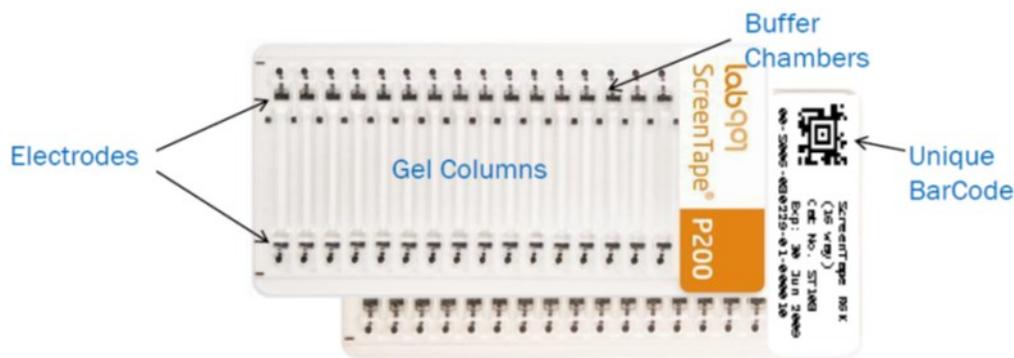


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| <p>Institution: The University of Edinburgh</p> |
| <p>Unit of Assessment: 1</p> |
| <p>Title of case study: T: Commercialisation of ScreenTape™ - a microfluidic tool for genomics, next-generation sequencing and proteomic analysis</p> |
| <p>1. Summary of the impact (indicative maximum 100 words)</p> <p>Impact: New business, technology, intellectual property and employment resulting from the invention and exploitation of a micro-scale laboratory device (ScreenTape™).</p> <p>Significance: New business and technology commercialised resulting in sales of novel products worldwide, acquisition by Agilent Technologies Limited (Agilent) for £[text removed for publication] in 2011, product sales of over £[text removed for publication] to August 2013, generation of sustained employment for 50–160 people, major inward investment (£6M) by local investors followed by a US multinational.</p> <p>Beneficiaries: The economy, commerce, employment, research and diagnostic laboratories, Agilent Technologies Inc. (Agilent).</p> <p>Attribution: UoE Prof Peter Ghazal and Dr Douglas Roy inventors on granted patent, establishment of multi-disciplinary research in biochip medicine, collaborators with ex-Motorola engineers, co-founders of spin-out company for commercialisation of intellectual property.</p> <p>Reach: Worldwide, including employment and product sales. Inward investment to UK.</p> |
| <p>2. Underpinning research (indicative maximum 500 words)</p> <p>Professor Peter Ghazal (Professor of Molecular Genetics and Biomedicine, UoE, 2000–present) and Dr Douglas Roy (Senior Lecturer, UoE, 1983–present), working with colleagues in Motorola, developed and patented a means to separate DNA in meso-scale on a tape. This led directly to the development of a product: ScreenTape™, now established as a micro-scale laboratory design for analytical and high throughput automation in genomics and proteomics.</p> <p>New microfluidic tools for genomics, proteomics, metabolomics research and medicine are rapidly progressing in research, with potential applications in diagnostics and point-of-care devices. Performing laboratory operations at micro/meso-scales enables the use of small quantities of samples and reagents, the ability to carry out ultrafast separations and detections with high sensitivity and resolution, and massively reduces costs. The design and fabrication of such systems is extremely challenging.</p> <p>Prof Peter Ghazal was founding Principal Investigator (PI) and Director of the Scottish Centre for Genomic Technology and Informatics (ScGTI) in 2001, a multidisciplinary academic model to foster an engineering link with genomics. As PI, he raised £10.4M in grant funds from European and UK sources between 2003 and 2007, followed by a further £2.3M in 2010, establishing a vibrant inter- and multi-disciplinary Centre incorporating:</p> <ul style="list-style-type: none"> • application and development of custom and high-density bioarray/microarray platforms for gene expression and proteomic studies; • utilisation of high-throughput approaches in biomedical and clinical research; • computational and systems biology; and • an environment for translational research and the development of commercial enterprises based on innovation, intellectual property and technology development, <p>From ScGTI/DPM's inception, industry and the private sector were engaged through outreach</p> |

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programmes including collaborations with ex-Motorola engineers Stuart Polwart and Joel Fearnley, which culminated in the generation of novel IP [3.1] (granted in 2012) for the development and commercialisation of the product “ScreenTape™”. Named inventors included Ghazal and Roy. Ghazal and Polwart made the principal inventive contributions in concept and design [3.2], conceived, designed and performed the first proof-of-concept experiments, involving separation of DNA in a meso-scale channel on a tape. This successful collaboration between UoE and industry was secured by the biological know-how of Ghazal and Roy with the engineering know-how of Polwart and Fearnley. With an initial investment of £230K from Angel Investors, in 2002 the team launched a spin-out company for product development and further enablement of patent claims. Ghazal and Roy were non-executive scientific advisors, Fearnley was CEO and Polwart CTO. The product, ScreenTape™, took over 6 years to develop from a simple concept to the first point-of-sale; the first main customer was in 2008, a Korean Diagnostic firm using ScreenTape™ for multiple pathogen screening in hospitals and airports. After multiple rounds of funding, the company was acquired by the US multinational Agilent.

ScreenTape™ is based on a micro-scale laboratory fabricated in a plastic substrate (Lab-on-a-Tape) for analytical and high-throughput laboratory automation in genomics and proteomics research [3.3, 3.4]. It comprises a unique “credit card” size, automated laboratory that is easy to use and, with scalable throughput, ideally suited for rapid (under 10 minutes) sample quality control in (a) next-generation sequencing and gene expression monitoring work flows, (b) protein electrophoresis and DNA fragment separation, and (c) RNA separation and quality control using proprietary software. Because it is a closed system, it is suited to diagnostics. For a video of the product see: http://www.youtube.com/watch?v=N2DU_Udvvts.



The picture above shows the first ScreenTape™ product (P200) for the rapid separation of DNA fragments, in particular PCR fragments less than 200 base-pairs. It has overall dimensions that are similar to those of an old 35-mm film. Fabricated in the device is a series of columns that are pre-packed with running gel and reagents. Integrated at the ends of the column are electrode contact points. The ScreenTape™ is loaded and samples run in an automated sample loader machine.

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

Publication was restricted for commercialisation reasons.

3.1 Polwart, Fearnley, Roy and Ghazal. US patent granted 28 February 2012: “Apparatus and methods for microfluidic applications”, US8124029B2. This patent describes a non-rigid tape apparatus and fabrication methods for microfluidic processing applications such as gel electrophoresis are provided, where microfluidic processing is performed on selected areas. Foreign patent documents: 0 976 453; 1388369; WO 94 26414; WO 97 47967; WO9919717; WO 99 03584; WO 99 19717; WO 99 43432; WO 99/65664; WO 01 07892; WO 01 26812; WO 01 30490; WO 01 54814; WO 02/081934; WO 03/045557; WO 2004/071660; WO 2004/080597(<http://www.google.com/patents/US6863878>).

3.2 Edinburgh Research and Innovation (ERI) licence/revenue-sharing agreement ref: LIC2200065. ERI tech ID: TECH1100400. [Available on request. Provides details of inventive

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contributions.]

3.3 Laghaee A, Malcolm C, Hallam J, Ghazal P. Artificial intelligence and robotics in high-throughput post-genomics. *Drug Discov Today*. 2005;10:1253–9. DOI: 10.1016/S1359-6446(05)03581-6.

3.4 Livingston A, Campbell C, Wagner E, Ghazal P. Biochip sensors for the rapid and sensitive detection of viral disease. *Genome Biol*. 2005;6:112. DOI: 10.1186/gb-2005-6-6-112.

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

The founding by Ghazal of a cross-disciplinary research Centre (ScGTI) to facilitate and foster multidisciplinary interactions within and between academia and industry was essential to generate innovation within a rapidly emerging yet poorly served field. Ghazal identified the biological applications and, with the founding team, enabled determination of the essential set of materials and processes needed to convert this early technology (developed with UoE) into a working commercial product. Using experience gained from founding an earlier microarray-based company in Scotland, Ghazal with the founding team secured initial first-round funding to form a spin-out company to attract private investment and to develop the technology. The company, Lab901, was formed in 2002 with initial investment contacts provided by Ghazal and commercialisation led by Fearnley and Polwart. From the outset Lab901 established research facilities and a development team at an industrial park.

The founding patent for the company was granted in full in 2012. Lab901 initially secured £0.23M funding in 2002 with further rounds in 2003 (£0.56M), 2004 (£0.34M), 2006 (£1.34M and £1.5M), 2008 (£3.6M) and 2009 (£2.4M). Lab901 worked collaboratively with UoE, especially in the early phases of its development, but this reduced as the business started to develop and market its products. From 2007, Lab901 employed between 40 and 50 people and this employment has been maintained since its acquisition. Currently there are approximately 160 employees at the Edinburgh facility; this includes all of the original employees of Lab901.

Impact on commerce and the economy

The first product sales of ScreenTape™ were in 2008. From 2008–2013, product sales reached over £[text removed for publication]. In February 2011, Lab901 was acquired by the US multinational company, Agilent: the world's premier measurement company and a technology leader in chemical analysis, life sciences, diagnostics, electronics and communications [5.1–5.3]. The acquisition price was £[text removed for publication]. Agilent's 20,000 employees serve customers in more than 100 countries, and it had revenues of US\$6.9B in fiscal 2012. The acquisition resulted in UoE-generated IP being preserved and maintained, 50 employees from Lab901 securing continued employment with Agilent, a further 110 jobs being created, considerable inward investment and wealth creation in the UK and beyond, and global market opportunities for the product [5.4].

Impact on practitioners and services

The product, ScreenTape™, has been bought and used by a wide range of practitioners, including research and diagnostic laboratories. Applications of the microfluidic ScreenTape™ tool were developed by Lab901 for DNA and genomics analysis [5.5], including workflows for next-generation sequencing, for rapid high-sensitivity quality-control analysis for RNA, and for proteins and antibodies.

Impact on health and welfare

ScreenTape™ has been used by both academic and diagnostic laboratories around the world, and has recently secured a global market presence through the acquisition of Lab901 and sales by Agilent [5.4, 5.5].

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

5.1 Agilent Technologies Inc. acquisition (Feb 2011):

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<http://www.agilent.com/about/newsroom/presrel/2011/28feb-gp11006.html>.

5.2 Scottish Investment Bank Annual Review 2010–2011. <http://www.scottish-enterprise.com/~media/SE/Resources/Documents/STUV/Scottish-Investment-Bank-Annual-Review-2010-2011.ashx>.

5.3 Investors press release at acquisition by Agilent (Mar 2011):
<http://www.tricapital.co.uk/content/news/LAB901Exit.php>.

5.4 Agilent Technologies Inc. global launch of product (Nov 2011):
<http://www.agilent.com/about/newsroom/presrel/2011/07nov-ca11075.html>.

5.5 Agilent Technologies Inc. launches genomic DNA ScreenTape (Feb 2013).
<http://www.agilent.co.uk/about/newsroom/presrel/2013/20feb-ca13014.html>.