Institution: University of the West of Scotland

Unit of Assessment: 15 General Engineering

a. Context

Engineering offers solutions to the full range of societal developmental and sustainability challenges. Engagement with beneficiaries is therefore potentially with every sector of society. Engineering research at UWS focuses on materials, manufacturing and management in the key sectors of construction, energy and environment. These areas are key because they are significant areas of development for growing economies and sustainable futures for global society. Research in these areas is necessarily interdisciplinary; as research must cross scientific, social and humanities boundaries to meet the grand challenges of sustainable development.

The unit's research improves processes, including decision making, engineering management and materials engineering, and improves the understanding of material systems. The impact is gained by close working relationships and direct collaboration with external stakeholders in industry and the public sector who are also the beneficiaries of the research. All research is industrially relevant with a potential economic, environmental or social impact.

The research conducted in the unit is clearly related to contemporary sustainability agendas in a world facing developmental challenges, for example mitigation and adaptation in light of climate change. Reduction in resource use depends on the adoption of smart strategies and technologies that make use of renewable energy sources, better energy storage, better management and improved understanding of materials and processes used in construction- all these are our areas of research.

b. Approach to impact

During the period of assessment, especially until the increase in research active staff from 2011, research and knowledge exchange work has focussed on construction materials and manufacturing engineering (prototyping) and energy systems. Research from physics, submitted as part of this unit, on the fundamentals of nuclear structures attracts significant funding and involves participation in large collaborative projects using large scale facilities. Though more challenging to relate to applied economic and social impacts, it does furnish knowledge that underpins technological developments, including some that are patentable. For example research has begun that looks at the production of isotopes for use in medical applications, as a spin off from the knowledge staff have on the fundamentals of materials. Future strategy will emphasise thinking around potential impacts and applied aspects of nuclear research where possible.

In construction materials there has been engagement with industry, public bodies and 3rd sector actors through knowledge exchange schemes and the provision of consultancy services. For example research on the incorporation of waste streams (old tyres) and recycled materials into concrete mix designs and the effects of specialist additives on the properties of cement microstructure has been pursued with industry and with the support of public initiatives for waste reduction (e.g. Zero Waste Scotland, BASF, Knowledge Exchange to the Built Environment KTTBE). Heritage masonry research has consistently involved conservation-related authorities (such as Historic Scotland and the National Trust for Scotland), and specialist contractors in applied work on mortar specification, through KE schemes (KTTBE 2008, innovation voucher schemes).

Recent interdisciplinary research in heritage science (AHRC 2009 and 2013) has typified the approach taken since 2008, of directly involving beneficiaries (e.g. Historic Scotland and the National Trust for Scotland) as partners and contributors to the research activities, and supervisors in doctoral projects. The most recent funding in this area (AHRC 2013) grew from a previous network grant from the Science and Heritage Programme, that unlocked a follow-up opportunity to consolidate themes explored in the network. This required a flexible approach to source partners,

but these were in place due to the previous collaborative research activity and the outward facing attitude of the unit.

Research administration support at UWS is structured to be flexible, with a named contact to assist with both research council bid development and industry linked knowledge exchange work, to short deadlines if required. The School of Engineering has recently run significant external knowledge exchange programmes (e.g. Scottish Government SEEKIT), that facilitate technical research support for SMEs. The university's Innovation and Research Office is proactive in encouraging industry links and is a founder member of the Centre for Engineering Education and Development (CeeD).

Involvement in EU research programmes has necessarily brought staff into collaboration with industry and industrially funded research institutes, not just in the UK but also in Europe. For example the EU CODICE project saw work pursued with BASF and Technalia (Spain). This was possible because of our unique infrastructure (in Scotland) that supports nano-indentation studies of materials. From this collaboration on the understanding of micromechanical properties of cement composites, BASF commissioned directly funded research in 2012. The EU HEROMAT project involves work directly with SMEs in the UK (Eura Conservation), Slovenia (Sanning) and Serbia (HGP) on the characterisation of new consolidant and self cleaning materials for the treatment of historic buildings. New staff appointments have brought extra capacity for engagement in knowledge exchange and applied research, and opened up additional contacts and sectors of engineering in energy and industrial management.

The school has also been involved since 2007 as a partner in the Glasgow Research Partnership in Engineering (GRPE, a Scottish Funding Council pooling investment in engineering research amongst the four Glasgow Universities) and the Scottish Universities Physics Alliance (SUPA also SFC funded). This has brought funding to support a three lecturers, in addition to access to pooled laboratory infrastructure and the collaborative graduate school.

c. Strategy and plans

We aim to continue our outward view of collaboration and impact generation as before, but now with an expanded active staff base our impact should increase across the themes of energy, smart materials, construction and manufacturing. Moving forward, we are partners in the development of the industry led Scottish Funding Council funded "Construction Scotland Innovation Centre" (CSIC) that will coordinate and develop academic-industry relations (between 9 universities) in this economically vital sector for at least the next 5 years.

As many of the staff in the unit are early career researchers, the University undertakes to emphasise the importance of directing and structuring research to achieve impact. As mentioned the university's Innovation and Research Office is proactive in driving academics to engage with external non-academic partners.

d. Relationship to case studies

Both case studies exemplify the unit's intuitive approach to achieving impact for research. The characteristics of this involve close working relationships with beneficiaries which over the whole unit has significant reach in industry, the public and 3rd sectors. This was achieved through sharing resources with our collaborators, the co-supervision of students and/or staff, and involvement and partnership in national research and KE funding schemes. In concrete technology the sheer scale of the industry, and scale of research need therein, has meant that the reach of the research activities, adopted by industry through development of standardisation has been very extensive. In heritage research the close fit of academic research to the needs of conservation authorities and other stakeholders, including the repair and refurbishment construction industry is borne out in the commissioning of research by these stakeholders and their close involvement in its completion.