

Impact template (REF3a)

Institution: University of Portsmouth
Unit of Assessment: 12 Aeronautical, Mechanical, Chemical and Manufacturing Engineering
<p>a. Context</p> <p>Impact has been integral to our research endeavors. It arises from our substantial research across the subject areas within this UOA, but particularly in <i>Materials and Structural Integrity</i>, <i>Biomechanical Engineering</i> and <i>Polymer and Composites</i>.</p> <p>The main beneficiaries of our research are, firstly, <i>industries including aerospace, construction, healthcare, energy and marine</i>, who have benefited from the introduction of new or improved technologies and processes that have, in turn, improved <i>economic performance and competitiveness of their businesses</i>. In addition, our research has had a substantial impact on the <i>environment</i> through the incorporation of advanced materials in aero-engine components, with a consequent reduction of CO₂ emission. The second significant beneficiary group are <i>healthcare professionals</i> and <i>patients with severe arthritis</i>. Our research into fixation integrity has had a significant impact on <i>health</i> by improving the quality of lives of patients through the mitigation of potential premature failures of primary total hip replacements, and as a result of improved surgical practice and training of <i>healthcare professionals</i> informed by our research. Lastly, potential future losses in both <i>economic</i> and <i>human</i> terms have been mitigated by improved methods of damage assessment and life management of critical engine parts.</p>
<p>b. Approach to impact</p> <p>Our approaches to impact are guided by the principles that strong impact can only arise from international quality research; and that strong and sustainable partnerships with key stakeholders are essential to maximise the delivery of potential benefits. On this basis, researchers within this UoA have been strategically supported through a variety of mechanisms to develop and deliver impact.</p> <p>Our key approaches to impact are:</p> <p>Developing strategic and sustained partnerships with key stakeholders based on research excellence</p> <p>One example of this approach is our long-established research on nickel-based superalloys, for which the group <i>acquired custom-made equipment and testing facilities commissioned and approved for work specifically for Rolls-Royce (RR) and US Air Force</i>. Collaborative work started with <i>consultancy and materials testing</i>, progressing to <i>jointly-funded PhDs and industrially-funded projects</i>. These interactions have intensified, with two joint EPSRC/MOD projects initiated and supported by RR and Dstl/QinetiQ. More recently, we were invited to join a bid to a TSB call on Lightweight Materials, which was funded and successfully completed, leading to the certification of new disc materials used on the latest aero-engines. The University has fully supported this excellent partnership by <i>funding site visits</i>, such as to RR Derby engine testing and assembly sites; <i>participating/reporting to special interest groups</i> at RR and QinetiQ, technical meetings in collaborative programmes as well as scientific conferences. Interactions with industrial users involve research staff and research students, as well as <i>undergraduates and postgraduates who often participate in student projects</i> that are developed from the funded research/development programmes. Our staff development strategy ensures that <i>new staff engage in collaborations immediately</i> on joining a group, some of whom have secured grants based on the long-standing industrial collaborations within the UOA (such as an EPSRC first grant and subsequent Royal Society-Leverhulme Senior Fellowship awarded to Zhao, 2008-2012).</p> <p>Developing consultancy and exploiting of our expertise and facilities</p> <p>Significant investment in our facilities has been key in attracting industrial clients for both collaborative research and consultancy. Since 2008, investment has been made in <i>new equipment and facilities</i> to support the <i>Materials and Structural Integrity</i> area (£620k), together with 3 PGRAs funded by the Faculty Research Strategic Fund to support collaborative research and consultancy. As a result, a total of £646k external income has been generated in this area during the assessment period. Another key objective has been to develop emerging areas of research excellence to serve the local and regional economy. We have established <i>close relationships with</i></p>

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many local, regional, national companies, with expert and swift responses to industrial demands. In particular, the *Polymer and Composite* group has established a very good research profile, with expertise in polymers, thermoplastics, thermosets, adhesives, coatings, elastomers, polymer composite, nanocomposites and other advanced materials. Their lab is well-equipped as a result of university investment of over £600k in recent years, enhancing our capability in characterisation, analysis, selection, formulation, manufacturing, design and mechanical testing, and thus enabling us to support industry in R&D, as well as resolving production problems and difficulties associated with materials and manufacture. The group has provided expert support and consultancy to a number of companies, including: Pall Europe. Material Technology Ltd, Magma Global, Safeguard Europe, Guit, Elta Fan, McMurdo, Property Care Association, Spur Electron Ltd, Wartsila, UniVar Europe, Brett Landscaping and Bac 2. In particular, our TSB-funded research with Bac2 has helped this small company to grow into a fully-fledged specialist in the production of commercial-scale conductive polymer composites, a key ingredient in high performance fuel cells, based on a novel thermoset catalyst technology developed by the UoP research group.

Developing research to address user-defined challenges

Orthopaedic-related research is one example of how the Unit's activities are focussed on addressing user-defined challenges. *We responded positively and swiftly to an initial enquiry* from a consultant at a local NHS hospital in 2002. The university invested in this emerging area by supporting the design and build of a unique hip simulator for fixation testing of cemented acetabular implants (£110k), as well as low force mechanical testing facilities suitable for hard/soft tissues (£130k) and a microCT with *in situ* loading capability (£200k). The hospital staff/patients have benefited directly from our expertise and capabilities as our *research has been built on answering clinical-related questions* from the start. One of the surgeons, Heaton-Adegbile, has since become the first clinical candidate awarded a PhD in Medical Engineering at UoP, and was subsequently awarded a prestigious Fellowship at the Robert Jones and Agnes Hunt Orthopaedic Hospital and became a Consultant Surgeon. Most recently, he won the British Orthopaedic Association (BOA) fellowship 2014 to travel to Europe and US as an ambassador for the UK and BOA to develop international/European collaborative research. This success has led to further collaborations on clinical related projects, including knee implants, spine and trauma; and to recent discussions with Portsmouth NHS Trust on a joint Masters programme to provide systematic training for junior surgeons. Mutual understanding and a strong interaction between the university staff and the clinical staff have been the keys to these successes.

Delivering impact through strategic recruitment, visiting appointments and staff development

Special provisions have been made within our staffing strategy and staff development to support interaction with industries and NHS hospitals. *We have appointed new staff with some industrial background (Simandjuntak; Jadhawar, Karabla)* who offer not only new perspectives to our research and knowledge exchange strategy, but also provide more effective links to key industries through *collaborative projects (Simandjuntak; Jadhawar; Karabla), professional training (Simandjuntak)* and potential *industrial secondment*. We have operated an *industrial visiting scheme*, where academic staff pay regular visits to our placement students in local and regional companies. These visits have initiated discussions on potential collaborative projects; some have led to *sKTP awards* (such as recent awards with Medway Fibreglass on computer-aided design of swimming pools; and with Magma Global on modelling fatigue and bulking of composite pipes). Close industrial interaction is also evidenced by the *visiting posts* made to some of our long-term collaborators who have played significant roles in developing our research programmes. For example, a Visiting Professorship was awarded to Dr Harrison, formerly a senior scientist and a specialist on creep modelling at QinetiQ, who was instrumental in the development of our research programmes on FOD (UOP12FOD) and creep-fatigue (UOP12FATIGUE). Visiting Lecturer Dr Vermulen (2008-2012) from QinetiQ, visited regularly to deliver guest lectures on the latest challenges facing the aerospace industry. Discussions with Visiting Research Fellow Dr Cornet from Airbus, have generated new topics of research into fatigue and fracture in the airframe domain, opening new directions for our, up to now, more aero-engine focused work. *Visiting posts to senior NHS surgical staff have significantly strengthened our links with NHS hospitals* so that we can respond to challenges in clinical practice more rapidly.

To increase the *visibility of the research profile*, research websites have been developed and regularly updated with information on publications, grants and PhD projects. Research brochures have also been produced with the assistance of the marketing department, and distributed at relevant events such as R&KT seminars and open days, as well as to overseas collaborators via the University International Office. Research specialists are listed in an expert directory published by the university and distributed nationally. We have also organised Research Days and Lab Open Days, inviting external visitors to these events to promote further interactions, which have led to many research and development projects and consultancy work with local SMEs, most notably with the *Polymer and Composites* group.

c. Strategy and plans

Our future research strategy and implementation plan clearly signal continuing development in delivering *impact*, with an emphasis on *Reach* and *Sustainability* as well as on *Significance*.

Our strategic objectives are:

- To engage more widely with partners in the aerospace industry and to engage with potential new partners in the power generation industry, as our expertise in creep-fatigue-oxidation can be readily applied to similar problems with direct and immediate impact. We will achieve this through networking, special conferences/meetings, as well as utilising our existing visiting staff and industrial contacts.
- To exploit the University's strategic partnership with the Portsmouth Hospitals Trust, to explore the delivery of professional training/short courses/Masters in Orthopaedic Methods to junior surgeons and specialist registrars; and to engage with colleagues in NHS hospitals and other healthcare providers in new areas, such as Cardiology and Tissue Engineering.
- To explore new areas of potential impact, such as human vibration, trauma and energy engineering, and new avenues of user engagement with the support of the University's Research and Innovation Services.
- To engage ECRs fully in collaborative user-defined research, providing staff with enterprise and commercialisation training and support.
- To encourage staff to explore opportunities for industrial secondments; maximising the opportunities arising from placement visits to actively engage with local SMEs to develop new KTP and consultancy links.
- To appoint visiting lecturer/fellows from key industries to further integrate industry challenges and perspectives across our research themes.
- To consolidate and build our relationships with commercial companies and to attract funding for translational research and innovation, and knowledge exchange.
- To embed the importance of impact-related activities into our systems and processes by recognising and rewarding impact-generation activities; and to incorporate an assessment of such activities as part of our annual Professional Development Reviews.
- To develop a system in line with the best practice across the sector for monitoring and evidencing of significant impacts across our research groups; to review our approach to impact annually.
- To provide significant resources, such as setting up a network fund, to support publicity and outreach as well as networking activities.

d. Relationship to case studies

The three impact case studies are based on our substantial research in aerospace materials and orthopaedic research, and exemplify our approaches to impact. UOP12FOD demonstrates the importance of effective interaction with industry, which underpinned collaborative R&D projects and consultancy work. UOP12FATIGUE illustrates the importance of international quality research in delivering impact and how effective engagement of ECRs has ensured the sustainability of international collaboration. UOP12ORTHOAEDIC exemplifies developing user-defined research, driven by challenges in clinical practice and involving beneficiaries in the research itself.