

<p>Institution: The University of Huddersfield</p>
<p>Unit of Assessment: 15 General Engineering</p>
<p>a. Context</p> <p>Engineering at the University of Huddersfield has a formidable track record of productive engagement with industry with the recent award of funding for the creation of an EPSRC Centre for Innovative Manufacturing in Advanced Metrology a testament to this track record. Granting of this funding was dependent upon clear demonstration of industrial engagement and the advocacy of key partners such as NPL, Rolls Royce Taylor Hobson and Renishaw.</p> <p>The primary user groups of our research are industry and these users are clustered around our research partners; the broad groupings include; aerospace (measurement, machine tools, training), instrument manufacturers (new designs, software and patent licensing), machine tool manufacturers (design services and licensed software), automotive (design, testing measurement), rail (testing, design simulation modeling, infrastructure), energy/oil production (sensor development, design), and biotech (measurement, testing). Our researchers are extremely active in impact activities through a wide range of KTP's. Our impact covers large multinationals such as Rolls Royce, Borg Warner, Network Rail and London Underground to high value SME's such as Orthox – a new successful TSB bid.</p> <p>Impact through industrial engagement is core to the ethos of Engineering at the University of Huddersfield and in fact virtually all of our research is carried out with industry. The core research activity is invariably carried out collaboratively with partners having significant input with a view to exploitation. By design, the later stages of many of our projects; EU and EPSRC, are based around exploitation of the developed project technologies. This is through demonstrator activities, prototype development, licensing of patents or direct sales of research output e.g. software. We have many examples of staff following a project from the research phase through to exploitation in industry, where staff have been employed by the company concerned – see for example our impact case study on the development of metrology software. In addition these types of relationship have led to staff transferring from industry partners into the UoA to smooth the IP exploitation e.g. Prof Paul Scott has a 0.8 contract with the UoA and 0.2 FTE with Amatek Taylor Hobson Ltd. Other core partners engaging with us based on this approach include, Network Rail, Cummins, DePuy, Renishaw, Fidia, Schlumberger, David Brown, and Weir Valves.</p> <p>In recognition of the University's general approach to such matters and the central support for this research exploitation activity the University was voted Entrepreneurial University of the Year in the Times Higher Education Awards 2012.</p>
<p>b. Approach to impact</p> <p>Engineering staff are closely involved at several levels with the users of our research output. Primarily this takes the form of industrial projects designed around IP exploitation and can be based around process, product or even training development. Researcher mobility plays a key role and staff have passed in both directions. Consultancy is significant and has remained a good conduit for research impact. Additionally expert witness work has provided further paths for impact, a recent example being supply of technical information to the Metropolitan Police Service in a high profile murder case where forensic metrology was a part of the critical evidence.</p> <p>Currently, Engineering has two industry-sponsored Chairs, The Taylor Hobson Chair in Surface Metrology (held by P. Scott) and the Precision Technologies Group Chair in Machine Tool Design (held by A. Myers). P. Scot currently holds a split contract and works between Taylor Hobson and the University on knowledge transfer into industry. The UoA has two innovative software products which have arisen from previous projects, VCS and SURFSTAND; both of the products are sold under license, by Dapatech and Taylor Hobson respectively, and they form the basis of two of our impact case studies. License incomes from these products are returned to the respective research groups to support their future development. Several patents have resulted from recent research and these are now the subjects of corresponding licensing agreements (Taylor Hobson, IBSPE (Holland) and Atout Process Ltd. One of the UoA chief collaborators is NPL (National Physical Laboratory) as part of our engagement and our continuing relationship NPL operate a commercial</p>

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measurement laboratory within the UoA that is focused primarily on the aerospace sector. In collaboration, the UoA and NPL transfer the latest measurement technologies and training materials into this target sector. The UoA and NPL are currently developing a matrix of training courses on metrology to be provided to industry; recent customers have included Rolls Royce and Hewlett Packard.

Staff wishing to engage in impact activities are supported at all stages of the process by the two Business Development Managers employed by the School of Computing & Engineering. This support encompasses contract negotiation, contract costing, IP exploitation, setting up licensing agreements, initial legal advice and help in patent drafting/development. Additionally the Business Development Managers (BDMs) are involved in marketing research at external events – a recent example being the Farnborough Airshow 2012. A further key role for the BDMs is research exploitation funding bids. This funding has led to proof of concept and patent applications (e.g. US Patent Application No. 13/641511, European Patent Application No. EP 11720154.1).

Centrally, the University provides funding to support impact activities in a number of forms. The Collaborative Venture Fund provides funding to allow researchers to interact with industry on focused projects relating to knowledge transfer. The UoA has made extensive use of these since they were introduced in 2008. The initial costs of patent protection are met from a specific Patent Development Fund held institutionally. The fund supports the patents until suitable licensing agreements or other exploitation routes are established. The University's Research & Enterprise Directorate provides further advice on exploitation and funding to support impact and acts as a conduit to specific legal support around IP and liability etc.

c. Strategy and plans

Our implementation of impact is through a strategy of developing stronger and deeper links with current and new industrial partners. Other partners such as research institutes (e.g. NPL and public bodies such as the NHS and Network Rail) are also targeted.

The EPSRC Centre for Innovative Manufacturing in Advanced Metrology has recently established a user club with both Tier 1 and Tier 2 status. Tier 1 is aimed a multi-nationals such as Rolls Royce and provides members with block periods of tailored research effort and first access to new exploitable research output. Tier 2 status is based on a similar model, however the research period is reduced to reflect the membership fee. The strategy in this case is to widen the user club in two ways: firstly down the particular supply chain and secondly to develop other sectors such as biotechnology and transport. The Centre and the UoA as a whole have industrial advisory boards and these provide strategic direction in terms of sector targets. The future vision for the EPSRC Centre is to establish a European Doctoral Training Centre in Metrology which will offer industrial PhD's in collaboration with the Centre's primary partners. The funding will be sought based on our successful ERC and FP7 project outcomes. Funding will also be sought for a future Doctoral Training Centre via EPSRC initiatives.

The UoA has developed a significant portfolio of EU projects with the Centre for Precision Technologies and the Institute for Railway Research being particularly successful in this area. These projects by their very nature are heavily industrially skewed and require significant knowledge transfer and impact activity. We intend to increase participation in EU programs in the future under Horizon 2020. In 2009 the Research & Enterprise Directorate engaged Kite Innovation, a project development company, to facilitate this activity and this approach has already proven successful with five projects established since 2009.

Engineering's strategy builds on government policy in that we see the recently established Catapult Centres as significant facilitators of research impact exploitation. We have established excellent links and projects with the Advanced Manufacturing Research Centre (AMRC, Sheffield), the Manufacturing Technology Centre (MTC, Coventry) and the Centre for Process Innovation (CPI, Sedgefield). We will seek to expand our relationships with these and other centres. Research has also been actively applied through KTP projects, in areas such as machine-tool metrology, diagnostics/condition monitoring, and fluid flow modeling.

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It is clear from our recent strategy development that energy generation – both nuclear and from sustainable resources – will be a major technological challenge in the future and a significant portion of our effort will be to engage with industrial developers of such technologies in order to exploit our research output. Work with the nuclear sector will be established through our Rolls Royce links and through working with the Nuclear Advanced Manufacturing Research Centre (NAMRC) in Sheffield. Sustainably energy, in particular wind and marine turbines, are a further area where we see significant opportunities to exploit our research output. This strategy will be tied into our research partners David Brown (turbine gearboxes), and through EU collaborative projects concerned with energy generation (FP7 Nanomend) Other work related to improving energy efficiency includes a high profile and very recently announced £6.3M strategic partnership with Borg Warner focused on developing a research centre at the University with a named Chair being recently appointed The research will support the next generation of automotive turbochargers. The basis of this relationship is discussed in detail in one of our impact case studies.

The recently opened 3M Buckley Innovation Centre ([3MBIC](#)) is a further example of our research being applied to deliver impact. This £12M cross-sector centre is a focal point for spin-out, spin-in and joint venture collaboration with industry, and also acts as a 'shop window' to promote our research. Diagnostics, surface metrology and machine tool metrology groups all have a permanent presence in the centre to showcase their research output and impact.

d. Relationship to case studies

Case Study 1: SURFSTAND. This case study is based around software that was developed for the characterization of 3D surface topography. The software resulted from both EPSRC and EU projects and significant elements were also developed into 9 ISO world-wide standards thus ensuring maximum impact. Support to facilitate this impact was given by the University in terms of licensing negotiations with Taylor Hobson and researcher activity on the relevant ISO (International Standards Organisation) committees. Eventually the SURFSTAND product was embedded into all Taylor Hobson surface metrology software renamed TALYMAP

Case Study 2: VCS (Volumetric Compensation System). This was originally a software tool (and later both hardware and software) developed under the auspices of several EPSRC projects. It deals with mapping both geometrical and thermally-induced positional errors in machine tools and correcting for those errors within the machine tool controller. With the help of our Business Development Managers a licensing agreement was signed in 2011 with the company Dapatech for a world-wide license. Prior to this licensing agreement, regional development agency funding (Yorkshire Forward Proof of Concept award) was secured again through the efforts of the Business Development Managers. This proof of concept award to develop a machine tool controller interface was critical in securing the licensing agreement.

Case Study 3: Borg Warner This case study based around our expanding relationship with Borg Warner. The research underpinning this case study has been undertaken in combustion diagnosis, acoustic monitoring of fuel injection systems and wider areas such as neutron scattering imaging of novel materials for automotive applications. The output of this research and the relationship with Borg Warner has led to their reintroduction of R&D capabilities within the UK. This commitment has also enabled Borg-Warner UK to secure ~£0.5billion in contracts which were dependent upon the relationship between Borg-Warner and the University; this is because Jaguar Land Rover Automotive plc wanted to see key supply chain companies actively up-skilling their workforce and developing their R&D capabilities. We believe this case study demonstrates the University's approach to long-term strategic collaboration with key industrial partners.

Case Study 4: . Fluid Flow. University of Huddersfield research into the optimal design of flow-handling systems has been credited with "transforming" the development strategies and global market sales of Weir Valves and Control Ltd. The company has enjoyed a 75% saving in design lead time and an 18 fold increase in annual sales up to 2013 through the structured integration of researchers' expertise in its design process and a better understanding of the fluid dynamics within its range of products. The success of this collaboration, which has been described as an exemplar of a Knowledge Transfer Partnership, has also led to further research contracts.