

## Impact template (REF3a)

<b>Institution:</b> University of Southampton
<b>Unit of Assessment:</b> 8 Chemistry
<b>a. Context</b>

Chemistry at the University of Southampton (UoS) actively encourages the translation of research from our laboratories to real world applications and impact. The major user groups, beneficiaries and audiences of the impact from our research are: **(a) commercial and industrial organisations** (from spin-out companies and SMEs to large multinationals), including global pharmaceutical, health, life sciences, agrochemical companies, defence, electronics and automotive industries; **(b) the general public** involving local and national science events from primary school onwards.

Our research is clustered into five themes that cover the breadth of chemistry: *Electrochemistry; Magnetic Resonance; Molecular Assembly, Function and Structure; Molecular Diagnostics and Therapeutics; Computational Systems Chemistry* that, together with *Education and Characterisation and Analytics*, form the primary strategic groupings in Chemistry. These groups align with UoS strategy, for example, through the Institute for Life Sciences (IfLS) established in 2010, in which Chemistry plays a major role. Our structure aligns with our strategy to enable and encourage strong interactions with external groups within three main categories:

- (i) **Commercial/industrial engagement**, including consultancy, sponsorship, CPD, research collaborations, staff-secondments, alumni and advisory board membership;
- (ii) **Spin-out companies**, Ilika Technologies, Karus Therapeutics and ATDBio, that contribute strongly to the knowledge-based enterprise economy;
- (iii) **Public outreach and education**, that aims to increase understanding of major scientific issues and of our key research projects, by working closely with schools, teachers and the public through internal and external events, including science fairs, roadshows, interactive workshops and talks.

The UK benefits from economic impacts deriving from the supply of highly skilled scientists and researchers resulting from Southampton Chemistry's research and training. Members of society benefit from the environmental & healthcare impacts and from increased appreciation and awareness of the industrial and commercial relevance of the research performed in Chemistry.

<b>b. Approach to impact</b>
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We actively encourage both knowledge transfer and identification and exploitation of research impacts, through a combination of strategy and opportunity. The UoS **Research and Innovation Services** (RIS), a specialist department with c.60 staff, provides dedicated support and expertise to facilitate interactions with our user partners and to support incubation of new businesses. A specialist legal team in RIS provide support in commercial contracts and intellectual property (IP) management, as well as advice and training to staff on developing IP. Six dedicated Collaboration Managers with relevant industry/sector experience are responsible for guiding the exploitation route and negotiating licences. The UoS operates an 'easy to do business with' framework, with 'fast-track' templates for commercial contracts and IP sharing, developed in partnership with individual companies, similar to the 'Lambert toolkit' for universities.

RIS has been instrumental in fast-tracking patent applications with industry partners, e.g. '*Radiofluorination Process*' with GE Healthcare, and negotiating licensing of a new '*Ammoximation Process*' with Honeywell. The Faculty Patent Panel evaluates and provides options for commercialisation of research, evidenced by patenting of early work such as '*Electrodeposition of semiconductor materials from non-aqueous solvents*'. Faculty investment in IP on recommendation of the panel is linked to a high probability of support for licensing. Thus, the spin-out Ilika is built on a patent portfolio established by Chemistry, and Karus Therapeutics from Chemistry and Medicine. The result is a flexible but robust approach to impact – as required by the diverse nature of end-users and stakeholders. Since 2008, 42 patents have been granted from inventions involving Chemistry staff, and a further 49 patents filed.

RIS provides access to venture initiatives (e.g. the SET Squared incubator on the UoS Science Park at Chilworth) to support new business developments, and manages the UoS's participation in the KTS and KTP programmes, which are often important stages in realising commercial opportunities. For example, acceleration of **Birkin's** work with Leighton (UoA 15) on developing a new ultrasonic cleaning technology, *Starstream* (Royal Society Brian Mercer Award for Innovation, 2011; IChemE Innovation Award, 2012), through technology prototype-showcases that demonstrate the new technology to a wide range of companies.

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We actively solicit feedback from stakeholders, providing staff with opportunities to consult them for advice, guidance and direction, to ensure optimal alignment of our research with needs and opportunities in these communities. This also helps us to identify new challenges and opportunities, directly shaping the research programmes and strategy.

Chemistry's Advisory Board (AB) provides external and industrial perspectives and guidance on the Department's strategic priorities. AB membership includes alumni in senior positions in key stakeholder organisations (including Prof. D. Tildesley - VP Unilever Discover Platforms until 2012 and AB Chair; Prof. A. Bell - Chief Scientist DSTL, Porton Down; Dr A. Gibson - Head of Research Alliances, Medical Diagnostics Discovery, GE Healthcare). Many of our main research programmes, DTCs and EU projects also benefit from direct industry engagement through advisory panels, for example, **Bartlett's** Programme Grant has an advisory panel chaired by Prof. P. Dobson, Director, Begbroke Science Park, and employs a dedicated Tech. Transfer Officer. In the Southampton-led EPSRC Dial-a-Molecule Grand Challenge network (est. 2010, PIs=**Whitby, Harrowven**, [dial-a-molecule.org](http://dial-a-molecule.org)), over 40% of partners are industrialists. The network (>460 members) focuses on improving the synthetic pipeline to key industrial compounds, using efficient, sustainable processes and engages directly with policy-makers in BIS, promoting the importance of synthetic chemistry to the UK economy and the need for increased investment in R&D.

Engagement with users/employers across the main industrial sectors is central to Chemistry's education and training, including global pharmaceuticals, life sciences and agrochemicals companies (AstraZeneca, Boehringer Ingelheim, GE Healthcare, GSK, Pfizer, Syngenta, Schering Plough, QIAGEN, UCB Celltech, Illumina, Novartis, Lonza, Eli Lilly), energy and fine chemicals industries (BP, Sasol, Honeywell, SigNa, Johnson-Matthey, Exxon), materials manufacturing companies (Merck), SME's and spin-outs (Oxford Nanopore, Prosidion, Pharmorphix, Karus Therapeutics, ATDBio, Tibotec Pharmaceuticals, Ilika), Government laboratories (DSTL, DTRA, MoD, QinetiQ, LGC, Home Office), as well as software companies (Accelrys, Microsoft, IBM).

At UG level, our MChem programmes include placements with >20 chemistry-related companies annually. Student bursaries have been provided from AstraZeneca, GSK, Merck Sharp & Dome, Novartis, while the Organic Chemistry Summer School, a four week lab-based course established in 1994 and delivered during the vacation for students entering Year 3, is delivered by industry partners. User partners also contribute to our lecture and transferable skills courses (IBM, DSTL, AstraZeneca, Pfizer), annual employer, careers and alumni events. We provide CPD to industry in the practical applications of electrochemical methods *via* the Electrochemistry Summer School (c.35 attendees pa), which has run successfully for over 25 years.

Beyond our five specific ICSs, emerging impacts including the *ONETEP* program for *ab initio* quantum chemistry simulations of materials (**Skylaris** with collaborators in Cambridge & Imperial) now commercialised by Accelrys, and the *LabTrove Electronic Laboratory Notebook* (ELN) software, based on e-Science Research from a £2.3M EPSRC award to **Frey** in 2003, developed under a £1M HEFCE UMF grant (2011) and EPSRC Impact Acceleration funding, which will come to market in 2013 *via* commercial hosting partner Liberata. New opportunities are likely in the coming period from the scale-up of research on reagentless and flow chemistry to support manufacturing, through the '*Factory in a Fume Cupboard*' project (**Harrowven** and **R. Brown**).

The UoS, through its subsidiary **Southampton Asset Management Ltd** (SAM), has an agreement with the IP Group plc, an independent investment company, (formerly IP2IPO) providing start-up funding for its spin-outs at a pre-determined market value that significantly accelerates the start-up process. Chemistry, through **Bartlett**, played a pivotal role in setting up SAM; **Bartlett** is currently a Director of SAM (with external business and investment experts), *Southampton Innovations plc* and *Photonic Innovations Ltd*. The UoS also has a framework in place to provide seed-corn funding through the Wyvern Seed Fund, Higher Education Innovation Fund (HEIF) and EPSRC Impact Acceleration.

The UoS and Chemistry have a pro-active approach to exploitation of its research, with a sifting process involving professionals (SAM and RIS) to help to identify realistic enterprise opportunities and processes that ensure robust business planning, sourcing of seed-corn and VC investment, incentivising and mentoring of staff, all of which are important in creating successful businesses. 'Enterprise' activities are fully recognised alongside 'research' and 'education' in staff development and reward in the University. In the period 2007-10 the UoS has been ranked 1<sup>st</sup> or 2<sup>nd</sup> for income from SMEs, in the top-10 for consultancy income and also for investment attracted into spin-out companies. Within this period it has generated ~£20M annually from contract research, spinning

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out 15 companies since 2000, of which four have floated on London's Alternative Investment Market (AIM) with a combined market value of £180M. Chemistry is one of the most successful, spinning out four companies since 2004, three of which feature in our Impact Case Studies.

We actively support research- and education-led academics who incorporate an innovation and enterprise component (for example **Hayden**, CSO Ilika since 2004), and in developing laboratory and facilities access agreements with individual spin-outs and SMEs. These are arranged to support enterprise by providing a realistic cost model basis that recognises the benefits to the Department, and allows the companies to grow. The principal of the cost model is that it is of equal financial benefit to Chemistry as are Research Council facilities agreements, but less than that normally applied to external companies.

Engagement with the public and schools is a priority in Chemistry. Our strategy here is spearheaded by **Read**, appointed in 2007 as Chemistry School Teacher Fellow to lead outreach & public engagement and to consolidate and enhance our PE and outreach portfolio. He received the RSC Higher Education Teaching Award in 2010 for this work. **Read** also delivers CPD for teachers via the Science Learning Centres; 42 courses delivered, c.600 teacher CPD days. One specific theme of public engagement is around 'catalysis' and features in Impact Case Study E. However, our PE strategy includes much broader coverage of other work associated with Chemistry. Public engagement provides excellent opportunities for UGs, PGs and ECRs to contribute to development, coordination and delivery and to hone their communication and presentation skills. Chemistry, through **Evans**, led the 'Promotion of Science' work packet within the EU FP6 IDECAT *European Network of Excellence in Catalysis* from 2005-10, and continues as one of only two UK partners of the European Research Institute of Catalysis (ERIC), which has strong representation from major international companies.

Over the REF period our students have had notable success promoting their research to the public and to policy makers; A. Treharne was awarded a gold medal and was overall winner in the ECR's *SET for Britain* competition at the Houses of Parliament (2011) and T. Nguyen was a gold medallist in 2010, while S. Newland won the 2012 Salter's Prize for her UG research project.

The UoS received £450k EPSRC funding in 2010 for developing Pathways to Impact, and Chemistry benefited from this for development of videos demonstrating the wider impact of several of our research programmes, as well as establishing an on-line module (via the Blackboard VLE) for ECRs across the Faculty to develop their business awareness and entrepreneurial skills.

### c. Strategy and plans

**Strategy:** Chemistry has a well-defined and demonstrably successful strategy for impact that has been developed over the last decade and aligns with the UoS's strategic framework for supporting impact (<http://www.southampton.ac.uk/strategy/index.shtml>). We will continue to evolve our strategy to maximise the potential for translating our research in a continuously changing global marketplace. Central support provided by RIS for application and commercialisation of our research has successfully underpinned our impact and this is integral to our future success. We are also supported by an active Advisory Board (currently chaired by Tildesley) and will continue to target other key individuals from the commercial sector to serve as members. Our goal is to improve the 'pipeline' for impact i) by identifying opportunities for enterprise and outreach at the earliest opportunity and ii) by establishing beneficial collaborations with external partners.

**Plan:** We will ensure close dialogue with strategic user groups to inform and shape our education, skills and training provision. On an academic unit level this will be via the Chemistry AB, the Dial-a-Molecule, the Directed Assembly Grand Challenge networks, our InterReg programmes and our many interactions with end users. At UoS level the two primary sectors we are engaged with are *Health & Pharma* and *Maritime*. **University Industry Sector Team** (UIST) Business Fellows have been appointed (including **L. Brown**) to increase business awareness of the research activities and expertise present within the University under the UIST theme. The role includes; i) technology mapping of our research; ii) targeted promotion and advertising of research of interest to the business community through specific UIST events; iii) arranging introductory meetings for staff with members of the business community. She has also mapped our research against declared pipeline needs of the top-10 pharma companies whom the Faculty interact with, as well as local SMEs.

We will actively promote collaboration, and co-sponsoring of R&D, with industry and other users. By supporting academics such as **Hayden**, **Russell** and **T. Brown** in commercialising their research, through adopting a flexible approach to secondments *etc.*, we have demonstrated our

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approach is successful and we will continue to support emerging impacts in this way. We will work with RIS to provide continuing professional development for staff, ECRs and PGs in IP and enterprise to increase awareness amongst our community for translating their research. A revised UoS consultancy policy and implementation guidance framework was introduced in 2013, with streamlined processes for licensing and easy access IP. This also provides a defined framework for a spectrum of spin-out options, case studies for each style of spin-out, and addresses issues including share ownership by the University, access to IP and capital investment requirements.

We have a sustained policy of encouraging our community to engage with the public about all of Chemistry's activities, to further develop our outreach programme to increase its relevance to a general audience and to link it to school curricula. This is supported by the Chemistry Policy and Resources Committee (and recognised through annual staff reviews). **Read's** role (from 2013) on expert advisory panels for several A-level Chemistry specifications will provide important opportunities in this context, as well as in shaping national policy in chemistry education with the aim of ensuring the talent pipeline in UK science reaches from schools through to university and beyond. A priority will be to develop further our methods for evaluating the reach and significance of our public activities. We will collaborate more closely with HEIs regionally for outreach and will formalise PG training in outreach and public engagement to develop and share best practice. We have established a group of senior PGs with extensive outreach experience to spearhead these developments.

We will continue to provide facilities access and specialist skills (spectroscopy, diffraction and scientific glass-blowing) to industry on a commercial basis through *Southampton Chemistry Analytical Services* (SCAS), providing a coordinated, easy-access route to these services.

### d. Relationship to case studies

**A. Ilika plc [...]:** This spin-out company was founded to commercialise IP derived from research on high-throughput methods for materials discovery. The strategic decision to enable Hayden to commit 50% of his time as CSO at Ilika since its founding, contributed strongly to the company's growth, leading to its £18.7M flotation on AIM (2010) and continued economic and scientific impacts. Hayden has played a major role in developing key projects with multinationals (Toyota, Shell, NXP). Support from Chemistry and the UoS to nurture the company in the early stages, to secure VC funding and to identify the CEO were especially important.

**B. Scorpion Primers [...]:** This exemplifies Chemistry's strong culture of industrial collaboration, in this case with AstraZeneca, leading to development and patenting of the Scorpion Primer technology, followed by the creation of biotech spin-out, DxS, to develop this enormously successful technology, ultimately leading to the £120M sale of DxS to multinational QIAGEN in 2009. Scorpion technology is now used by several major drug companies in FDA-approved companion diagnostics kits, with huge patient health and economic impacts.

**C. Karus Therapeutics [...]:** Exemplifies the impact of collaborative research between Chemistry and Medicine, and how embedding the spin-out in the University in the early stages allowed it to minimise operational costs and to secure several phases of investment (support from RIS) to develop its business. The proximity to the academic groups and agreements to access University research, analytical and administrative facilities, have been crucial for both Karus and Ilika.

**D. ATDBio [...]:** This successful company was spun-out to meet the needs of a wide range of small and large organisations (LGC, Illumina, Oxford Nanopore, DSTL) by developing the custom oligonucleotides for their particular diagnostic applications. Brown's expert research input was essential and Chemistry supported this initiative by reducing his administrative and management workloads, as well as by providing research space and competitive facilities access agreements.

**E. Electrocatalysis [...]** This exemplifies the benefits borne of a long-term collaboration with Johnson Matthey (JM) that led to a much improved understanding of the structure-function relationships in JM's fuel cell electrocatalysts, contributing to their strategic direction in this area and bringing significant commercial benefits. A Royal Society Industry Fellowship award to Russell was crucial in creating this impact, and in enabling a close relationship with JM staff, enhancing the company's skill base. Consequently, catalysis has provided a strong theme for **public engagement and outreach**, exploited to build a sustained and highly regarded programme of events with effective audience interactions and impact evaluation facilitated by **Read's** innovative use of electronic personal voting systems (interactive talks with >5900 school children, workshops with ~6000 members of the public).