Institution:University of Derby

Unit of Assessment: UoA 15 – General Engineering

a. Context: The School of Engineering and Technology (SoET) comprises four research groups: Creative Technologies Research Group (CTRG), Built Environment Research Group (BERG), Electrical, Electronic and Software Systems Research Group (E2S2RG) and Mechanical/Manufacturing Engineering and Industrial Design Research Group (MMEIDRG). The strategy adopted by the School and, hence, UoA is one that actively encourages engagement with businesses and seeks out beneficiaries of research projects. As a result, the four research groups have elicited impact locally, nationally and internationally with some distinct, focussed areas and others with a broader, more inter-disciplinary remit. Research carried out in the SoET often has industrial partners, is focussing on issues that have been associated with the real-world application of research or involve companies in the research process directly. In order to support this, University and Faculty level research funding is used to help facilitate impact in terms of company visits, symposia, attendance of external events, carrying out the research and transferring the knowledge to non-academic users. Benefits have included economic and health impacts, impacts on culture and creativity and impacts on practitioners and professional services with projects under way which also aim to elicit impact in the area of public policy and services.

b. Approach to impact: The UoA's approach to impact has been multi-faceted with a number of different methodologies resulting in impact. The School's overarching approach is to target specific projects built on expertise and existing relationships, as well as fostering new, often local, business relationships utilising Business Breakfast, industrial advisory board events and free showcase/symposia, with the Institute for Innovation and Sustainable Engineering (IISE) poised to take the lead and focus in this area (see section c). In a University-wide context, internal funds have been made available to researchers in the guise of Research for Learning and Teaching Fund (RLTF) with potential and expected impact being an explicit part of the application and audit process. This has resulted in impact both from case study led applied research projects, and from the actual results or outcomes of a project being made freely available to a wider, non-academic audience. This has proved especially useful for small, focussed projects that, otherwise, would be difficult to fund externally. In 2008, members of the UoA, funded by the EPSRC as part of the SpACE-NET Spatial Audio Network (http://space-net.org.uk/) held a free symposium around the theme of Spatial Sound & Music. This showcased work not just from academia, but also from contacts in industry, to an audience comprised of national and international researchers in the field and, importantly, relevant and interested industrial representatives and the public. This model has been carried forward as part of the UoA's impact strategy with internally funded joint symposia held in 2011, 2012 and 2013 with presenters and audience members from BBC R&D, Funktion One, Dyer Audio, Davis Derby and Phaedrus Systems as well as from other HEAs. Feedback from the events has been excellent with industry representatives, in particular, praising the format. Clear economic impact delivered by Dr Oraifige and Dr Harmanto's (MMEIDRG) project on the development of a lean park homes production process (2011) which demonstrated the application of methods to achieve leaner processes using both discrete-event simulation and empirically observed and studied changes in the UK Park Homes production industry. The impact due to the cost savings resulted in the survival of a company that previous to the work carried out was becoming financially unviable. Dr Wiggins and Dr Hill's work in the area of Audio and Electro-acoustic research have demonstrated impact on practitioners and professional services in a live sound reinforcement context. Large-scale surround sound work with Funktion One led to a measured benefit of lower noise levels off-site, and more enveloping audio on-site compared to other stages controlled in a standard stereo based manner. The software is now a feature of Funktion One live events. Work in the area of Finite Difference Time Domain (FDTD) acoustic simulation has been commissioned by JL Audio (USA) to assist the company with their research as well as enabling them to advise customers on ideal subwoofer placement within JL Audio home theatre systems. Loudspeaker simulation software is currently being developed for JL Audio as an offshoot of the FDTD work. The Chameleon Subwoofer Array (CSA) low-frequency control system (Dr Hill) is currently being explored by Bowers & Wilkins (UK) in their high-end home cinema loudspeaker systems with Dr Hill's low-frequency control techniques for live sound reinforcement being utilized by Gand Concert Sound (USA) at large-scale outdoor music festivals with the goal of even audience coverage and minimal sound energy on stage (2013 Pitchfork Music Festival in Chicago, USA). The UoA is engaged with local businesses in many aspects of University business,

a good example being a KTP scheme which enabled the UoA to work with Davis Derby Limited. Expertise in the area of electronic and software systems and signal processing contributed to the development of a people and object recognition system which interfaces with the vehicle and engine management systems of forklifts in order to augment driver responsibility for safety when used in mines, quarries and warehousing where a number of serious accidents and fatalities occur every year, giving clear health and well-being benefits (2011). Dr Shafik's work in the design and development of ultrasonic servo control feed drives for electro discharge texturing and machining systems for aerospace and automotive applications have begun to generate impact externally. Using ultrasonic servo control technology the project has demonstrated improvements of the material surface profile, enhanced EDM process through reducing the arcing and short circuiting process and consequently reducing the machining time. This has led to adoption of the system by local companies such as Smart Technology-UK and other companies in China and Japan with Rolls-Royce now investigating the use of the technique to develop manufacturing cost models for use in the manufacturing of film cooling holes for Turbine Blades. A collaboration with the Derbyshire Fire and Rescue Service, where work led by Dr Harmanto and Steve Hill (SoET) resulted in a new training vehicle for Derbyshire Fire and Rescue Service (DFRS). The reusable training vehicle can be disassembled and rebuilt indefinitely without compromising the structural integrity of the vehicle so the DFRS could practice patient removal from road traffic accident techniques. Impact stemmed from improvements in training efficiency and productivity using the unique design that was recognised globally thanks to the free exhibition space given to the project at the Emergency Services Show in September 2011 generating impact on society. Further enquiries have come from Australia, The United States and the Middle East with the DFRS commissioning two further projects (2012), an extrication simulator based around a HGV Tractor Unit and a saloon car air-bag and SRS system simulator. Both were displayed to the public at the Emergency Services Show in September 2013, as well as being covered by BBC news in July 2013. The same team is now commencing on the design of the motorbike that is to be used for a world land speed record attempt, which is a project led by the former GP and TT sidecar competitor, Alex Macfadzean.

c. Strategy and plans: The UoA is involved with a number of on-going projects that have been initiated in order to exhibit impact, along with a major development in the form of the Institute for Innovation in Sustainable Engineering which will be fully on-stream in April 2014. Located in a newly acquired building near to the University's Derby Campus, the remit of the Institute is to support the on-going engagement with industrial partners at all levels, as well as provide a resource for bid activities with regional and national agencies and encourage and support the research agenda for the School and University. The institute is based specifically around the research of the UoA and will focus on creativity and innovation alongside partner businesses and Knowledge Transfer Projects. The University has appointed a director (Professor Richard Hall), and will employ 5 professors in the next 4 years to complement the 4 visiting professors already in post (see REF5). The new £3 million four storey building provides an extra 1,550 m^2 and will provide significantly improved physical and staff resource to the UoA with £2.5 million of equipment planned. Projects are already being discussed with Rolls-Royce, Bombardier, Toyota and their supply chain. Significant new work being targeted by the IISE with one of the first live projects is the Engineering Supply Chain Solutions (ESCS - www.engineeringscs.co.uk) a collaboration between Derby City Council, the University of Derby, Aston University and Cranfield University. ESCS works to improve the performance of supply chain companies, particularly SME's in the Derby locality but also further afield in the East Midlands, operating in or wanting to access the transport engineering sectors such as aerospace, automotive or rail. Although IISE will concentrate the focus of the UoA's future efforts, current, on-going projects which are impact led are numerous. Tracada has been funded by the European Lifelong Learning Programme in collaboration with the Giovanni Michelucci Foundation (Italy) in a project related to the Leonardo B.E.S.T. Self Build Processes Project. €22,000 has been awarded to train young people from local communities seeking to solve their problems of unemployment and lack of housing. Dr Ceranic is currently involved in the Retrotek project (Transforming Empty Homes Through Sustainable Solutions www.retrotek.co.uk), which involved developing a novel design and procurement strategy for sustainable refurbishment of empty homes. EKV Design, SoET and the University of Lincoln formed the collaborative group and the project focusses on sustainable and energy efficient housing. This is particularly attractive as new planning laws are focusing on empty housing

(www.bbc.co.uk/news/uk-politics-19496204) and the intention is to apply for a new Homes and Communities Agency (HCA) trench funding in collaboration with Derby City Council DCC, to realise the impact of this project through a pilot study in Osmaston Triangle area, Derby (£1million). SmartPOD (www.smart-pod.co.uk) is another live project from BERG which will deliver impact from the development of sustainable, modular, autonomous, reusable and transportable buildings. The project has gained a highly commended Lord Stafford Award and has been developed as part of a consortium, which are currently negotiating with the University and a large international construction company two prototypes build, to be installed for use and testing at the University of Derby Buxton site, Oakland Manor. Tracada is involved in a Leonardo da Vinci Programme European funded project (£15,000) which is a pilot project preparing students in architecture courses (designers) to be able to liaise with project self-build processes. The project has links to the National Self Build Association (www.nasba.org.uk), which, in July 2011, working with the Government, published an action plan to promote the growth of self build in the UK. The project's impact will be in supplying training schemes such as one in Tuscany in collaboration with habitat et habitation Leuven-la-Neuve, Belgium. Tracada is also the Editor in Chief of the Journal of International Society of Biourbanism (www.biourbanism.org) which is a journal with a remit "to support the dialogue between practitioners and academics, by avoiding a purely academic discussion on design" and to "Increase the visibility of the bio urbanism among academia, scholars and the public". Dr Bousbaine's research in the 42V automotive system has led to the development of the solar model car project for the undergraduate students at the University of Derby which promote the use of renewable energy sources and its impact on the environment. The over-arching aim for this project, and his continuing research, is in developing a fully electrical power system for the automotive market with public dissemination of this project planned for 2014 and Dr Shaffik's current, internally funded, design and development of a 6D wireless telehealth monitoring network for elderly people using radio-frequency identification and ZigBee wireless technology project is focussed on helping elderly people across the UK to live independently and improve their quality of life using smart sensors and actuators, 3D video-audio technology, radio frequency identification and ZigBee and/or Bluetooth wireless technology combined with iCloud and semantic data technology with clear economic and health impacts. Dr Kharaz is part of a joint project with Dr Ian Robinson of the National Physical Laboratory (NPL). The project, funded by SoET and NPL, is to develop an educational version of the watt balance, the expected future international kilogram standard. Dr Harmanto's current work with CFD and FEA analysis techniques is in the simulation and design of the motorbike that is to be used in a land speed world record attempt in September 2014. The current record stands at 376.363mph, set by American Rocky Robinson and ratified by the Fédération Internationale De Motocyclisme with this project being led by Alex Macfadzean, the current British motorcycle land speed record holder. The impact generated by the research resulting in the new motorbike design will be internationally significant with news of the record attempt, and the UoA's involvement having already been featured by the BBC, Yahoo Sport, Fox News and MSN among others.

d. Relationship to case studies: Dr Wiggins' work on spatial sound software was born from the idea of creating local academic impact allowing music students to benefit from the research. However, through engagement on email groups that contained both academic and non-academic beneficiaries, coupled with the decision to release the software to the public, interested non-academic beneficiaries soon surfaced. Now, twitter (@BruceWiggins) and a more complete web presence (www.brucewiggins.co.uk) enables much faster, yet still targeted dissemination to occur leading to much improved reach compared to 2008. For example, after tweeting a picture of a new surround sound bone conduction headset, a Philips innovation and research engineer contacted Dr Wiggins in order to discuss the design, and results gained in the 1st stages of this internal project. This has, in some way, helped shape how the UoA engages with as yet unknown beneficiaries of work currently being undertaken, and has also led to a number of guest and keynote speaker sessions at a number of conferences and HEAs in 2012. The work of Professor Wu was a more traditional approach of a funded collaborative project, which reflected the UoA's previous and continued desire to work with non-academic partners to achieve measurable impact with the UoA sponsoring the project and giving continued financial support in this area. Both case studies have benefitted, significantly, from the internal research inspired curriculum fund (RICF) and faculty research funds in order to maximise the actual impact of the work, with the continued RICF proving a high quality, and cost effective, methodology.