



The research commercialisation office of the University of Oxford, previously called **Isis Innovation**, has been renamed **Oxford University Innovation**

All documents and other materials will be updated accordingly. In the meantime the remaining content of this Isis Innovation document is still valid.

URLs beginning www.isis-innovation.com/... are automatically redirected to our new domain, www.innovation.ox.ac.uk/...

Phone numbers and email addresses for individual members of staff are unchanged

Email : enquiries@innovation.ox.ac.uk

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Anaesthetic & vaccine focus

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How Isis Enterprise is helping SMEs down under

Isis is a research and technology commercialisation company owned by the University of Oxford.

NEWS

Rapid response to investment opportunity

The University of Oxford Isis Fund, set up by Parkwalk Advisors with Isis Innovation as the Fund's Investment Advisor, raised over £1.25m within six weeks of launch and closed, oversubscribed. Technology project applications for this funding are now being assessed, and Parkwalk expect to launch a follow-on fund shortly.

Melanoma treatment progress

Oxford-based Immunocore has announced that its immune therapy has shown promising early signs of efficacy in a Phase I trial in advanced melanoma patients. Immunocore has its roots in Avidex, a company spun out by Isis Innovation in 1999, and is now in collaborations with Genentech and GSK.

New spin-out to manufacture nanomaterials

Designer Carbon Materials, based on research from the Department of Materials' Dr Kyriakos Porfyrakis, has been established to cost-effectively manufacture commercially useful quantities of the spherical carbon cage structures known as fullerenes or bucky-balls. These materials offer the prospect of more efficient solar cells and improved medical imaging, and DCM is already receiving interest from organisations developing these applications, which until now have been unable to access useful quantities of such materials. Investment in the company has been led by Oxford Technology and the Oxford Invention Fund.

SMEs to benefit from Isis award

Isis received a prestigious UK Intellectual Property Office award for its initiative, 'Encouraging IP uptake for SMEs through the Oxford Isis Smart IP Scheme'. The scheme offers SMEs access to University-generated IP with a lower cost barrier and reduced risk. The award will help further lower the cost barrier. It is being actively promoted to encourage take-up of IP and enhance support for the SME community.

Tissue creation

Groundbreaking research resulting in a technique to print synthetic tissue-like materials from thousands of tiny water droplets each coated in a thin film mimicking a living cell's external membrane, and studding these membranes with protein pores so that they act like simplified cells, is being commercialised through a new spin-out company, OxSyBio. The technology was devised by Professor Hagan Bayley's group at the University's Department of Chemistry, and has attracted £1million from IP Group plc, the developer of intellectual property based businesses, subject to the achievement of milestones. In the longer term the company aims to print synthetic tissues for organ repair or replacement.

Isis Innovation establishes auto industry support programme for partnering in China

Building on the Isis experience in evaluating new auto engineering products, its established network of collaborations with local government, investors and manufacturing businesses in China, and the strong local base for automotive engineering and motorsport in the Oxfordshire region of the UK, Isis has launched a pilot support programme for automotive engineering companies looking for Chinese partners.

For more details, see page 26.



Enterprising Consultancy

News from **Oxford University Consulting** and **Isis Enterprise**



Supporting technology SMEs in Iceland

Isis Enterprise has been working with a small SME in Iceland to support their latest round of fundraising. Oculis ehf is a spin-out from the University of Iceland developing an ophthalmic drug delivery platform to enable the administration of a range of existing licensed drugs for more effective eye-drop treatment of back-of-the-eye diseases. This patented nanotechnology can reduce or replace the use of more invasive, expensive intraocular injectable/implantable drugs.

Oculis is not only offering a more convenient, less invasive way of treating retinal diseases with existing drugs, the delivery platform is also proving of great interest to companies developing new small molecules and even biologics.

Oculis came to Isis because of our international investor networks and experience in supporting spin-outs to raise equity funds. We worked with the company to evaluate their technology and review their business plan. We then presented Oculis to a range of relevant investors within our networks to test their appetite for investing in this space.

All the results were then reported back to Oculis for further follow up.

Oculis is a classic example of exactly the kind of technology SME Isis Enterprise can help to realise a step change. The founding academics are truly world class, the corporate IP position is strong, and there is plenty of data to support the technology. In the case of Oculis, clinical data exists to show the efficacy of their eye-drop-based nanotechnology to be on par with leading intraocular injectable/implant therapies.

This has been an exciting opportunity for Isis Enterprise, and we look forward to hearing more positive news from the business in the coming months.

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Vodafone – dialling for consultancy

For a number of years, Vodafone has conducted wide-ranging research into the potential for mobile phones to positively affect social, economic and environmental development. In this vein the Vodafone Foundation commissioned Oxford University Consulting to undertake a project exploring the role of the mobile phone in improving the lives of women.

Professor Linda Scott, DP World Chair for Entrepreneurship and Innovation at the Saïd Business School, University of Oxford, produced a report framing the impact of mobile technology across a variety of domains and events that typify women's lives worldwide. This built on the work carried out by mobile operator association GSMA and the Cherie Blair Foundation in 2010, which identified a gender gap in mobile phone ownership of 300 million women in low and middle income countries. The report also drew upon Vodafone Foundation research, and publicly available global data on women, with special emphasis on countries where Vodafone operates and has conducted research. The findings give further understanding on how mobile phone ownership and use benefits millions of women and families.

Professor Scott is best known for her creation of the concept of the Double X Economy – a perspective which describes the global economy of women in both the developed and developing world, and the roles of women not only as consumers, but as investors, donors and workers. Her consultancy for Vodafone was managed by Oxford University Consulting.

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The portfolio

The latest **spin-out** and **investment** news

Dynamic Consent

Dynamic Consent, a proposed spin-out from the University of Oxford, is a personalised, communication interface to enable participants to become more engaged in the donation of their tissue samples and personal information for research purposes. This approach is 'dynamic' because it allows interactions over time, and enables participants to alter their consent preferences as their circumstances change and for this to travel with their sample. Through a secure, password protected website, participants can alter their contact details, change their consent preferences, receive information on the use of their samples and information, enrol in new studies and complete online surveys. Donors are therefore able to engage with the research study in their own time, as much or as little, as they choose.

Donor-driven

Dynamic Consent places participants at the centre of decision-making. The website has a public area with hypertext, videos and connection to social media on new research initiatives, which can be adapted for users with visual impairment and hearing or learning difficulties.

The interface can be tailored both to meet the information and communication needs of participants and the resources and capabilities of researchers. Participants can set their preferences about the kind of information they receive from the biobank, how often they receive it and select whether it is in the form of text messages, emails, or letters.

High standards

Dynamic Consent meets the highest international ethical and legal standards for consent in a world where data protection laws are in flux. It enables participants to keep all of their information

“Dynamic Consent places participants at the centre of decision-making”

in one place, so they know exactly what they have consented to, and the research that they are involved in, allowing them to become more active partners in the research process.

Collection of one-off consent for research can often occur at a stressful time for the person concerned, such as prior to treatment or surgery. Dynamic consent removes this pressure by allowing participants to return to their decision and review their consent preferences in their own time, creating a clear distinction between research and the clinic.

Dynamic Consent promotes scientific literacy as participants become more informed about the research carried out on their samples and information, which encourages public trust by making research more transparent and accountable.

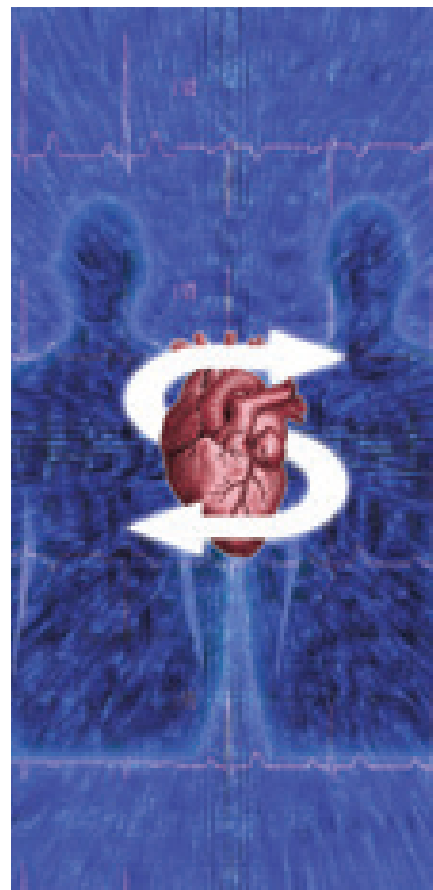
For researchers, the interactive functionality provides an easy mechanism to identify individuals who have consented to being approached and recruited for new studies to participate in online surveys or to canvas opinions on a range of concerns.

Dynamic Consent can be tailored for specific situations, as a 'one-stop' portal to facilitate better translational research and enable clinical and research activities to be co-ordinated around the patient.

The Future

Researchers from the Centre for Health, Law and Emerging Technologies at Oxford are developing Dynamic Consent with partners from LSE and

HW Communications. Isis is currently working with three Oxford-based biobanks (Oxford BioBank, Oxford Musculoskeletal Biobank and Oxford Radcliffe Biobank) and collaborating with the Oxford Sarcoma and RUDY research teams in the Oxford University Hospitals NHS Trust. We are looking for new partners and investors with IT and healthcare (particularly NHS) experience to develop this initiative.



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Jo Szegota, Head of Small Business at Milton Park Innovation Centre, outlines the facilities on offer to companies looking to make the site their home

Milton Park is home to one of the UK's foremost science and technology communities, accommodating over 200 companies of all sizes and ambitions.

From start-ups to world-class PLCs, companies come to Milton Park to take advantage of purpose-built facilities provided in a range of units, allowing every kind of business to find the space they need and on the right terms.

The concentration and diversity of science companies at Milton Park make it a genuine centre of excellence for research and development, and it is home to the region's largest bioscience cluster. Networking opportunities and a campus environment help to create a perfect environment for collaboration and innovation. Excellent travel links make it an easily accessible location for both local and international visitors. In addition, a recent £7 million government grant will facilitate the development of the new Milton Science Centre (MSC), designed to provide a fully-fitted and serviced lab facility. We work with a number of Isis Innovation spin-outs, some of whom have been located at Milton Park for more than 20 years. With more Isis Innovation spin-outs based at Milton Park than any other single location, the on-site team have the experience and expertise to recommend the best solution for your business.

Isis/Oxford spin-out companies who have already chosen to locate their business at Milton Park include:

- Immunocure
- Adaptimmune
- Oxitec
- Yasa Motors
- Oxford Immunotec
- Summit
- OBS Medical
- Intelligent Ultrasound

By building strong customer relationships, offering flexible leasing arrangements and providing a range of accommodation, the team at Milton Park has the ability to respond to business needs, ensuring that customers can satisfy their changing requirements.

Accommodation available at Milton Park is as follows:

Business lounge

The Business Lounge is the perfect professional working environment to meet colleagues, clients or contractors.

The lounge is free of charge to use and open to all working professionals, offering a Costa coffee bar, free Wi-Fi and charging points.



Meeting and conferences

The Innovation Centre has a number of meeting rooms available for hire to accommodate between 1- 60 people, with additional on-site conference facilities available. An exclusive 10 percent discount is applicable for all Isis Innovation businesses.

Virtual packages

If you are looking to register your company at a recognised business address but do not need office premises, a virtual package is a great way to get your business started. With hot desk facilities and discounted meeting room hire, you can select what you need from your virtual package, whether it is postal, telephone or office support services.

Serviced offices

Based at the heart of Milton Park within the Innovation Centre, there are a number of serviced offices, able to accommodate businesses with 1-20 people.

With flexible packages (minimum of 30 days) and easy to manage all inclusive packages, you can spend the time you need to concentrate on growing your business while we manage the rest.

Office, laboratory or warehousing (from 3,000 sq ft)

If you are looking for other solutions across Milton Park, please get in touch or visit the website for the latest list of current availability.

Web link

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Vaccine Renaissance



Speaking at the Oxford Innovation Society in March, **Professor Adrian Hill**, Director of the Jenner Institute, University of Oxford, discussed technologies for targeting new diseases



Vaccines are the most cost-effective health care intervention ever deployed, saving millions of lives by preventing fatal illnesses every year. Vaccines also represent one of the fastest growing sectors of the global pharmaceutical industry with a market of about \$25 billion per annum. Access to vaccination has improved markedly in recent years and in some very low income countries as many as 10 vaccines are routinely administered to infants. Vaccines are key to ambitious plans to eradicate diseases such as polio, measles and malaria but as yet only one human disease, smallpox, has disappeared. But vaccination is also an important contributor, directly or indirectly, to biosecurity, food security (through livestock vaccination), and economic growth.

few based in a leading research university. Many of the seven programmes in clinical development use vaccination technology based on recombinant viral vectors that allow potent induction of cellular immunity in addition to antibodies. This broader immune response has provided promising vaccine candidates that are now showing efficacy against difficult disease targets such as malaria, and larger scale field trials are also in progress for tuberculosis, hepatitis C and HIV. A complementary technology is to express protein-based vaccines as virus-like particles, typically of 20-100 nm in diameter. These have been found to induce exceptionally potent and durable antibody responses, for example in targeting the human papilloma virus that causes cervical cancer.



The prospects for increased use of vaccines to make an even greater impact on health have never appeared brighter. This results from a wide array of new technologies that are being applied to vaccine design, which in turn are broadening the scope of vaccination in exciting directions.

Other new technologies focus on identifying better target antigens for vaccine design, starting with whole genome sequences of the pathogens, filtering potential targets by bioinformatic analysis and then comparison of a limited number of candidate antigens expressed in microbes or cell lines. This approach can now be complemented by mass spectrometric sequencing of femtomolar amounts of peptides eluted from the HLA molecules on the surface of infected cells, to define precisely the vaccine targets of cellular immunity.

New technologies

Several such technologies are under development at the Jenner Institute at Oxford University, aiming to provide innovative vaccines against major global health challenges such as HIV, malaria and tuberculosis. The Jenner Institute is the largest non-profit vaccine institute in Europe and surprisingly one of the

A different set of technologies are under development to simply vaccination, including the use of microcapsules to allow delayed release of vaccine antigen. Such encapsulation of the booster doses



of a vaccine in novel biodegradable polymers could reduce the several immunisations required for most vaccines to a single dose.

Wider applications

With increasing definition of the target antigens of autoimmune and inflammatory diseases these are fast becoming options for therapeutic immunisation. In many cases monoclonal antibodies have been developed and shown to be effective but these are often unsuitable or too expensive for long term administration. Vaccination against these diseases is difficult because the immune system is naturally tolerised and unresponsive to self-antigens, but new very potent immunogens are now showing some promise. Leading targets are the cytokines TNF and IL-17, for inflammatory diseases such as arthritis and psoriasis, and the amyloid beta peptide for Alzheimer's disease.

Perhaps even more exciting is the prospect of immunisation against several forms of cancer, an opportunity identified by Science magazine as the 2013 "breakthrough of the year". For many years efforts to manipulate the immune system by targeting antigens overexpressed or uniquely found on tumours has had limited success. More recently characterisation of the immunosuppressive environment present locally at the tumour site has allowed the use of new monoclonal antibodies, known

as checkpoint inhibitors, to reverse this immunosuppression. These new drugs show significant efficacy used alone, probably by allowing the body's natural cellular immune response to tumours to be more effective. But the real excitement lies in the prospect of combining these new checkpoint inhibitors with a suite of powerful new therapeutic vaccines that have been designed to target key cancer antigens. Administration of vaccines as a component of cancer management and even prophylactic use to reduce the risk of tumour development now seems likely.

Vaccination has moved from immunisation of infants and children to include teenagers and older adults. In the longer term vaccination will be used throughout life to prevent tumours in addition to infections and to fine-tune the balance between autoimmunity and pathogen resistance.

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Catalysing Collaborations

Patrick Verheyen, Head of Johnson & Johnson Innovation, London delivered a keynote talk to the Oxford Innovation Society about new ways of sourcing innovation in the healthcare industry and the company's new collaboration approach

Science and technology are creating unprecedented opportunities to transform healthcare. To help drive breakthrough new products for patients and consumers, Johnson & Johnson Innovation has taken a new global approach to collaboration – one that seeks to combine resources, ideas and technologies in new ways to catalyse innovation.

A significant proportion of innovation in the company's pipeline comes from external sources, and during the past decade, the percentage of its medicines under development that originated elsewhere has risen significantly. Industry wide, more than 70 percent of medicines recommended for marketing authorisation in the EU have originated from small or medium-sized enterprises (SMEs), academia, public bodies and public-private partnerships, while the marketing authorisations of nearly 60 percent of these medicines are held by large companies.

Johnson & Johnson Innovation's collaboration approach is focused on driving early-stage innovation and seeking out the most compelling science that addresses unmet patient and consumer needs. To do this, the company seeks to identify and advance innovative product ideas that are strategically aligned with the company's areas of focus across its pharmaceutical, medical device & diagnostics and consumer businesses. Its partnership model enables access to a full range of ingredients necessary to support emerging life science companies

such as access to R&D expertise, funding and R&D facilities.

In seeking out collaboration opportunities, the company takes a wide variety of factors into account – from the passion and conviction of the scientific advocates, to the ability to establish pre-clinical and clinical POC, to the societal impact the potential product can create.

Developing truly innovative healthcare products requires deep expertise, large networks and a personal commitment. Deep expertise comes from a fundamental understanding of biology and the ability to rapidly integrate emerging research, clinical findings and patient insights. Having a large network opens doors to meaningful and sustained engagement in the regional ecosystem, allowing access to the best scientific thinking. Ultimately, innovative ideas always benefit from a passionate champion whose vision and willingness to take risks drives the product forward.

What we believe differentiates the approach we have taken, through our Innovation Centres, is the critical mass of scientific leaders from the Johnson & Johnson Family of Companies who now live and work in the life science communities around the world. We recognize that proximity to innovators and having local resources necessary to advance the science is the best way to approach our collaborations.



“In seeking out collaboration opportunities, the company takes a wide variety of factors into account – from the passion and conviction of the scientific advocates, to the ability to establish pre-clinical and clinical POC, to the societal impact the potential product can create”

Company information

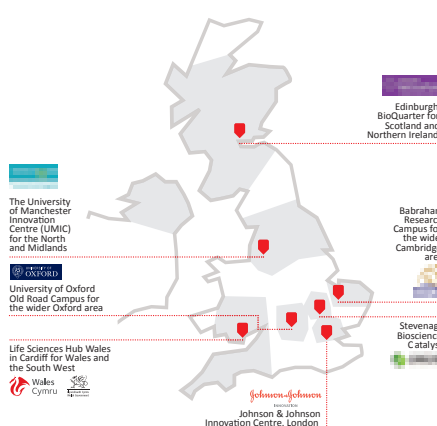
Johnson & Johnson Innovation is committed to finding and developing the best science and playing an active role in advancing the life science ecosystem.

Innovation Centres aim to better enable scientists, entrepreneurs and emerging companies to deliver innovation with experts who can drive partnerships across the pharmaceutical, medical device and diagnostics sectors, and consumer healthcare companies of the Johnson & Johnson family of companies.

The London office represents the European region and is comprised of science, technology and business experts with local deal-making capabilities to flexibly adapt deal structures to match early-stage opportunities and establish novel collaborations that speed up development of innovations to solve unmet patient and consumer needs.

Johnson & Johnson Innovation has established a network of partnering offices across UK life science clusters in order to interact more directly with life science ‘hotspots’ throughout the UK.

University of Oxford Old Road Campus serves the wider Oxford area and is one of the 6 partnering offices established throughout the UK to interact more directly with regional life science clusters.



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Are you awake?

Dr James Groves presents an Oxford University invention that could provide a superior method for measuring consciousness during anaesthesia

General anaesthesia remains one of the most significant developments in the history of medicine, allowing surgeons to carry out invasive procedures safe in the knowledge that their patients are shielded from the pain and shock that would otherwise cause major suffering or death. While all medicines require careful dose consideration, the major limitation of anaesthesia is that both too high and too low a dose carry significant health risks, a phenomenon known as the 'Goldilocks principle'.

The Goldilocks principle of anaesthesia

If a patient is under-anaesthetised there is a risk of 'intraoperative awareness', the rare but terrifying experience of waking up on the operating table. The seriousness of this has led to intraoperative awareness being classed as a 'never event', a label preserved for the most severe yet preventable breaches of patient safety. Unfortunately, this risk cannot be mitigated by simply cranking up the anaesthetic dose. Even a mild excess can lead to prolonged recovery, nausea and cognitive impairments, while a severe

overdose may be fatal. Determining the level of anaesthesia that is 'just right' to maintain a patient within this narrow plane of consciousness is complicated by a host of variables, including the patient's age, body weight and medical history, the class of anaesthesia used and the type of surgery being performed.

Measuring consciousness

At present, the dose of anaesthetic used is based on a patient's level of consciousness, and therefore awareness, during surgery. However, there is currently no definitive method for determining this state, and instead anaesthetists need to make a judgement based on a variety of indirect physiological measures, such as heart rate, blood pressure and respiration. It would therefore be a major step forward if a surgical team were equipped with the means to objectively and unequivocally assess their patient's state of awareness.

A signature of awareness

Using complementary brain imaging methods researchers from the University of Oxford have identified a 'slow-wave saturation' signature that could be used to provide the first hypothesis-driven and personalised measure of awareness during surgery.

The study, published in the journal *Science Translational Medicine*, involved recording electrical brain activity as subjects were slowly immersed into a state of unconsciousness. By extending this normally rapid process of induction the researchers were able to observe



“Despite hundreds of thousands of anaesthetics being administered daily to patients, remarkably there is no robust, individualised indicator of perceptual awareness available”

Professor Irene Tracey, Director of FMRIB at the University of Oxford

a gradual increase in slow-wave brain activity, which reached a saturation point soon after the participants became unresponsive, and remained unchanged despite additional dosing.

Carrying out the same experiment in an FMRI brain scanner showed that this ‘saturation signature’ corresponded with the brain becoming functionally isolated from the outside world, providing convincing evidence that this marked a definitive point at which perceptual awareness was lost. In addition, the saturation signature was shown to correlate with the volume of the participant’s grey matter, suggesting this awareness marker was truly personalised.

A foundation for superior anaesthetic monitoring

There is widespread recognition that brain-focussed consciousness monitors have the potential to improve both patient safety and post-surgical recovery. While such systems are available, the slow-wave saturation signature presented here could provide the foundation for the first rationale-driven and personalised anaesthesia monitoring platform. These unique benefits would represent a step-change in patient monitoring, enabling anaesthesia to be delivered at the right dose and at the right time. The development of such a monitor would have a positive impact on patient recovery and consequently hospital budgets, while also ensuring that intraoperative awareness is confined to the medical history books.

References

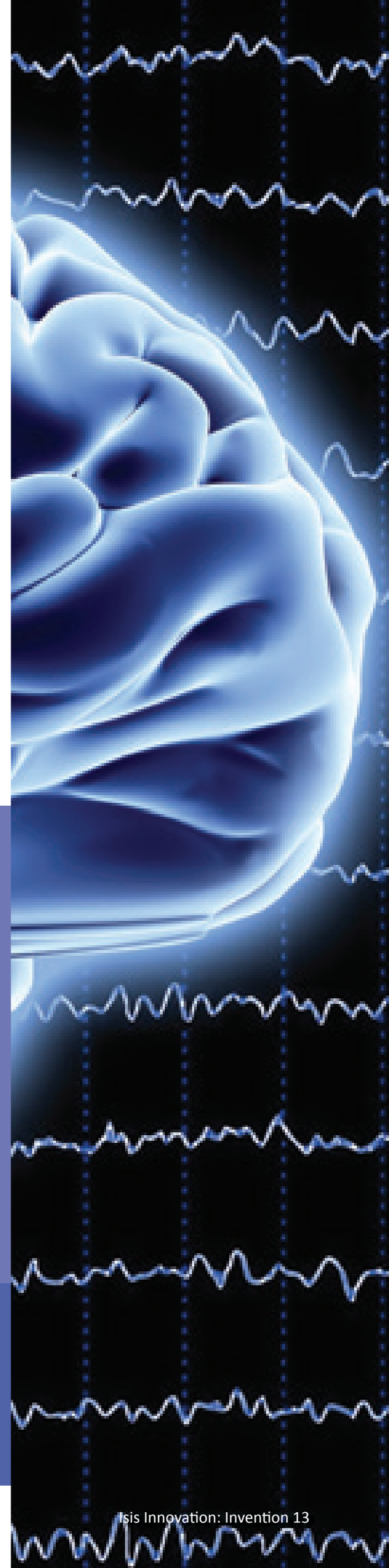
Mhuircheartaigh, Róisín Ní, et al. “Slow-Wave Activity Saturation and Thalamocortical Isolation During Propofol Anesthesia in Humans.” *Science translational medicine* 5.208 (2013)

“Our goal is to allow anaesthesiologists to look at a patient’s brain activity and know with confidence that they are safely asleep”

Dr Roisin Ní Mhuircheartaigh, lead researcher, University of Oxford

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Gestational diabetes management prototype

Dr Nikolaos Chalkias introduces GDM-health, a remote monitoring, management and communication tool for patients and health care providers

It is estimated that gestational diabetes mellitus (GDM) affects 5 - 16 percent of all pregnancies, equating to between six and twenty million cases worldwide. The cost and burden of GDM for both the health provider and the patient is considerable. Conventional management of GDM involves the patient measuring their blood glucose up to six times per day using an electronic blood glucose meter and writing the results in a paper diary. The patient is required to visit the hospital every two to four weeks, where the healthcare professional can review the results and adjust the medication dose as necessary. It is important for the health of the mother and baby that glucose control is maintained with the titration of medication as well as dietary modification. Medication requirements of the patient vary during pregnancy, and therefore frequent review and adjustments are required.

It is expected that improving the management of GDM and reducing the number of clinic visits would offer significant benefits to patients and service providers alike. The ideal solution for the management of GDM would incorporate real-time management of blood glucose control and communication with the patient. The newly developed Oxford GDM-health management system

addresses both of these needs. The system comprises of a smartphone app, with a Bluetooth-enabled blood glucose meter which the patient uses, plus a secure website, with optimised data presentation and alerting algorithms. The website is used by healthcare professionals for real-time patient management and communication with both the patient and other healthcare professionals involved in their care. The app interfaces to standard blood glucose meters via Bluetooth and automatically transmits the blood glucose measurements to the website, along with annotations entered by the patient. In addition, the app provides visual feedback on blood glucose control to the patient. The system has a built-in capability for communication between healthcare professionals and the patients, and allows the former to send text messages to the patient's phone with a view to helping them with the self-management of their condition.

“GDM-health has been incorporated into the management of 50 volunteers with excellent results”

“The real-time patient management and improved communication between healthcare professionals has made new workflows possible and led to greater efficiency”

Greater communication

The system has been designed with extensive input from both patients and clinicians. GDm-health has been incorporated into the management of 50 volunteers with excellent results. The use of the system improved the efficiency of the workflow by streamlining the process between midwives and patients. The real-time patient management and improved communication between healthcare professionals has made new workflows possible and led to greater efficiency. Specifically, the software prioritises patients for review by midwives and health care professionals. The system also allows healthcare professionals to observe the effects of medication adjustments as soon as they occur, without having to wait for a patient’s next visit to the clinic.

Status of the opportunity

The GDm-health management system is a fully working prototype and both the smartphone app (Android) and website have been used within a service development initiative with great success. With the existing smartphone penetration worldwide the GDm-health management system represents a considerable commercial opportunity that will have a

beneficial impact to the health of millions of expectant mothers. Isis is actively seeking to engage with a partner to bring this innovation to the market and maximise its impact.

Versatility

In addition to GDM, the system could be used for other forms of diabetes.

- Women with pre-existing Type 1 and Type 2 diabetes who become pregnant
- Adapted for people with Type 1 or Type 2 diabetes

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Improved ultrasound quantification

Dr Alex Marshall introduces software for quantifying structures in ultrasound images which does not rely on intensity gradients

Ultrasound (US) imaging is extensively used in clinical practice due to its non-invasive nature, real time acquisition, and low cost compared to other imaging modalities. Medical practitioners often wish to use ultrasound to quantify the size of key organs or tissue layers. For example, in the foetal imaging field, it is common clinical practice for the size of the head and abdomen of the foetus to be estimated using US. However, US images can have signal dropouts, missing boundaries, attenuation, shadows, and presence of speckle, which makes US image-based quantitative analysis challenging. There is therefore a need for improved ways of quantifying the size of objects, such as body organs, in noisy ultrasound images.

Limitations of current image measurement methods

The traditional technique to try to quantify structures in US images is for an operator to manually select boundaries around the object of interest from which distances can be determined. However, such manual delineation is laborious, subjective and highly dependent on the characteristics of the image and the expertise of the operator. More modern methods seek to automate object measurement using algorithms that often make use of intensity gradients in the image. Unfortunately, these methods often do not work in US where contrast within the same object of interest can vary considerably and object boundaries can appear fuzzy or are missing altogether from the image.



“Oxford academics have developed a method for quantifying structures such as organs or tissue layers in grainy ultrasound images that is significantly more accurate than existing techniques”

Oxford breakthrough

Oxford scientists have developed a way of improving the ability to detect and quantify objects within grainy medical images. This new method is based on a coupled ellipse detection framework that uses feature information from an oriented edge map, derived from local phase and local orientation rather than simply relying on image intensities or gradients.

The oriented edge map is then used within a modified Hough transform framework to retrieve the best coupled ellipses that fit the data and from here the dimension of the ellipses can be readily determined. The validity of this new approach was demonstrated on cross sectional US images of the foetal arm, the object of interest being the adipose tissue layer, which is an indicator of nutrition.

The approach is also applicable to other objects such as the heart. The new approach is faster and more robust than current techniques and can also deal with “signal dropout”, where objects in ultrasound images appear to have pieces missing as a result of denser structures preventing the penetration of the ultrasound waves.

Technology and patent status

This technology is at the prototype stage and is the subject of a patent application. Isis is interested in hearing from companies that wish to commercialise this technology.



Competitive advantages

- Faster and more robust object identification and quantification
- Method can be used on poor quality images
- Can account for signal dropout
- Can be applied to different imaging modalities

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Precise pH sensing

Dr Andrew Bowen champions a low-cost electrode that can be electrochemically optimised to perform precise pH measurements over a wide range. The electrode is unbreakable, offering a real advantage over the current generation of glass electrodes used for this purpose

A global market

The determination of pH is crucial in both industrial and academic environments throughout the world. Measurements of pH underpin processes in a wide range of applications. In the water industry, knowledge and control of pH levels are important in the provision of drinking water and essential during the treatment of wastewater. Meanwhile in chemicals and petrochemical production, precise reaction conditions are required to obtain consistent, high quality product. In the food and beverage industry, to give a third example, pH levels help determine the properties of the product. However, despite the vital role that pH sensing plays, the technologies involved in measuring pH have not advanced significantly in nearly a century. The concept of 'modern' pH was established in 1924 and even though the global pH meter market has grown to more than \$750 million per year, the technique is still based on the same components.

Current pH sensors

The measurement of pH is most commonly carried out using a pH meter, which typically consists of a probe connected to an electronic meter. Currently, the most prevalent probe is a glass electrode. However, glass electrodes are fragile,

provide measurements that are prone to drifting and suffer from instability and alkali errors. Due to their fragility they can be impractical for certain applications and are often expensive due to their complex construction. Some non-glass electrodes have been developed, but these often rely on additional surface modifications.

The next generation of electrodes

Researchers at the University of Oxford have made a significant step forward in improving the stability and cost-effectiveness of pH sensing by developing a simple, cheap alternative to the glass electrode. This novel electrode uses a carbon-based material, edge-plane pyrolytic graphite (EPPG), which is electrochemically optimised to perform pH measurements. The EPPG electrodes have been shown to provide a linear response from pH 1.0 – 13.0 and are also suitable for pH measurements at varying temperatures. Pyrolytic graphite is readily available, cost-effective and does not require any extra reagents or surface-modifications. These graphite electrodes also have the advantage that they are almost unbreakable, potentially saving customers' money and opening up more business opportunities in applications too challenging for glass electrodes, particularly environmental measurements and processes in harsh environments.

Market readiness

The electrodes have been tested in the laboratory over a range of pH values and with a variety of different buffer solutions. They give a highly accurate, linear response over a wide pH range and offer a real alternative to the current generation of glass electrodes. It is expected that this technology will be of interest to manufacturers of pH sensing equipment and industries with a reliance on pH sensing who require customised pH sensing systems.

Supporting data and patent protection

Some of the experiments and data related to the development of these electrodes are described in

“Voltammetric pH sensor based on an edge plane pyrolytic graphite electrode”

Min Lu and Richard G. Compton, Analyst, 2014, 139, 2397 – 2403. DOI: 10.1039/C4AN00147H.

The underlying technology is also the subject of a UK patent application. Isis welcomes contact from companies interested in licensing this technology to develop a disruptive new generation of pH sensors.

“Glass electrodes are fragile, prone to drifting and suffer from instability and alkali errors”



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Ultra-high bandwidth

Chim Chu explores the versatile potential of Oxford's enabling technologies in visible light and optical wireless communications

Ever increasing demand for data delivered over the mobile internet is causing a 'spectrum crunch' due to the shortage of licensed frequencies in existing radio frequency (RF) wireless networks.

Bandwidth in the hundreds of THz frequency range - many millions of times that available in the RF region - can be exploited in the optical spectrum, which is not subject to licencing. New optical networked devices and systems built over 15 years by the Oxford Optical Wireless Communications Group make use of this abundant spectrum in optical networks.

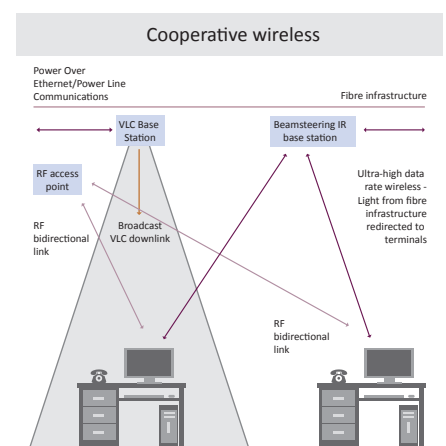
Oxford's two-stage optical concentrator

Performance in optical wireless systems is fundamentally limited by the receiver and the optical 'antenna' that collects light.

The Oxford innovation is a two-stage optical concentrator, capable of overcoming this limit by using wavelength conversion in the receiving arrangement, to give many orders of magnitude increases in performance over conventional approaches. This novel approach is useable within mobile devices and laptops and has the potential for mass production.

Oxford expertise

The invention is the latest in a series of patented technologies from the Optical Wireless Communications Group (including Isis Project 923 – Optical Local Area Network Communications and Isis Project 532 – Optical Identification). The Group's development, with industry, of optical devices and systems is enabling hybrid networks to form future wireless infrastructures consisting of many cooperating systems. These infrastructures provide seamless ultra-high bandwidth connectivity for users. Applications include ultra-high capacity optical networks for wide areas, local networks inside buildings and local highly secure networks. RF networks (Wi-Fi) and optical wireless networks (Visible Light Comms -VLC) working in cooperation are able to provide continuous coverage, as seen in the image below:



“The emergence of these ultra-efficient LEDs coupled with improvements in transmission techniques makes ‘Li-Fi’ – an optical Wi-Fi system – feasible”

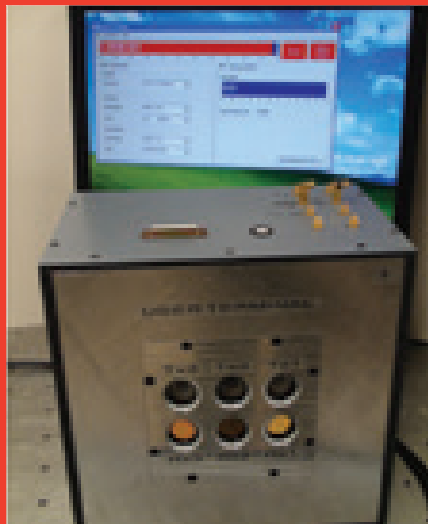
Oxford solutions

In the infrared region of the spectrum the Oxford Group has demonstrated a prototype terminal (Figure 1) operating at 1.25Gb/s. LEDs are seen as the solution for future lighting, while the technology can also serve as the infrastructure for optical networks using visible light as the medium for communications. The emergence of these ultra-efficient LEDs coupled with improvements in transmission techniques makes ‘Li-Fi’ – an optical Wi-Fi system – feasible. Data rates of Gbits/s are achievable using these techniques.

They have also recently demonstrated (with partners) more than 3Gbit/s using an optimised LED. Figure 2 shows a prototype visible link.

Readiness for market

A PCT patent application has been filed with 38 claims. Application engineering expertise is available to support the exploitation of this invention and to productise the technologies with the chosen industrial partner in this application domain. The Technology Readiness Level is rated at TRL 3.



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Long life in deep space

Chim Chu delves into the evolution of Stirling machinery at Oxford and probes the wide range of applications

Oxford engineers have re-designed Stirling machinery so that a highly efficient closed-cycle linear system can be maintenance-free for many years. These cryocoolers can be sent to deep space, or installed in earth-based systems, with excellent operational reliability.

Stirling engines are external combustion engines that can be powered from many renewable sources of heat, including nuclear sources. Existing Stirling machines, operating as engines or cryocoolers, need oil lubrication and regular maintenance and are not cost-effective for long life, 'deploy and forget' applications such as satellite cooling systems.

The designs build on the Oxford Stirling Cryogenics Group's research and development with major industry partners over the last 25 years.

The new designs developed in Oxford include:

Multi-cylinder linear generators

A number of linear Stirling engine generators being arranged in an open network, with a small amount of power fed into one component that drives and controls all the units in synchrony. Expansion work from one power unit can provide the compression work for another power unit via a linear transducer. This is made possible by the harnessing of piston assemblies at both ends.

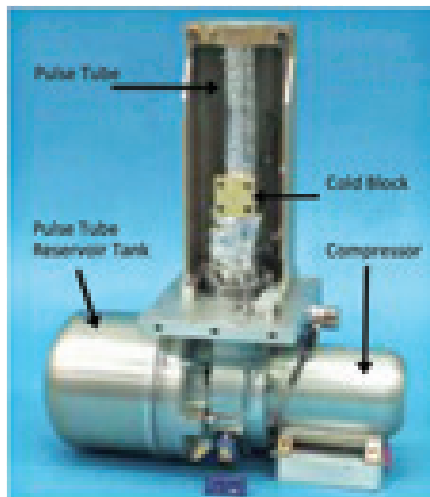
Novel gas spring coupling

When used for electrical power generation, this design transfers mechanical power from the expansion processes to the compression processes, via an efficient fluidic coupling between

adjacent Stirling engine units. This allows multiple linear Stirling engine generator units to form a compact power pack. Close coupling with a novel gas spring coupling set-up minimises overall weight and permits better form factors to fit confined installations and improve power densities. For cryocoolers, the close coupling may permit higher performing cryocooler arrangements to enable a more efficient use of satellite weight and volume capacities. For earth-based cooled-detectors, the coupling allows lighter instrument designs for the same cooling power.

Pulse tube

An enhanced flow, high efficiency pulse tube for low temperature refrigeration. Typically these tubes must work at temperatures of ~ 80 K -- the temperature of liquid nitrogen – for infrared sensing



and astronomical applications. The latest Oxford design allows tubes to be manufactured at a lower cost.

Pressure containment system

This modular design of a Stirling machine features a pressure containment vessel integrated with an outer electromagnetic circuit enabling thinner but stiffer mechanical construction with economical use of expensive magnetic materials. Machine performance is also enhanced by better heat dissipation, and modular design reduces the number of different components, the size, the weight and the cost.

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Software as a service

Academics across the University of Oxford sometimes write software to support their research or teaching and this may also have commercial applicability. Rather than turning to the traditional software licensing model, whereby software is provided to customers for their own installation and use, many customers are now seeking to access software as a service (SaaS) from the University through Oxford University Consulting. **Kerry Antcliffe** describes three recently developed programs

Sortition

Sortition is an online randomisation system for allocating participants in clinical trials. Sortition provides researchers, nurses and clinicians with a wide range of powerful statistical tools, delivered through a friendly interface. Originally developed in-house to aid researchers at the Nuffield Department of Primary Care Health Sciences, Sortition has been developed into a package, offered via OUC, that delivers a value-for-money solution to clinical trial units globally. The complete 'participant allocation system' offers full auditing and email notifications, along with 24/7 treatment resource management.

In a commercial setting, Sortition operates as a complete service rather than a standalone software package. It provides users with a fully customisable solution with the reassurance that their data is safe and their participant group allocation complies with the current regulations. Clients adopting Sortition also benefit from full support to ensure smooth integration into their clinical trials framework.

VirtualAssay

VirtualAssay aims to address the increasing importance of and attention to in silico modelling in physiology and pharmacology, from both the commercial pharmaceutical sector and regulatory bodies such as the US FDA and UK MHRA. VirtualAssay generates populations of cellular biology models mimicking experimentally-observed inter-subject variability.

The populations are calibrated against experimental data, retaining only those models consistent with experimental observations. Once calibrated, these populations can be used to analyse the effects of different pharmaceutical agents on cellular response at the population level.

VirtualAssay is created by researchers from the Department of Computer Science and is offered as a Service to customers who can provide datasets and receive in return a calibrated population of cell models, along with an interpretation from the academic researchers.

“Offering Sortition as a complete service rather than merely a standalone software package provides users with a fully customisable solution and a reassurance that their data is safe”

Online disease assessment training in Vasculitis

A team of clinicians from the Nuffield Department of Orthopaedics, Rheumatology & Musculoskeletal Sciences have now developed a software solution to allow certification of clinical assessment in vasculitis. The software has been adapted from the team’s established training and certification course, and the fully-automated online system provides an interactive experience that mimicks real life case scenarios. The trainee is provided with immediate detailed feedback on performance and can retake cases if necessary, in order to certify. The certification system is used to assess progress and is supported by either a physical presentation from the lead academic or a recorded presentation screened via an online meeting platform. Other additional training materials are also available.

The team, supported by OUC, have already used this system to train clinicians for two pharmaceutical trials. The software could be readily adapted for other conditions requiring standardised disease assessment.

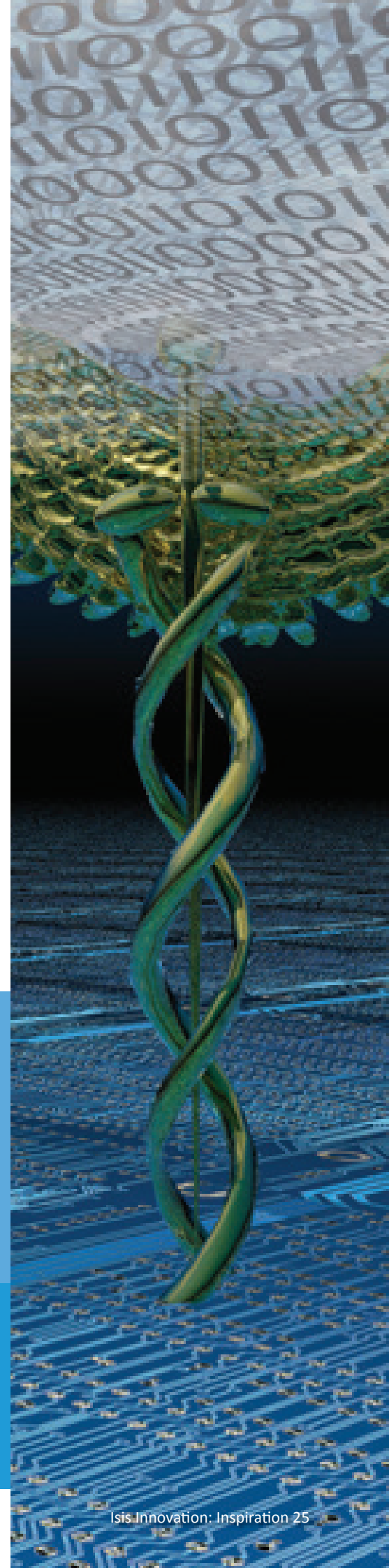
SaaS is increasingly utilised by businesses and this is both driven by – and facilitates – customers’ desires to connect virtual teams and to enable employees to remain productive while working remotely or in the field. Compatibility across the business is ensured as all users receive the same version of the software. Local resource requirements for data storage and processing power are also reduced, allowing greater use of low-power (e.g. mobile) devices.

Software as a Service

Software as a Service (SaaS) is a software distribution model in which applications and associated data are hosted centrally and made available to customers over a network, typically the internet. SaaS is increasingly exploited to enhance applications related to email, social media, accounting, customer relationship management, virtual meeting services and database management systems.

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Taking Australian Innovations to the world

Helen Ujvary, Australian Representative, explains how Australian organisations are accessing international markets through Isis Enterprise

With a population of around 22 million, Australia's main export destinations are China, Japan, Republic of Korea, India and the United States. Asia's growth presents significant opportunities for Australia's continued strong engagement in this dynamic region. Over the last 20 years Isis Innovation has built up strong business networks in Asia which include offices in Hong Kong and Japan as well as collaborations in Malaysia, Singapore, Thailand and Vietnam. As such Isis is well positioned to help Australian SMEs accelerate their growth in the Asian market.

International commercialisation

Many SMEs reach a point where their growth is limited by their geographic boundaries; however, expanding internationally can be a daunting step for many small businesses. Isis Enterprise is involved in a number of international programmes to lower the perceived barriers to entry for companies looking to enter foreign markets. International commercialisation can involve trading, partnering or gaining distribution in foreign markets, as well as licensing IP to development partners around the globe.

One such Isis programme is the pilot Australian Autoindustry Support Programme, which helps eligible Australian high tech automotive engineering SMEs find appropriate partners for development of new products for the Chinese automotive supply chain. In addition to finding customers or distributors, Isis will also help companies find investors with an appetite to invest in growing businesses. Over the years, Isis has built strong relationships in Asia, and one auto-related Isis collaboration is in the Chinese National Level Liudong auto industry park in Liuzhou, southwest China. "The Oxfordshire region of the UK is a centre of excellence for automotive engineering and motorsport. BMW and many Formula 1 teams are based here, as well as specialist suppliers," Isis Innovation's Dr David Baghurst said. "Isis has a lot of experience in evaluating new auto engineering products. Isis has been developing in China by establishing a network of collaborations with local government, investors and manufacturing businesses. We realise that many of the partners in our collaborations are Chinese auto component entrepreneurs. These supporters are keen to identify next generation products to bring to fruition in the Chinese and overseas markets."



"As the automotive industry is transitioning, developing partnerships in markets like China will be critical to secure jobs and a sustainable future for the sector. This pilot is a valuable part of that effort"

Jay Weatherill MP,
Premier of South Australia



“The automobile industry in Australia has suffered a series of setbacks in the last few months with plant closures announced by the likes of Holden and Toyota. I hope that the introduction of a Support Programme will enable some Australian businesses to find appropriate export partners”

Helen Ujvary,
Australian Representative, Isis Innovation

Creating a regional environment in which entrepreneurial activity can thrive

Isis is the highest University international patent filer in Europe, has attracted investment into more than 100 spin-out companies, and in the last financial year provided expertise to over 150 clients in 22 countries. In 2013, Isis developed an Innovation Management Masterclass run by the Committee of Economic Development for Australia (CEDA), which was undertaken in South Australia and Northern Territory. The Masterclass topics included: alternative business models, product and service innovation, managing R&D, managing people and managing intellectual property. Each Masterclass included numerous case studies and presentations from local innovative SMEs, with a particular focus on the Advanced Manufacturing sector. An event in Darwin in 2013 led to the establishment of a local Innovation Club.

Developing Technology Transfer capabilities

Isis is one of the leading technology transfer offices in the world and for the last 10 years has been invited to support university and research institute clients in over 50 countries. In each case technology transfer models are designed and adapted to the local needs and Isis has recently contributed towards the Technology Transfer capabilities of various Australian

Universities and Institutions, including CQUniversity and Bushfire CRC. Professor Hilary Winchester, Deputy Vice-Chancellor (Academic & Research) at CQUniversity stated: “Isis has acted as our interim technology commercialisation arm over the past year, and has provided assistance with a number of projects. The scope of their work has included commercialising new CQU technologies, patent portfolio reviews and negotiation support on licensing agreements.” Isis is currently providing project support to Bushfire CRC, which has led to the following comment from Lyndsey Wright, Research Manager, Bushfire CRC: “We all know documenting IP is important but so often we push it aside thinking it is a hard task. Working with the team at Isis made the job straightforward, and made best use of the information and knowledge that we already held. The process and templates they have developed will help us ensure we have strong, consistent IP documentation across our broad range of projects.” Isis hopes to continue working with Australian Institutions, establishing long term partnerships and developing a stronger presence in Australia and Asia Pacific.

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Oxford Innovation Society

Forthcoming meetings of the Oxford Innovation Society will be held on the following dates:

- Thursday 18 September 2014
- Thursday 4 December 2014
- Thursday 19th March 2015

Meetings are held in Oxford for OIS members and invited guests, and are followed by a formal reception and dinner in an Oxford college hall.



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