Institution:
University of Cambridge

Unit of Assessment:
UoA12

Title of case study:
Psynova Neurotech Ltd

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

Psynova Neurotech is a prize-winning spin-out company founded by Professors Sabine Bahn and Chris Lowe from the University of Cambridge. It focuses on the commercialization of novel blood-based biomarker tests for conditions like schizophrenia, depression and bipolar disorder. *Psynova* and its partner company Rules Based Medicine (now Myriad RBM Inc.) launched the first commercially available Aid for the Diagnosis of Schizophrenia (VeriPsych^{TM}) in 2010. In June 2011, Psynova and Rules Based Medicine were acquired by Myriad Genetics Inc. for £50 million. In February 2011 Psynova Neurotech and Professor Bahn were announced winner of the ACES best European Life Science spin-out award.

2. Underpinning research (indicative maximum 500 words)

Schizophrenia is a disease that typically begins in early adulthood; between the ages of 15 and 25, affecting 51 million people worldwide. Schizophrenia is a complex and challenging disease, yet current diagnostic approaches continue to be based on patient interviews and a subjective assessment of clinical symptoms. It can take several months or even years until a diagnosis has been established.

Biomarkers have multiple applications, which include the identification of high-risk individuals and disease subgroups that could serve as target populations for intervention trials; facilitation of "objective" diagnosis; monitoring of patient response to drug treatments; and assessment of patient compliance.

Professor Sabine Bahn joined the University as an NHS Research Fellow in 1997. From 2001 she was a Clinical Lecturer in Psychiatry before joining Chemical Engineering and Biotechnology in 2004. She was promoted to Professor in 2013. Her research team within the Cambridge Centre for Neuropsychiatric Research (CCNR) has developed molecular diagnostics for major neuropsychiatric disorders and determined the cellular mechanisms that regulate the expression of biomarker molecules altered in specific psychiatric disease states so as to develop novel therapeutic approaches. The team's work relates to the novel application of multiplex ELISA and mass spectrometry applications for psychiatric disorders.

CCNR uses advanced molecular profiling techniques (microarrays, proteomics, lipidomics, and metabolomics) to globally investigate abnormalities in gene/protein/metabolite/lipid "expression" in postmortem human brain tissue and in blood and other samples derived from schizophrenia patients and matched controls, to establish evidence-based hypotheses. For example, the team's examination of postmortem brain tissue of patients with schizophrenia provided evidence of abnormal brain glucose utilization [Ref 3]. Since 2002, Bahn and her team have investigated cerebrospinal fluid (CSF) collected from living patients. The team studied CSF samples from drug-naive or minimally treated patients with first-onset paranoid schizophrenia and demographically matched healthy controls.

The CSF findings also suggest alterations in glucoregulatory processes in CSF of drug-naive patients with first-onset schizophrenia. The results also imply that the initiation of antipsychotic treatment during a first psychotic episode may influence treatment response and/or outcome [Ref 6].

In 2007-08 the team moved to using its molecular profiling techniques on blood serum. During the developmental stage of Aid for the Diagnosis of Schizophrenia (VeriPsych), 200 biomarker candidates were investigated to assess their connection to schizophrenia. Bahn's team discovered

a set of 51 biomarkers linked to schizophrenia and to various biochemical pathways, including inflammation and metabolism, as well as cell-to-cell signalling.

In a 2009 study (reference 2 below), the 51 biomarkers were validated using a mathematical algorithm to separate patients with schizophrenia from normal controls. The study included analysis of more than 800 blood samples. The panel of 51 markers yielded an average sensitivity and specificity of 85% or greater across 5 clinical centres.

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

*1) Emanuel Schwarz, Paul C. Guest, Hassan Rahmoune, Lan Wang, F. Markus Leweke, Matthias Rothermundt, Johann Steiner, Dagmar Koethe, Laura Kranaster, Patricia Ohrmann, Thomas Suslow, Michael Spain, Bernhard Bogerts, Nico (JM) van Beveren, George McAllister, Simon Baron-Cohen, Natalya Weber1, David Niebuhr1, David Cowan, Fuller Torrey E, Robert H Yolken, **Sabine Bahn** (2011)
Identification of a Biological Signature for Schizophrenia in Serum.
Mol Psychiatry. 2011 Apr 12. IF 15
DOI: 10.1038/mp.2011.42

2) Schwarz E, Izmailov R, Spain M, Barnes A, Mapes JP, Guest PC, Rahmoune H, Pietsch S, Leweke FM, Rothermundt M, Steiner J, Koethe D, Kranaster L, Ohrmann P, Suslow T, Levin Y, Bogerts B, van Beveren NJ, McAllister G, Weber N, Niebuhr D, Cowan D, Yolken RH, **Bahn S.** (2010)
Validation of a blood-based laboratory test to aid in the confirmation of a diagnosis of schizophrenia.
Biomark Insights. 2010 May 12;5:39-47
Link to article: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2879227/

*3) Guest PC, Wang L, Harris LW, Burling K, Levin Y, Ernst A, Wayland MT, Umrania Y, Herberth M, Koethe D, van Beveren JM, Rothermundt M, McAllister G, Leweke FM, Steiner J, **Bahn S.** (2010)
Increased levels of circulating insulin-related peptides in first-onset, antipsychotic naïve schizophrenia patients.
Mol Psychiatry. 2010 Feb; 15(2):118-9. IF 15.0
DOI: 10.1038/mp.2009.81

4) Levin Y, Wang L, Schwarz E, Koethe D, Leweke FM, **Bahn S.** (2009)
Global proteomic profiling reveals altered proteomic signature in schizophrenia serum.
Mol Psychiatry. 2009 Jun 23. IF 15
DOI: 10.1038/mp.2009.54

5) Herberth M., Krzyszton D.N., Koethe D., Craddock M.R., Bulger E., Schwarz E., Guest P. Leweke
F.M. and **Bahn S.** (2008)
Differential effects on T cell function following exposure to serum from schizophrenia smokers
Mol. Psych Nov 11. IF 15
DOI: 10.1038/mp.2008.120

*6) Huang, J. T-J, Wang, L., Prabakaran, S., Wengenroth, M., Koethe, D., Gerth, C.W., Nolden, B.M., Gross, S., Schreiber, K., Lilley, K., Leweke, F.M. and **Bahn S.** (2007)
Independent protein profiling studies show a decrease in apolipoprotein A1 levels in CSF and peripheral tissues.
Mol. Psych 2007 Oct 16. IF 15
DOI: 10.1038/sj.mp.4002108

*Denotes those outputs most representative of the quality of the research.

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

Psynova Neurotech was founded in 2005 by Professors Sabine Bahn and Chris Lowe to commercialise the diagnostic products developed through Professor Bahn's research.

In June 2008, Psynova Neurotech announced a partnership with CLIA approved Rules-Based Medicine, Inc. (RBM), to develop and commercialise a blood test for the diagnosis of schizophrenia. In 2009 Psynova Neurotech entered a collaboration with RBM to provide a route to market for their first product, VeriPsych (ref10, 14), the first and only blood test to aid a psychiatrist in the diagnosis of recent-onset schizophrenia. VeriPsych was commercially released in autumn 2010 (ref 12) and tested by over 30 institutions in a variety of treatment settings including psychiatric hospitals and centres trying to distinguish drug induced psychosis from genuine mental illness. 300 tests were used, confirming that VeriPsych worked as intended, with samples investigated blind to diagnosis (ref 15). In addition to aiding clinicians in their diagnoses of schizophrenia, VeriPsych was in some instances found to help patients with poor insight (ref 16) and their families (ref 17) accept diagnosis.

Due to market pressures, since the acquisition of Psynova/RBM by Myriad Genetics Inc. in summer 2011, the offer of VeriPsych has been temporarily suspended in order to focus on the development of diagnostic tools that address bi-polar disorder and depression in addition to schizophrenia. In July 2009, Psynova Neurotech was one of an eight-member consortium which received a £2.35 million grant from the European Commission aimed at developing early-stage diagnostics for mental disorders (ref 11). In December 2009 Roche contracted Psynova and RBM to develop companion diagnostic immunoassays for a schizophrenia drug in development (ref 8, 13). This collaboration yielded a number of potential biomarkers with utility in prognosis of disease progression and/or predicting the efficacy of the drug under development. One of these, CFHR1, was selected in 2011 for further development by Roche. This is being developed as an assay as part of their Phase III clinical trial programme and royalty payments will be made to RBM on sales of the assay kits (ref 15).

In February 2011 Psynova Neurotech and Sabine Bahn were announced winner of the ACES best European Life Science spin-out award (ref 9). In June 2011, Psynova Neurotech, including its portfolio of 35 patents (ref 18), and Rules Based Medicine were acquired by Myriad Genetics Inc. for £50m (ref 7). The Vice President of Myriad commented that 'a key driver for the acquisition was the portfolio of diagnostic opportunities in mental illness that came from Psynova' (ref 15).

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

7) Business Weekly – corroboration of acquisition by Myriad Genetics Inc.
http://www.businessweekly.co.uk/biomedtech-/12142-psynova-boosted-by-80m-acquisition

8) Genetic Engineering and Biotechnology News – Roche contracts Psynova to develop further biomarkers
http://www.genengnews.com/gen-news-highlights/roche-taps-psynova-to-develop-schizophrenia-companion-diagnostic/70028613/

9) Winner of the ACES best European Life Science spin-out award
http://www.sciencebusiness.net/news/75133/ACES-Winner-Psynova-Neurotech-delivers-the-first-blood-test-for-the-objective-diagnosis-of-schizophrenia

10) Psynova and RBM co-develop diagnostic blood test
http://www.thefreelibrary.com/Rules-Based+Medicine+and+Psynova+Neurotech+to+Co-Develop+Blood+Test...-a0179960817

11) 2009 European Commission funding for Psynova
http://www.growthbusiness.co.uk/news-and-market-deals/fundraising-deals/1058917/psynova-neurotech-gets-eu-funding-boost.thtml

12) Announcement of commercial release of VeriPsych
http://multivu.prnewswire.com/mnr/rulesbasedmedicine/46237/

13) Press release about milestone in Roche Companion Diagnostic Programme
http://www.psynova-neurotech.com/downloads/press/Update%20May11%20agreement%20with%20Roche.pdf

14) Information about VeriPsych
http://www.veripsych.com

15) Vice President, Myriad RBM – statement on file

16) A New Blood-Based Diagnostic Aid for Schizophrenia, Deanna L. Kelly, Pharm.D., B.C.P.P., Sheryl Thedford, Pharm.D., & Gopal Vyas, D.O. in PSYCHIATRIC SERVICES, September 2011 Vol. 62 No. 9

17) Rules-Based medicine aims for new medical frontier with test for schizophrenia,
http://www.statesman.com/news/business/rules-based-medicine-aims-for-new-medical-frontier/nRSYT/

18) Chief Medical Officer, Myriad RBM – statement on file