Institution: Queen's University Belfast

Unit of Assessment: 3a Pharmacy

Title of case study: Commercialisation of a platform technology for production of diagnostic and therapeutic reagents

1. Summary of the impact (indicative maximum 100 words)

Protein reagent production techniques developed at QUB, were transferred to UK-based biotechnology company, Fusion Antibodies Ltd, to increase their competitiveness in the production of diagnostic and therapeutic reagents. These techniques were commercialised by the company as the Fusion Expression Technology™ (FET) platform technology, to deliver contract research orders. The transfer of this technology allowed Fusion to accelerate its completion of orders and secure higher value projects. This increased competitiveness led to the tripling its technical workforce (at graduate and doctoral levels), securing new orders from over 15 countries and producing on average £300K per annum (from 2008 onwards) in revenue.

2. Underpinning research (indicative maximum 500 words)

Dr Chris Scott (postdoctoral researcher in the School of Pharmacy from Sept 1999-July 2001 and subsequently lecturer from 2003 onwards, and now Chair in Biomolecular Science) was approached by Fusion Antibodies Ltd., to examine issues that they were having in the rapid production of recombinant proteins as part of their contract research business. Specifically, these problems included the ability to produce the protein solubly at useful levels, which was limiting purification and the speed at which projects could be completed – which routinely took 3 months.

The Scott lab had developed know-how to improve the levels and speed of recombinant protein production using bacterial systems. This research involved the development of new promoters, translation initiation motifs and new fusion protein tags or partners which were fused to the target protein and elicited their own biophysical characteristics onto the target protein, including factors such as stability, solubility and expression yields. Scott and his team had been examining such technologies as part of a programme for the recombinant production of proteases – a programme that Scott originally worked on as a post-doctoral fellow (1999-2001)[1] and then took up again as a new lecturer from April 2003 onwards. This research interest was further pursued by Scott and was the focus of a BBSRC award to Scott and Prof Brian Walker (2004-2007).[2]

The Scott lab and Fusion Antibodies initiated a collaborative project, funded through the Knowledge Transfer Partnership (KTP) scheme. This project ran for 30 months from late 2004 to early 2007 with one KTP associate, Dr. Hang Fai (Henry) Kwok, employed. Dr Jill Caswell was also involved as a researcher in these technologies as an employee of Fusion Antibodies, but enrolled on an industrial part-time PhD program in 2005 with the School of Pharmacy, under the supervision of Dr Scott and Prof Walker. The focus of this project was to develop improvements in the production of recombinant proteins – from gene sequence to purified proteins, such that milligram quantities of protein could be prepared within 4 weeks of orders placed.

The research led to skills being transferred to the company in terms of selecting portions or domains of proteins that are more likely to be expressed solubly and in useful quantities. In one case, this has led to the production of a panel of bovine tuberculosis antigens that have subsequently been licensed to Enfer Scientific, Ireland for the development of a new mycobacterium tuberculosis (TB) diagnostic kit.[3] Another example of technology adoption and transfer was the development of a fusion protein purification and solubility tag, based on the bacterial protease sortase which Scott and Walker had been researching. This led to the development of a new tag (Solubility Enhancing Ubiquitious Tag, SNUT) which was found to improve synthesis, solubility and purification of difficult proteins.[4]

3. References to the research (indicative maximum of six references)

1. **Scott C.J,** McDowell A, Martin SL, Lynas JF, Vandenbroeck K, Walker B Irreversible inhibition of the bacterial cysteine protease-transpeptidase sortase (SrtA) by substrate-derived affinity labels (2002). Biochem J. 366, 953-8.
2. Quinn D.J., Cunningham S, **Walker B, Scott CJ**. Activity-based selection of a proteolytic species using ribosome display. (2008). Biochem Biophys Res Commun. 370, 77-81.
3. **Kwok HF, Scott CJ**, Snoddy P, Buick RJ, Johnston JA, Olwill SA Expression and purification of diagnostically sensitive mycobacterial (Mycobacterium bovis) antigens and profiling of their humoral immune response in a rabbit model (2010) Res Vet Sci. 89, 41-7.
4. **Caswell J**, Snoddy P, McMeel D, Buick RJ, **Scott CJ**. Production of recombinant proteins in Escherichia coli using an N-terminal tag derived from sortase. (2010) Protein Expr Purif. 70, 143-50.

References 3 and 4 involve work that was undertaken prior to 2008, but only released for publication at a later date for commercial reasons

Grant Funding:

I. BBSRC. C.J. Scott, B. Walker. High Throughput methodologies for the identification and characterisation of protease species 2004-2007. £182,000.
II. Knowledge Transfer Partnership C.J. Scott. Recombinant Protein Production Methodologies 2004 – 2007. £140,000.

4. Details of the impact (indicative maximum 750 words)

Fusion Antibodies is a UK-based biotechnology company that offers contract research offerings to third parties to produce custom proteins and antibodies. The impact of the research undertaken by the Scott lab was to improve the company's ability to rapidly produce high-quality purified proteins, thus improving the speed and cost effectiveness of their service[1]. On average, the company were able to speed turnaround of protein orders from 3 months to around 1 month. Furthermore, the innovations led to the successful production of reagents that previously had not been successfully produced, thereby increasing the reputation and competitiveness of the company. This research was carried out from 2004-2007 as part of a Knowledge Transfer Partnership (KTP) scheme[2], and then subsequently commercialised under Fusion Expression Technology™ (FET™)[3]. The KTP associate employed under the project, Dr Henry Kwok, won the best regional KTP scheme award[4,5] in 2008 and was shortlisted for the UK award[5]. Dr Jill Caswell was awarded her PhD from the School of Pharmacy in 2012.

The FET™ platform has been marketed internationally by Fusion Antibodies since 2008 and is the underpinning technology platform for the contract research service that they provide[1, 3]. This service supports the employment of 12 people (from 4 original members of staff) and has generated, on average, £300,000 income per annum. The application of the FET™ platform is marketed worldwide and to date international orders from biotechnology and pharmaceutical companies have been secured from Austria, USA, Canada, Croatia, France, Germany, Denmark, Italy, Israel, Switzerland, Norway, Finland, Sweden, Ireland, Spain and Portugal[1].

A particular example of the impact has been the development of a range of mycobacterium tuberculosis protein antigens by Fusion Antibodies. These antigens have now been licensed to Enfer Scientific Ireland, who have developed them into the Enferplex™ TB assay[6], which is currently undergoing clinical trials in Ireland, UK and USA.

5. Sources to corroborate the impact (indicative maximum of 10 references)

1. Fusion Antibodies CEO, www.fusionantibodies.com

2. Knowledge Transfer Partnership (KTP) Head, KTP & Business Networks
http://www.qub.ac.uk/directorates/KTPandBusinessNetworks//

3. FET™ Technology http://fusionantibodies.com/services/recombinant-proteins/

4. KTP awards
http://www.ktponline.org.uk/assets/Uploads/eTransfer_Issue12.htm

5. KTP final report available upon request from KTP

6. Enferplex™ TB assay
https://www.enfergroup.com/?page_id=661

(websites accessed 23rd September 2013)