Institution: University of Sheffield

Unit of Assessment: 8 - Chemistry

a. Context.

The department's goal is to conduct world-class fundamental research, and to encourage its technical translation and commercial exploitation wherever and whenever this is applicable. The impact of our research mostly benefits the global chemical industry, particularly in the following sectors: (i) home & personal care products (Unilever, P & G, Reckitt Benckiser, Boots etc.); (ii) pharma (GSK, AstraZeneca, Novartis, Pfizer); (iii) agrochemicals (Syngenta); (iv) speciality chemicals (DSM, Cytec, Cabot, Croda, Peakdale); (v) engine oils & lubrication (BP, Lubrizol); (vi) biomedical materials & devices (Biocompatibles, Smith & Nephew, Camstent, QuantuMDx); (vii) paints & coatings (AkzoNobel); and (viii) commodity chemicals (Dow).

b. Approach to impact.

Impact generation is *facilitated* via an effective programme of practical support that is well integrated across departmental, faculty, and institutional levels. Research impact is an important criterion used to assess an individual's performance in annual reviews, with all academic staff being incentivised via promotion and salary enhancements. In addition, the department prioritises the award of Doctoral Training Account (DTA) PhD grants to staff who obtain at least CASE-level support from an industrial partner, and provides partial teaching remission to encourage further industrial engagements such as secondments and Knowledge Transfer Partnerships (KTPs). An important institutional incentive awards individual staff a high proportion of the income that they generate *via* either consultancy activity or IP exploitation. Departmental and faculty Away-Days encourage staff to share ideas and collaborate across traditional boundaries, which often results in enhanced scientific impact via joint publications or successful research grant applications. DTA PhD funding is top-sliced at faculty level to provide a pool of studentships for cross-departmental projects and also for industrially-supported CASE awards. These mechanisms underpin impact generation, encourage staff engagement and ensure a diverse and balanced portfolio of research projects.

If potentially exploitable IP arises, the impact generation process begins with a web-based 'commercial opportunity disclosure' (COD) facility which enables academics to alert the University to each new technical concept. New CODs are reviewed regularly, and the more promising ideas are identified and followed up by a face-to-face meeting with the relevant academic(s) to assess (i) potential commercial partners and (ii) appropriate internal and/or external funding sources that will enable 'proof-of-concept' studies to be conducted.

This proactive, flexible and rapid-response approach identifies potential impact efficiently and then provides academics with the *resources*, *practical support* and *time* to develop their ideas. Many industrial collaborations and potential impact-generating projects within the department have been aided by: (i) provision of seedcorn funding for promising projects (e.g. METRC [see below] support for QuantuMDx collaboration with **D Williams**); (ii) timely advice regarding IP protection (e.g. **Armes** patent sold to DSM); (iii) introductions to potential industrial partners (e.g. via Faculty of Science business development managers); (iv) practical support in terms of either teaching remission or PhD studentship provision to develop the concept further (e.g. the recent secondment of **Harrity** to *Peakdale Molecular* – see below).

The range of mechanisms available to facilitate our research impact is extensive. Financial support for many early-stage projects has been provided via our **EPSRC Knowledge Transfer Account (KTA) grant** (£5.7M, Oct 2009) – one of only 8 such awards in the UK. During the REF period, this grant awarded numerous proof-of-concept grants to individual academics, supported several larger collaborative R&D grants (jointly-funded by an industrial partner), provided funding for incoming industrial and outgoing academic secondments; and enabled the purchase (or refurbishment) of essential equipment. Examples of such KTA projects include:

(i) Harrity was seconded to *Peakdale Molecular* for 15 months on a part-time basis. The department supported this initiative via partial teaching remission. Compound libraries prepared by

research groups led by **Harrity** and **Jackson** are now sold by this company.

(ii) KTA support provided **Armes** with (i) an incoming industrial secondment (one-year PDRA) from Cytec Specialities to undertake a project on pressure-sensitive adhesives, and (ii) a £30k Collaborative R&D grant with DSM, which persuaded this company to fund a post-doc *and* a PhD CASE award to develop next-generation anti-reflective coatings (see Impact Case Study).

(iii) Fairclough has participated in two successful KTPs. One £77k project with CPD led to this company spinning off a separate company (Floreon) to develop disposable polylactide-based biodegradable drinks bottles. A second £128k project with Pipeline Engineering led to design of polyurethane elastomers for cable protection.

In 2008, the University received £2.3M from The Northern Way (via N8 Research Partnership Ltd) to set up the **Molecular Engineering Translational Research Centre (METRC)** within the Chemistry Department (director, **Armes**) to assist in the translation of 'molecular engineering' research from the N8 universities to UK industry. Over £200k was awarded to Sheffield Chemistry academics over the REF period and resulted in numerous tangible impacts. For example, METRC introduced **D Williams** to a medical diagnostics company, QuantuMDx, which enabled his expertise in nucleotide chemistry to be transferred to this SME. A £10k **METRC** Proof-of-Concept grant led directly to £350k in further funding from a range of sources, including QuantuMDx, NIHR i4i, EPSRC and BBSRC, which has supported 3 PhD students and a visiting industrial scientist to work in the **D. Williams** team. This collaboration led to QuantuMDx creating four new jobs in the UK. As a result, QuantuMDx won prestigious industry awards and secured an exclusive worldwide licence with a major US company.

In addition, the chemistry department benefits from hosting the **Polymer Centre** (**PC**) (director: **Armes**), which is a virtual centre representing the polymer science-based expertise of 48 academic staff based in the Science, Engineering and Medical faculties. It is a highly efficient vehicle for fielding enquiries in this specialised field from a wide range of global companies, as well as many local and regional SMEs. With experienced support staff and a database of more than 1,000 companies, the **PC** provides us with the capacity and infrastructure to respond efficiently to commercial enquiries and is considered an exemplar for third party engagement within the University. The **PC** has been led by Chemistry academics since its inception in 2002.

Practical support in developing industry-led collaborations comes from **Farapack Polymers (FPP)**, a university spin-out company originating from strong chemistry involvement in the **PC** (founded by **Ryan** in 2004; **Armes** has been a director since 2009). **FPP** offers rapid turn-round polymer science-based research services for the industrial sector by focusing on the efficient delivery of short-term projects (e.g. feasibility studies, contract synthesis, analysis and characterisation) for industrial clients ranging from UK SMEs to blue chip multinationals. During this REF period, **FPP**'s turnover has exceeded £1.4M. **FPP**'s ability to efficiently and consistently deliver short-term proof-of-concept projects for its industrial clients has often led to full-FEC contracts and new relationships between academics and **FPP** clients (e.g. an initial £10k **FPP** contract with Reckitt Benckiser led to a £250k two-year post-doc grant with **Armes**). **FPP** provides an extremely effective mechanism for industrial engagement: **Rimmer**, **Ryan**, **Armes**, **Twyman** and **Fairclough** have solved technical problems for many industrial partners.

c. Strategy and Plans

Robust institutional mechanisms for early identification of *potential* impact to ensure that this leads to *real* impact are embedded in the department. Further areas for development include:

• ***Maintaining our strategic approach to conducting high-quality research.*** We have recently made a concerted effort to attract more EU funding. This strategy has recently led to the award of two ERC Advanced Investigator awards (**Hunter, Armes**) and several Marie Curie postdoc fellowships to diversify our funding portfolio. We have also just recruited four new staff in key research areas, which will reduce average teaching loads. In our experience, excellent impact case studies are most likely to emerge from world-class fundamental research so we have taken appropriate steps to safeguard our future capacity to perform this vital task.

• ***New funding sources to promote impact.*** Several funding sources will become available over

the next REF period. We intend to exploit these resources to ensure maximum impact.

(i) The University's £2.4M EPSRC Impact Acceleration Account (**IAA**) builds on our earlier KTA grant. From 2013–15, **IAA** funds will support (i) proof-of-concept projects; (ii) collaborative R&D grants; (iii) incoming or outgoing industry secondments; and (iv) Early-Career Researchers (**ECR**s). In the first **IAA** call, **Armes** and **Jackson** received 2 proof-of-concept grants (£36k).

(ii) IAAs from other Research Councils, as well as the annual £2.85M HEIF grant will be targeted towards ensuring the impact of *non-EPSRC* research, such as that funded by BBSRC, MRC, Wellcome Trust *etc.*

(iii) The success of METRC (see above) has resulted in £1.1M of follow-on funding from the N8 consortium. Academic staff can bid for £5k 'innovation vouchers' from a ring-fenced allocation of £120k to facilitate interactions with UK-based companies, particularly SMEs.

• ***Mentoring and support of junior staff.*** **ECR**s will be formally introduced to Knowledge Exchange (KE) mechanisms as part of their induction and training. The importance of KE activity will be emphasised in terms of funding opportunities and new institutional IP capture and exploitation policies will be explained. **ECR**s will be encouraged to apply for funding from the above sources and will be supported in their applications for EPSRC and ERC fellowships.

• ***Early identification of impact.*** This is essential for the effective translation of fundamental research. We plan to use our annual staff appraisal system as a mechanism for identifying future impact possibilities as soon as possible in order to maximise their impact during the next REF period. Rather than relying on individual staff to initiate the KT process, the department will be proactive about identifying possibilities and providing targeted support quickly. Close engagement with KE activities will become an expected norm for all academic staff.

• ***Senior staff contributions to the impact agenda.*** Chemistry's new Impact Champion is **Armes**, who will be able to advise **ECR**s. He also serves on the University's new Impact, Innovation and Knowledge Exchange committee, which administers the **IAA** grants and thereby promotes non-academic impact. **Leggett** co-directs a CDT in 'Molecular Scale Engineering' to develop technologies for manipulating molecular materials on the nano-scale and **Armes** will lead a new Chemistry-led CDT on 'Polymers, Soft Matter & Colloids' (50 PhD studentships over 5 years); both CDTs are expected to generate substantial impact over the next REF period.

d. Relationship to case studies.

The **Armes** case study can be directly linked to institutional impact strategies. The University's KTA grant provided a £30k Collaborative R&D grant that persuaded DSM to invest £240k to support a PDRA and a CASE PhD studentship with **Armes** in an anti-reflective coatings project. This co-operation arose from DSM's purchase of Prof. Armes' patent in Sept 2007.

Hunter uses DTA PhD studentships part-sponsored by chemical companies such as Cresset and Syngenta to ensure that his fundamental research on molecular interactions leads to commercial impact, in addition to academic recognition. His impact case study follows directly from his relationship with Cresset and was underpinned by company-sponsored PhD students.

Pickup's case study with OpenEye Scientific Software arose directly from the department's policy of encouraging incoming industrial secondments, and provides an outstanding example of the value of this activity. We will access the University's EPSRC IAA grant to emulate this remarkable success with new industrial partners in the future.

Ryan's long-standing partnership with ICI (now AkzoNobel) was facilitated via CASE awards and grew into a deeper, mutually fruitful relationship. His characterization expertise enabled AkzoNobel to optimise their formulations for maximum commercial advantage (see case study) and has just led to **Ryan** being invited to join AkzoNobel's Scientific Advisory Board.