Institution: Sheffield Hallam University

Unit of Assessment: 5 Biological Sciences

a. Context: Academic research in the Biomedical Research Centre (BMRC) is undertaken within four research groups, Bioanalysis, Biochemistry, Disease Mechanisms and Molecular Microbiology. **Key beneficiaries** of this research are: **(i)** Industry, mainly pharmaceutical, **(ii)** Government bodies including: The Home Office and Health and Safety Laboratories, **(iii)** NHS clinicians, patients and carers, **(iv)** The public.

Our main types of impact include: enhanced pharmaceutical industry productivity by application of our research knowledge and expertise in state of the art analytical technique developments, specifically in the field of mass spectrometry; application of our analytical technique expertise to new fields; successful protection of our IP and inventions by patents and subsequent licensing to UK companies; clinician, patient and public engagement in our research ensuring a sharing of our new knowledge, leading to wider understanding of the research process and providing greater insights into disease mechanisms. This is enhanced by several joint research initiatives between BMRC scientists and clinicians at Sheffield Teaching Hospitals NHS Foundation Trust.

Technique/Application developments: We have developed and published novel imaging mass spectrometry techniques, most recently incorporating ion mobility, which have been applied in the pharmaceutical, clinical and forensic sectors. This impact has been facilitated through establishing long term relationships with companies, for example we have worked with GSK on collaborative projects since 2006. In recognition of our expertise and the value of this to their companies, Unilever (Netherlands) and Climostat (UK) have commissioned us to train their scientists in these techniques on a paid consultancy basis. The introduction of novel mass spectrometry imaging techniques in the pharmaceutical industry, based on cutting edge research in BMRC, has changed practice in the methodology applied in animal drug distribution studies. Application of the techniques to analysis of fingermarks, underpinned by eleven publications in academic journals in this REF period by **Francese**, is being undertaken in collaboration with the Home Office.

Patents: Patents have been granted, or are pending, for eight technologies developed in the current REF period. Two of these technologies have been licensed, the adaptation of the fibre optics in mass spectrometers with Elforlight and the powder discharge gun with Consolite Forenscis Ltd. for commercialisation. Biomaterials and their applications is an additional strength in BMRC; from 2008, three patents have been granted or are pending for the application of sol gel coatings relating to biofouling, Sol gel Biocote 1 (EP08788766.7), Sol Gel Biocote 2 (GB1221703A) and Sol Gel antibiotics (EP2328627B) for replacement hip joint coatings (Case Study 3) and two patents pending in relation to hydrogel formulation for treatment of back pain, filed in 2011 and 2012 (GB1114446AA and WO2013027051A).

Public Engagement activities: Staff are involved in public understanding of science events, including through a BMRC patient users group (around 12 regular attendees at usually an annual meeting), which promotes interaction between patients and scientists to increase understanding in a two way learning process. This is exemplified in relation to people with multiple sclerosis (MS) (Case Study 2). BMRC academics and research students have given presentations at public events and to schools and other groups annually as part of Science Engineering Technology (SET) week. Forty staff and research students are registered as STEM ambassadors. In 2011 and 2012, the work of Clench and Francese featured in BBC TV programmes (Case Study 1).

b. Approach to impact:

(i) *Engagement and relationship building with beneficiaries*: We apply our research knowledge and expertise to targeted beneficiaries, by marketing our knowledge transfer (KT) and consultancy activities through our commercial services team, led by the Business Development Manager (BDM). We exploit research outputs through protecting intellectual property and patenting inventions and actively searching for commercial partners for licensing opportunities. Since 2008, 2.5FTE staff have been employed to support the BDM in these activities, two at doctoral level. The BD team seeks external customers, locally, nationally and internationally and establishes and supports partnerships between academic experts and beneficiaries. The BDM is a member of external forums, which promote our interaction with business. These include METRC (http://www.metrc.co.uk/home.aspx) a university centre applying university research to industry with a focus on medicines, healthcare and chemicals relevant to our research (BMRC had a stand at '*Delivering Innovation Conference'* Sheffield 6/02/2012); and also the Healthcare Technology Group (HTG) of the Sheffield City Region Local Enterprise Partnership (LEP) which brings together

academics, industry and the local authority to enhance development of this sector in Sheffield. The HTG has sought to promote industry - university interactions, one initial success is a validated medical device diploma co-developed by BMRC with NSF Health Sciences (http://nsf-dba.com/pages/medical-devices-diploma). Our BDM works with other BDMs in related areas, such as the Materials and Engineering Research Institute, in order to pool resources and enhance our business offer. Many external partnerships have been established initially through personal contacts between individual academics with companies, and via research presentations at conferences in the UK and overseas. We promote opportunities for businesses in BMRC through Open Days (Case Study 1) and through trade exhibitions at relevant conferences, recently at Regener8, *Translating regenerative therapies to a global market*, (http://www.regener8.ac.uk/events/ev/217/nom/regener8-annual-conference-2013.htm). Our mass spectrometry imaging day at SHU in 2013 attracted over 100 delegates, evidence of the interest in our research. Collaboration with industry and NHS clinicians is enhanced through co-funding of PhD studentships. Four BMRC and clinical co-funded PhD students completed in 2009-2011, increasing the impact of our research within NHS settings via co-authored outputs. Three industry/BMRC funded PhD studentships with: the Home Office (Francese), Steifel (GSK) (Clench), and the Health and Safety Laboratories (Clench and Smith TJ) are ongoing (2013-2016). We have secured RCUK funded CASE studentships with GSK (two ongoing). These longstanding partnerships, structured around studentships have led to paid consultancy work with large Pharma companies, enhancing their businesses (see Case Study 1).

(i) *Follow through with beneficiaries to gain impact:* BMRC has used an EPSRC funded *'Bridging the Gap'* project and subsequent feasibility award (EP/H000275; EP/I016473/1 £934K) as a springboard to develop and commercialise novel products. For instance, Francese's patent of a powder discharge gun for fingerprint analysis, jointly developed with researchers in the Art and Design Research Centre, has been licensed to Consolite Forensics. The University has set up a follow-on fund, "*Imagine*" (£500K, 2012-14) which continues to embed a multidisciplinary approach into research and ensures projects have deliverable impact.

(iii) Support for staff to achieve impact: Staff development activities within SHU provide individuals with the skill-sets needed to gain most impact from their research. The University's Research and Innovation Office (RIO) provides training courses in KT skills, IP and commercialisation, in line with the Vitae Researcher Development Framework.

(iv) Institutional support for staff: Our business focused approach is supported at an institutional level by RIO through several mechanisms including: strategic allocation of HEIF funds for Knowledge Exchange activities, for example with Critical Pharmaceuticals in BioCity, Nottingham; promotion of KT activities with industry; commercial market analysis and contractual advice; dedicated staff providing assistance in the development of patent applications, including the funding of these applications, as evidenced by eight BMRC patented technologies granted or pending in this REF period; hosting a monthly University Business Engagement Forum to facilitate sharing of good practice across the University's KT staff; and raising awareness of opportunities through a central customer relations management system.

(v) Mechanisms to support and enable impact: We provide consultancy services through which external partners gain access to laboratory facilities and researcher expertise. Our excellent laboratory and equipment infrastructure provides smaller companies with access to equipment and researcher expertise. Proactive engagement with industry is promoted through Innovation Futures (IF), a university initiative that facilitates interactions with SMEs in Yorkshire and Humberside to help them innovate and develop services, products and processes. IF was established in 2009 and brings together biological sciences with research strengths in other disciplines in SHU to address technical issues or the potential development of new products for local SMEs. The first project phase (2009-2012) was funded through the University's own funds (£558K), HEIF4 (£600K), Yorkshire Forward Single Pot (£450K), and European Regional Development Funds (ERDF) (£1.674M). The success of this scheme was demonstrated by interactions with 125 SME businesses across Yorkshire and the Humber. The direct application of research knowledge from SHU with our clients led, for instance, to 3 TSB SMART Awards and 3 KTPs. A second phase has been launched (2013-2015), funded by SHU (£308K), HEIF 2011-2015 (£569K), and ERDF (£967K). BMRC was integrated into the IF team in 2011. We initiated four interventions with commercial companies, including interactions with. 'Sheffield Waste Recycling and Destruction' company, where our research demonstrated the addition of specific microorganisms to the

recycling process enhanced biogas production, and with Yara UK Ltd, York, where our research on YaraVita formulations, applied as a plant foliar spray, provided information on uptake mechanisms using mass spectrometry imaging techniques. We have taken advantage of an Innovation Vouchers scheme run by Business Link South Yorkshire to increase interactions with SMEs, and have supported two companies, Urban Hygiene and Aquaculture via this route.
vi) Public engagement: Staff and PhD students take a proactive approach to public engagement with 40 of our staff and students registered as STEM ambassadors, delivering talks and activities on their research expertise at schools and within SHU. Regular meetings between the Head of Research Centre and SHU media relations team help maximise the reach and impact of our research by using traditional media as well as the university's Twitter and Facebook channels. Bassindale (Analytical Research Group) writes a blog (www.weareforensic.co.uk/category/blogger) with 300 hits per week (source: Google analytics, 09/2013. Twitter feed associated with this blog has 715 followers 09/2013). Details of our research staff are available on the *'Find an Expert'* database, which offers our expertise to external organisations including industry and the media. Sheffield Hallam University Archive (SHURA) (http://shura.shu.ac.uk/) is also accessible to external users for them to interrogate our expertise.

c. Strategy and plans: Our approach to maximising **impact in the period 2014-2019** is to **(i)** Strengthen current industrial networks and partnerships and engage new users of our research through, biannual email updates and one workshop per annum for external partners. **(ii)** Proactively market our skills and services, including current patents, to industry, academics and clinicians through presentations/stands at four national conferences per annum and, with assistance from SHU's media team, through our website, social media and CRM systems. **(iii)** Engage with the University Alumni Office proactively to use our alumni in industry to promote our commercial consultancy offer and to work with three new companies per annum through this route. **(iv)** Build upon staffs' current expertise to increase their ability to gain impact from their research and ensure all new academic staff are engaged in the impact agenda via training from RIO staff, and through mentoring by current BMRC staff, with a track record in generating impact. We will use income generated through commercial activities to support staff develop their commercially applied research. **(v)** Develop our involvement with companies in the region through the Healthcare Technology LEP and the Innovation Futures ERDF funded project. We will work with six SMEs per annum in the Yorkshire region and support these companies with TSB bids in partnership with BMRC academics; we will build on our recent success with TSB funding of £93K for BMRC to work with Alcontrol, a large independent European Laboratory organisation, Sheffield and Sheaf Innovations Ltd., Sheffield, on detection of contaminants in food, under the TSB *Nutrition for Life* call: start date 01/2014. **(vi)** Ensure a strong presence during annual SET week at public (target six talks), and schools (target 20 schools) to share our research findings. **(vii)** Systematically capture quantitative and qualitative data on impact via a central BMRC database, maintained by our BDM who will gain feedback from external clients by 'end of project review meetings' focused on mapping future business opportunities and maximising impact. These reviews will be used on our website as examples of our offer to businesses, demonstrating how we can enhance their work.

d. Relationship to case studies The case studies reflect our approach and have informed our strategy in six key areas:**(i)** producing excellent research over a sustained period is a prerequisite to deliver impact, as evidenced by academic outputs as well as grant funding from RCUK, charities and co-sponsorship of research students by industry **(ii)** The importance of building up long term relationships with industrial partners. Clench's pioneering work in the field of mass spectrometry imaging, which he initiated at SHU in the 1990s is only now delivering impact, indicating the need for forward planning in achieving impact; **(iii)** Our novel patented materials are key conduits to impact; further promotion of their uptake and exploitation via licensing through companies is central to future impact; **(iv)** the value of our research knowledge and expertise to inform public understanding and debate. Case Study 2 exemplifies our approach to public understanding of science through dialogue with clinicians, patients and their carers; **(v)** The importance of staff with experience in achieving impact, sharing this knowledge and expertise with more inexperienced staff. Staff training and development in how to achieve impact will be a priority; **(vi)** The need to work across scientific disciplines to engender innovation of benefit to industry is a critical component in our approach, as reflected in Case Studies 1 and 3.