), which provide advice, funding support and external contacts for collaborating local SMEs and academics.

- *Embedded impact in the Unit's research strategy*:

Impact is formally introduced into the documented Research Strategy and related plans of the School of Architecture, Design and the Built Environment to which the Unit belongs. It has specific targets, actions and milestones. Each research group identifies its areas of impact and related plans, which are integrated into the School's research strategy. The strategy specifically emphasises the need to increase our research income, and that a proportion of the income generation should be through links to third stream activities. QR and School funds are available to invest in relevant activities. The School aligns its impact strategy with teaching, engaging PGT students with industry to capture the needs and develop better relationships. Working with the Local Enterprise Partnership (LEP) the School is building a portfolio of industrially sponsored projects at postgraduate level.

- *Developing stronger external relationships*:

The Unit has increased its systematic industrial relationship building at a regional, national and international level. The Unit has signed several industrial relationship agreements, including the signing of MoUs with key figures of 11 major industry partners, such as the CEOs of Vinci UK and Gleeds. This has resulted in an industrial engagement in our strategic growth priorities, such

as the Smart Cities Centre, forming the steering group of this Centre. Hosting focused small industrial workshops, in specific areas, such as district heating, allows us to understand the market needs. The European Regional Development Fund (ERDF) supported Future Factory project is creating new engagements with SMEs, focusing on low-carbon issues.

- *Building more targeted facilities*:

The new *Creative and Virtual Technology Lab* (*CVT*) is placed in a prominent location within the School, and is targeted at industry. The Smart Cities Centre will also be city-based, and within easy accessibility of stakeholders.

- *Promoting our expertise to the outside world*:

We are promoting our research better, through closer engagement with NTUs press office and commercial development. A press officer is normally present during our Researchers' Forum meetings, which has resulted in increased media coverage. In addition, the UoA is systematically prioritising two other areas of growth and the development of impact beyond the REF period:

- *Centre for Smart Cities*: Based on our current capabilities and high level (Dean) relationship with the CEO of our regional D2N2 Local Enterprise Partnership, we are planning to set up the project around Smart Cities. LEP have emphasised that the eventual project must be needs driven, resulting in economic growth. As a precursor, NTU is to set up a research centre in this area in the next few months.
- *District heating and heat networks*: This is a strategic alternative energy for the City of Nottingham, with 4 major projects being commissioned in the next year. We have partnered with our city to provide the research base and academic guidance for this area. We have identified key research questions and have already won one KTP, but have a long term bidding and resourcing strategy to grow this area.

**d. Relationship to case studies**

*Managing Heritage, Designing Futures*: The impact achieved with this case study originated from seed funding (£40,000) made available through the University-wide competitive Higher Education Innovation Fund (HEIF4), designed to support the University's strategies for research, innovation and knowledge transfer. The funding supported Bandyopadhyay to integrate impact with excellent research through a range of activities, including, a) employment of RAs and specialised skills inputs, b) overseas travel and subsistence, c) dedicated computer and data storage facilities, d) production of high quality impact outputs (reports), and e) dissemination through exhibition and building of a web-based repository. The funding initially led to securing support in kind from the Ministry of Heritage and Culture, Oman, and later significant and sustained funding towards continuing impactful work in managing heritage at 8 other oasis settlements (over 2 years) in central Oman. Additional QR funds were made available to support external communication with Omani government bodies resulting in securing funding for the training and 'capacity-building' project with Muscat Municipality. HEIF support contributed towards the production of training manuals and workshops for this impact component.Subsequent QR assistance provided bridging funds for retention of RAs, and made possible the purchase of specialised software and surveying equipment (e.g. microcopter). The £300,000 QR funding to establish the Creative and Virtual Technology Lab has helped the virtual reconstruction component of this case study's contribution to the National Museum in Oman. Logistical and advisory support was provided by the College research, finance, human resource and marketing offices, the latter providing platforms for enhancing visibility of the impact components.

*Sustainable Technologies*: This case study received initial assistance from the University's Future Factory initiative to support the development of sustainable material and components design. Future Factory has also helped in establishing links with East Midlands based SMEs, helping businesses source the expertise it needs to enhance sustainable production and add economic value. Future Factory supported development of the district heating initiative has benefitted from NTU's close links with SMEs and the Nottingham City Council, resulting in one of the researchers (Al-Habaibeh) being invited to join the Council's advisory panel. A £13,500 consultancy investment has identified "market pull" areas and research questions for district heating. As part of the impact case study Al-Habaibeh has also received c. £30,000 to develop demonstrator projects for a range of sustainable technologies. Travel grants have enabled several visits to China and Spain. A £40,000 QR allocation has acquired test facilities for LED lighting.