Institution: Kingston University

Unit of Assessment: 15, General Engineering

a. Context

The research conducted in the Unit has made impacts on the **environment** (noise control, pollution reduction), **economy** (energy efficiency, built environment, hybrid vehicles), **health** (engineering applications to medicine) and **policy** (review of fire fighting procedures). Specific measures have been taken to promote team working and to align the Unit's activities with industrial partners' priorities and the plans of collaborators, funders and end users.

The Unit works with a range of stakeholders, national and international and has active collaborations with over 100 companies which include prominent bodies such as BP, British Airways, Bombardier Aerospace Belfast, FG Wilson, HSE, Kingspan, Siemens, Pilkington, Zotefoams, Mitsubishi, TECNAN, MAN Trucks, Jaguar Land Rover, Lotus Engineering, Delphi, Essilor International, ANSYS International and the Department for Communities and Local Government as well as a number of SMEs.

b. Approach to impact

Strategic initiatives including specially designed mentoring systems, prioritised investment in space and facilities, and taking an entrepreneurial approach have been used to enhance the approach to impact. The Unit has been supported by financial investment in space and the development of facilities, graduate teaching assistants, doctoral fellowships and industrial networking events.

The research base of the Unit has been organised into three Centres of Excellence: the Centre for Fire and Explosion Studies (CFES), the Materials and Composites Research Centre (MCRC) and the Sustainable Technology Research Centre (STRC). This structure helps to promote the Unit's areas of research strength to the outside world, attracting commercial partners who can readily see the fit between the Unit's research and their own business needs. Relationships with stakeholders are managed so that specific research can be developed collaboratively or through programmes such as KTPs.

Industrial partnerships, collaboration with other HEIs and research organisations, cultivating existing strengths and staff development are the important elements of the strategy and are encouraged across the Unit. Interaction with key users and impact stakeholders has arisen from a number of routes and Unit members are encouraged to attend networking meetings to explore opportunities. These include links that were initiated from student placements with key industrial partners or that were gained from research reputation and track record. These have attracted approaches from governmental bodies and widening networks of existing partnerships.

Examples of research that has led to impact include:

1. Collaboration with a range of industrial partners in an EU FP7 project to develop a new manufacturing process for nanomaterials: (228885-2 (2009-2013)). This resulted in improved production rates of nanoparticles, and the technology has been adopted by TECNAN, a Spanish SME.
2. Knowledge Transfer Partnerships (Chess systems/Chess dynamics) in image processing for high precision manufacturing and accurate control systems. This has resulted in four KTPs and a work-based learning program that is continuing, and subsequently led to additional collaborations with the military.
3. Research in control systems that has led to interest from MAN Trucks Germany in the area of embedding control algorithms developed at Kingston in hybrid vehicles. This is now a major industrial collaboration with MAN Truck Germany with impacts on the environment and economy.
4. The FIRENET ITN attracted the attention of the Fire Statistics and Research Division of the Office of the Deputy Prime Minister (ODPM) and resulted in the ODPM commissioning a project that led to a review of procedures for dealing with basement fires, which have a recent history of fatalities to firefighters. This resulted in the Department of Communities and

Local Government recommending new firefighting procedures.

5. A collaboration with London-based SME IDS Ltd, as part of an "Innovation Associates" KTP, resulted in a new kind of automatic door control system. This detects the direction of movement of a person towards or away from the door, reducing unnecessary door opening and thus conserving energy. IDS is now marketing this product.

The Unit maximises interactions between research and enterprise to ensure benefits to end-users. This includes exploitation of commercial potential through IP protection and licensing opportunities or through knowledge transfer activities. These routes to impact are supported by a local Business Development Manager and personnel from the University's Enterprise Support Office.

Unit members are encouraged to attend external meetings for networking purposes, to disseminate research outputs via both academic and industrial networks and to respond to specific calls in relevant research areas. The Business Development Manager helps to identify these opportunities.

Facilities provided by the Institution, such as a clean room and preparative facilities for making and characterising of composite materials, an automotive engine centre and a specially designed fire laboratory, meet industry-required standards. Industrial collaborators such as Delphi and Lotus regularly use the suspension test rig in the automotive engine centre for damper testing. The Dynamic Impact Equipment (DIE) is a unique instrument, designed and manufactured at Kingston University to measure the high strain rate behaviour of ultra-soft materials such as polymers. In collaboration with an industrial partner, Zotefoams Plc, the DIE was used to study the dynamic performance of closed-cell, cross-linked foam materials. The engine test-cell dynamometer and the rolling-road dynamometer have been used by SMEs to test innovative concepts in engine operation and design. Recent work on conducting polymer blends and ceramic nanoparticles has led to commercial contracts and is currently producing licensable IP.

These facilities are well supported with technical staff and provision is made for postgraduate students and early career researchers. The examples of impact detailed above were made possible by the use of these facilities.

The supporting infrastructure and resources have attracted significant external funding and have led to collaborations with industry, EU partners and other academic institutions. The Unit plays an important part in the Enterprise Europe Network London (EEN) for which the Institution has received EU funding. The EEN provides a wide range of services for SMEs, entrepreneurs and Universities across Europe. This has enhanced collaboration and networking with stakeholders, including SMEs such as Effbox and Matrica, helping to realise the impact potential of the Unit. An example of this is a newly established collaboration between the Unit and Genetic Microdevices (GMD), an SME that uses engineering design principles to develop miniature devices for biomedical uses. A KTP is being prepared for submission in November 2013 to test biomarkers using GMD engineering technologies.

c. Strategy and plans

The strategic plan of the Unit comprises:

a) Outreach to establish the foundations that foster growth of impacts

b) Supporting staff in research by emphasising leadership and strengthening team work

c) Taking an entrepreneurial approach

<u>Outreach to establish the foundations that foster growth of impacts</u>

The Unit aims to capitalise on existing links, individual strengths, research excellence, and interactions between disciplines which cross-fertilise ideas within and beyond the Unit. Early career researchers are encouraged to work across the Centres, and PhD projects that are interdisciplinary are strongly encouraged. A holistic impact approach has been adopted to develop new avenues with broad reach and significance: e.g. materials science applications in nanotechnology for the aircraft industry as well as in the use of polymers for intraocular lenses; the use of Finite Element Analysis in automotive and aircraft designs and its application in biomedical engineering to model the joints and the eye and to use the results in the design of improved medical devices.

Collaborations that can exploit these avenues of research are already established with industry, government bodies, and local communities through KTPs. Existing industrial links are being enhanced, including collaborative research with Jaguar Land Rover on advanced control for optimisation of fuel consumption, and new partnerships fostered with other HEIs, research organisations and industrial partners. The Unit will continue to benefit from links established through the EEN.

The Unit works with a range of partners who have interests in engineering applications to medicine, biomedicine and the life sciences. Staff from the Unit are working with clinicians at the Great Portland Street Hospital in projects that require Finite Element Analysis of bone and soft tissue. Essilor International provides funding for projects in optical engineering applications to vision, looking at methods and devices to ameliorate vision loss with age, and the Unit has a KTP with Rayners aimed at preventing cell adhesion to implant lenses.

The Fire laboratory has developed a compartment for analysis of the dynamics of small/medium scale diesel fuel pool fires, currently leading to the development of a micromist suppression component in which Watermist Ltd has expressed interest. The Unit is developing water spray models for fire protection in collaboration with Softbits Ltd, one of the leading specialist companies in the field of design and analysis of flare systems. This work will advance the water spray modelling capabilities of their Flaresim software product, with impact on the overall flare safety design for the oil, gas, liquefied natural gas and refining industries.

Supporting staff in research by emphasizing leadership and strengthening team work

The Unit aims at fostering leadership by encouraging individuals to become impact and enterprise champions. A well-established mentoring system is in place to strengthen teamwork that aims to enhance the quality of research outputs and attract further external funding to support research. This scheme also covers outreach activity with advice and support on how to approach industrial networks. Mentors assist early career researchers with funding applications and KTP project proposals and help them to develop their own interests that complement the research in the three Research Centres and which will lead to research growth and increased impact potential. The Unit's interests have widened into areas of biomedical engineering and applications in medicine and healthcare. This has opened up new sources of funding (e.g. the eye research charity Fight for Sight) and new opportunities for impact.

Taking an entrepreneurial approach

The Unit continues to grow its relationship with Business Development Managers and personnel from the University's Enterprise Support office in order to maximise research impact locally, nationally and internationally. A coherent and robust methodology has been established for impact measurements, that provides a strong foundation for enhancing research reputation and expanding diverse strengths. For each knowledge transfer or research activity, an impact plan is developed and monitored throughout the whole life cycle.

d. Relationship to case studies

There are a number of examples where the research activities of the Unit have made a direct impact on industry and policy making with potential future impacts on the environment and the economy. Key examples are:

1. Research into novel techniques for nanotechnology and composites in the MCRC has benefitted from interactions with industry and FP7 funded projects. This has led to commercial exploitation of nanomaterial production that has wide-ranging applications given the diversity of customised nanoparticles and nanomixtures that can be produced with these novel techniques.
2. Development of advanced control algorithms for fast mechanical systems attracted the interest of vehicle manufacturers MAN Truck & Bus AG, a collaboration that has resulted in the embedding of the control algorithms in hybrid vehicles, resulting in a subsequent reduction in fuel consumption and in CO_2 emissions.