Impact template (REF3a)

Institution: Heriot-Watt University

Unit of assessment: UoA6, Agriculture, Veterinary and Food Science

a. Context

Application and impact, which are central to our research programmes, can be traced back to the earliest days of microbiology and brewing at Heriot-Watt in 1903. The contemporary breadth of our applied research covers not only brewing and distilling science, but also food science, aquaculture and toxicology as applied to human health. The non-academic user groups of our research reflect these research areas and include the brewing and distilling industry both in Scotland and internationally, the manufactured food industry (including some of the world-leading companies), the fish vaccine and feed manufacturing industries, and more recently national and international policy-making organisations tasked with regulating the toxicological impact of nanomaterials. Throughout our history we have engaged with users in industry and beneficiaries in innovative and effective ways to ensure that our research reached out to them and could be used by them easily and effectively. Our impact case studies reflect our close alliance to industry and illustrate our strategy of undertaking commercially relevant science with strong foundations in fundamental scholarship. Major investment by the University in recruiting research active staff is having a significant effect, and toxicological work in particular has benefitted from early investment, which has brought a renewed focus on the impact of environmental toxins, in particular nanomaterials on human health.

b. Approach to impact

Partnership with industrial users who can take our research to the market through improved and innovative products, which address the environmental, cultural and sociological challenges of the modern world, have been key to our strategy. Additionally we are now expanding to engage with policy development. Allied to this has been a willingness to create new vehicles to facilitate understanding and access to the potential of our research.

In **Brewing and Distilling** we created in 1989 an industrially focussed International Centre for Brewing and Distilling (ICBD) which, with the advice of an industrial Advisory Board, acts as a focus for industry relevant research and contract work, and as a portal for knowledge exchange and dissemination across the sectors, thus informing the research agenda as well as commercial practice. An example of the impact that research in this area can have is the work on high gravity brewing carried out by Stewart at HWU, which has been adopted by the industry worldwide and has resulted significant savings in time, energy and therefore money throughout the brewing sector. Apart from research publications, the work in ICBD is showcased to the industry through invitations to tailored open days, which focus on a specific topic that is developing in the industry, and supported by the ICBD newsletter, which carries news on the latest research outcomes and how these may impact on industrial practice.

Novel food ingredients are an equally exciting niche area for us. Research by Euston and Campbell into the functional properties of proteins have generated results describing the molecular properties of protein-based fat replacers, which have been taken to the market by a spin-out company (Nandi Proteins Ltd), who have licensed the technology to companies such as Friesland Campina, Rovita GmbH, Manton Eggs, Rembrandt Foods, General Mills and Tate And Lyle, which includes some of the worlds largest food companies. This very profitable initiative has been greatly aided by the University's Research and Enterprise Service (see details below). In addition, strong industrial partnerships in research by Euston and Campbell with other food companies (Premier Foods, Quorn/Marlow Foods, Wright-Agri, Mantons Eggs) has resulted in an EPSRC/TSB funded project to use Nandi patented technology to develop novel foaming and fat replacer ingredients for the food industry.

Aquaculture is an especially vigorous aspect of the Scottish economy; salmon farming in Scotland has the largest share in the EU with an annual retail value of over £1 billion in a global market (2011) of 84 million tons of fish production. Fish health is therefore the core concern of the industry. Heriot-Watt has been a pioneering exponent of probiotic and vaccine development for aquaculture. Key partnerships with major veterinary pharmaceutical

companies (for example Schering-Plough, now MSD) have created fruitful long-term collaborations in vaccine development and testing, using the purpose built in-house aquarium and microbiology facilities available to SLS, and the expertise of the University's Research and Enterprise Service to negotiate contracts.

In **Toxicology** the prime aims of current work are to advance understanding of nanomaterial hazards and to develop alternatives to animal testing. For example, *in vitro* models using cell lines can emulate the gut and be linked by microfluidics to vascular endothelial and liver hepatocyte cells. Our demonstration of such expertise has led us to partner with policy developers at international level and involved us in the generation of guidelines and scientific advice on nanotoxicology in human health; for example an advisory white paper for the International Life Sciences Initiative on nanoparticle release from ingested foodstuffs, and World Health Organisation (WHO) Guidelines on Protecting Workers from Potential Risks of Manufactured Nanomaterials.

Throughout we have drawn upon the University's professional **support for impact development:** Heriot-Watt University has a long tradition of working with industry (see also REF5). To reflect the changing policy and funding environment, in 2009 the University made a major investment by using a £2.9m ERDF award to create a £6.3m project to strengthen its holistic approach to research development, technology transfer and company engagement, building on the existing research funding and technology transfer group, Research and Enterprise Service (RES). This gave us a dedicated Business Development resource complemented by expert support in the delivery of marketing materials and events. The University is now wholly funding this approach. Within it, academic staff development is a major component and has two flagship vehicles. One is 'Crucible' the highly successful, professional & personal leadership and networking development programme initiated by NESTA and in Scotland led by the PVC for Research and other staff from Heriot-Watt. It was further developed at institutional level enabling HWU researchers to form networks with participants who were employees from industrial strategic partners and with external speakers and mentors who share their expertise. The other flagship is the pan-Scotland Converge Challenge programme to create market-facing entrepreneurs under the leadership of RES on behalf of all the Scottish universities and research institutes. It is funded by SFC, private sector and the universities.and complements the national and university programmes around Proof of Concept and spinout creation, which focus on making technology market-ready.

c. Strategy and plans

Our strategy, fully supported and resourced by the University, is to expand in those areas where we have proven strengths through the targeted recruitment of leading exponents. For example, Speers has recently been recruited to lead ICBD. His work on detection and prevention of premature yeast flocculation (PYF), which results in yield loss and quality issues in breweries, has resulted in novel methodologies estimated to save the industry in Canada alone $10 M in each year when PYF occurs. We are also expanding the nature of our impact from the more traditional interface with manufacturing to engage with legislation and policy. Thus, the appointment of Stone, who provides evidence and expert advice to support national and international toxicological policy relating to nanomaterials.

To ensure a robust research base and continued relevant impact, we intend to grow the critical mass of research active staff, particularly aiming at the interface between nutrition and health with an agreed strategy to recruit at least three academics over a five-year period in this area alone. Additionally, by strengthening our alliances with key international industries (MSD, Diageo, Nestlé, Farm Foods, GlaxoSmithKline, Unilever), industry representation bodies (Scotch Whisky Association, Nanotechnology Industries Association, relevant leading research institutes (The Moredun Institute, The Scotch Whisky Research Institute, The Hutton Institute) and internationally recognised opinion leaders (International Life Sciences Initiative and World Health Organisation), we are expanding our commercial and international policy outreach. The School is also a member of the SFC sponsored Innovation Centre for Aquaculture, which specifically focuses on industry relevant issues, such as fish disease and nutrition. Additionally, the School actively engages with the SFC-sponsored Interface Food and Drink (IFD), and we benefit from an embedded Technology Translator, who liases with industry on potential

projects, and manages those projects funded through IFD; there are currently eight IFD-funded projects in SLS worth £72k.

d. **Relationship to case studies**

The case studies submitted illustrate the different mechanisms that are used to generate impact from the work carried out in the School. The case study by Euston and Campbell demonstrates how laboratory scale basic research on functional aspects of food protein can, through patents and investment from the University, industry and Scottish Enterprise, evolve into a spin-out company (Nandi Proteins Ltd) with real impact in the food manufacturing sector, and ultimately on human health through fat replacement in the production of manufactured foods. The organoleptic qualities of fats in foods make them very attractive to consumers, but in excess these have a detrimental affect on health. Replacing fats with proteins that offer similar taste, flavour and mouth-feel can thus retain the consumer appeal of the food, but obviate the negative aspects of excess fat consumption.

The case study related to Brewing and Distilling illustrates how basic research on yeast fermentation of wort can result in savings worth millions of pounds when translated into economic practice. The theoretical concept of high gravity fermentation in brewing and in distilling had long been recognised but it took the work by Stewart and colleagues to make this technology an economic reality, by optimising the conditions required to produce high quality fermented products from high gravity wort. The realisation of the research, and the dissemination of the results to end users in industry was made possible by working together with ICBD, through which the necessary infrastructure for this work was made available, and through which the industry was made aware of the actual potential for enhanced processing efficiencies through high gravity brewing.