**Institution: University of Brighton**

**Unit of Assessment: B12 Aeronautical, Mechanical, Chemical and Manufacturing Engineering**

## a. Context

Automotive engineering at the University of Brighton (UoB) has, over 20 years, worked to address global agendas by producing tangible benefits to the natural environment, business enterprises and human safety and well-being. To achieve this we have harnessed robust science to applied innovation through a problem-to-solution approach that we co-produce with users and beneficiaries.

The user group includes: global vehicle manufacturers of passenger cars such as Chrysler, Fiat, Jaguar Land Rover, General Motors; producers of heavy-duty industrial vehicles such as Volvo and DAF; engine and vehicle innovation companies and automotive suppliers such as Ricardo, Denso and Delphi; UK Ministry of Defence; EU and NATO Standards and; land contractors for military vehicle systems such as QinetiQ. The main beneficiaries of our research have been companies that develop engine emission control technologies, the global passenger and industrial vehicle market, the public and natural environment, front-line soldiers and emergency services, and national government and policymakers responsible for military vehicle safety and procurement. Impacts from which they have benefited include the generation of multi-million pound new business, cleaner and more efficient vehicles and therefore improved human health, economic benefit to the consumer through fuel-efficient engines, enhanced crew safety in military vehicles, and standardisation of procurement policy for large, multinational military contracts.

Impact is delivered and managed through the two Research Centres (REF5) where the underpinning research is designed from the outset to stimulate change in producer and consumer behaviour.

## b. Approach to impact

Our approach is founded on a commitment to productive and mutually beneficial partnerships with long-standing industrial and governmental partners as well as responsiveness to emerging relationships and potential future partners.

**User-centred design:** By seeing the world from a user perspective, our problem-to-solution approach is based on co-production with both private sector and governmental partners. We work with them to understand the needs, application and limitations of a product and then use a process of robust experimentation and applied innovation to find solutions. We use the Steering Committees in our two Research Centres to define the problem, design and test the solution and then take the product to market or to its direct beneficiaries.

The Steering Committee of our Vetronics Research Centre (VRC) is composed of Ministry of Defence (MoD) stakeholders responsible for military application, armament procurement and vehicular/crew safety, and also industrial contractors and acquisition agents for defence technology and security. This Steering Committee enables all VRC research to be driven by user requirements (eg soldier protection on Mounted Close Combat/Front Line Command, Logistics Equipment and Support), and shapes the impact of the research in 'theatres' of war and peace-keeping operations. Through the Steering Committee, the research and its impact addresses national and international defence priorities and responds to emerging threats and technological breakthroughs. For example, the VRC has directly and indirectly influenced National Standards (eg Defence Standards 23-09 and 00-82 for the UK MoD, and Single Box Architecture for Emergency Services) and currently leads a working group that is transferring these internationally as NATO and EU Standards through the Military Vehicle Association (MILVA) and European Defence Agency (EDA). Research performed by the VRC has informed vehicle programmes such as the £4bn Scout (General Dynamics), £200m Foxhound (General Dynamics/Thales), and £3bn Warrior (Lockheed Martin) upgrade. The VRC shapes applied research requirements for Future Ground Manoeuvre Capability (FGMC) for beyond 2035 through think-tank contributions, and offers specialised training in Military Vetronics Architectures (MVA) that has now been followed by 96 participants from 5 governments, 13 countries and 20 companies.

The Steering Committee of the Centre for Automotive Engineering (CAE) has members from Ricardo (UK), including Visiting Professor Neville Jackson, who brings experience and insight from his senior executive roles in the automobile industry (eg Chair of the UK Low Carbon Vehicles Partnership, deputy chair of the UK Automotive Technology Council and vice-chair of the European Road Transport Research Advisory Council). Close dialogue with Ricardo UK has enabled early recognition of market trends and technological challenges (eg conforming to new EU legislation on vehicle emissions and the development of fuel-efficient engines, REF3b). The Steering Committee has also stimulated inward investment in the infrastructure of the world-leading Sir Harry Ricardo Laboratories (SHRL). Donations of equipment and direct funding from Ricardo UK and associated car manufacturers (eg Jaguar, Ford) have provided engine test cells and high-speed laser diagnostic systems.

**Working with business:** Researchers develop and maximise interactions with key end–users and audiences through other routes besides the formal Steering Committees, including:

- *Co-working with industrial partners:* Through joint supervision of four RCUK CASE awards (eg EPSRC/BP, EPSRC/Delphi); four industry-funded studentships (eg BP, Ricardo UK); nine studentships with MoD; partnership in projects worth £2.1m (REF5).
- *Knowledge Transfer Partnerships (KTPs):* Four projects funded by the Technology Strategy Board (TSB) and SMEs, including: Rivertrace Ltd with CRUA to develop and produce innovative methodologies to facilitate penetration of the offshore oil market; Kalimex Limited with HEIKAL and Miche to develop a validated test-rig for cooling system leak repair additives.
- *Staff secondments and dual-working*: For example, secondments transferring knowledge to and from Ricardo UK (HEIKAL, BEGG, CRUA), and into the wider research and academic community (eg HEIKAL's two-year secondment heading the Advanced Innovation and Technology Centre, University Technology Petronas (UTP), Malaysia in order to develop policy and strategy, IP and commercialisation).
- *Consultancy positions:* HEIKAL, BEGG and MORGAN are employed as consultants at Ricardo (UK), helping to drive improvements in engine technology to meet low carbon legislations; STIPIDIS, through Defence Equipment and Support (DE&S) at Abbey Wood, provides scientific advice to international co–operation and large procurement programmes.
- *Hosting industry–focused workshops and specialist training courses:* Including delivery of three workshops in 2012–13 to NATO members and industry (eg General Dynamics, Selex, Saab, BAE Systems, Diehl, Thales, Nexter, Sagem); eight specialist workshops divided into two areas ('Automotive air conditioning and design' and 'Development of engine cooling systems') involving delegations from Bentley Motors Ltd, McLaren Automotive Ltd, Nissan Moteor Iberica and Proton, and guest speakers from, for example, Aston Martin, Jaguar Land Rover, Sanden International, Delphi Thermal Systems and Honeywell Belgium NV.

**Enabling and supporting impact delivery:** A technology–focused business development manager (BDM), embedded in the School, works closely with staff to develop the necessary networks and partnerships to exploit IP and academic knowledge for the economic benefit of both the university and its partners. For example, the BDM has co–ordinated contracts with industrial partners in waste heat recovery and low-carbon technologies, and has supported the inception and progress of four KTPs in B12 as well as a further 11 throughout the rest of the School. Impact activities and the benefits accrued are captured and monitored by the university's Economic and Engagement (EASE) Department. In 2011, EASE, with its 51 support staff, joined with the UoB Research Office to become a single department responsible for bringing fundamental research to market and exploiting business opportunities.

Staff are encouraged to maximise the impact associated with their research through a suite of internal investment schemes, including the new 'Rising-Stars' Awards of £10k for ECRs and industrial sabbaticals (up to £20k). SAZHINA used a sabbatical award in 2009 to develop her mathematical work on auto-ignition kinetics and spray combustion in collaboration with Ricardo (UK) but also with fire safety and thermodynamics experts in the University of Karlsruhe and Petersburg State Polytechnic University. There is now formal recognition of impact through the staff promotion process and workload allocation. Impact engagement and delivery is included in the professorial promotion criteria from July 2013, where professors must demonstrate that their research has 'substantial impact beyond the university'.

## c. Strategy and plans

Our strategy for achieving impact feeds in to the future vision for our research ambitions (REF5, Section b), which relies on maintaining and building long-term partnerships and strategic alliances with industrial partners and governmental bodies. We will continue to use the expertise on our Steering Committees to recognise early–stage market opportunities, sell our design solutions to global business and align our research and investments with government policy. We have three strategic aims for enabling impact:

- *Strengthening the infrastructure:* Using our BDMs to fast-track commissioned research and consultancy though the University of Brighton Trading Company. A new Intellectual Property Policy introduced in 2013 is being used to stimulate the commercialisation of ideas and facilitate the licensing of work to other parties as a route to gaining both income and impact. An Enterprise Panel, also formed in 2013, will encourage, support and fund staff to take forward their innovative ideas that can form the basis for commercial exploitation.
- *Embedding impact into institutional planning:* Develop robust and measurable KPIs of impact activity that become part of the local annual Budget Centre Planning cycle. Integrate the delivery of impact into EASE financial targets, including collaborative R&D programmes and intellectual property income.
- *Training of researchers:* Ensuring that postgraduates and ECRs receive training on early identification of impact, types of knowledge exchange, and dissemination, both through its formal PGR training programme and in workshops offered at the *Future's Bright* annual conference for ECRs (REF5).

**Future ambitions:** Over the next three years we will direct resources and effort to:

- Disseminate and publicise the impact of our research through: offering training courses to all staff from a newly appointed Impact Policy Officer, on how to stimulate, document and publicise impact; and the launch of an entirely new University research website in 2014 that will provide examples of impact, including end-user testimonials for our research.
- Increase engagement and generate links with new partners, including via the university's new Green Growth Platform (2013–2018, total funding: £2.98m). This HEFCE Catalyst–funded programme links the knowledge assets of the University (particularly in low carbon alternative vehicles) with 1,000 high-growth-potential SMEs and private, public and third-sector partners, with the aims of supporting innovation, addressing skills shortages and stimulating economic growth. To support these interactions, we will appoint an 'impact champion' from the CAE to work with the BDM to co-ordinate joint working and knowledge exchange, and enable impact via this platform.
- From 2014, the School's annual research monitoring process will include: an explicit impact-related component that includes the identification of potential and current end-user groups; an analysis of the impact achieved to-date; plans to deliver future impact and, an analysis of resource requirements. These monitoring reports are received by the School's Research Strategy Committee that will make recommendations to the School's Management Group regarding allocation of resources to impact-related activities.

## d. Relationship to case studies

Our two Impact Case Studies (REF3b [1,2]) are selected to illustrate how we have worked alongside our industrial partners to apply robust science in the innovation cycle from start–to–finish. User-centred research informed both the delivery of research and the translation of research into impact. The managed approach through each stage of the cycle has ensured that the results are transformed into production ahead of other competitors and at a pace that is unusually quick for products to impact the global market. Both ICSs show how specialised, underpinning research funded by RCUK and industry, can have an exponential impact on a company and global business through precision technologies that generate technical advantages in the marketplace.