Bursting with ideas
University transforms innovation into winning businesses
Forty companies emerged during 2009/10. With that volume and qualities of propositions, the University is at the top table in Europe.

Turn to page 8 for more information.
There was a time when the economies of countries competed on the abundance of their natural resources such as deposits of coal, oil, gas, deep water facilities, natural harbours and rivers forming communication links. No longer. Increasingly, we live in a globalised world competing on knowledge and how to use it. Scotland is no exception.

Turning lead into gold was an insurmountable challenge for alchemists of old. Twentieth century scientists did achieve it, but with the input of enormous amounts of energy. The challenge of transmuting knowledge into wealth is the modern-day challenge facing Scotland. It still requires energy, but of a different kind.

Innovation is a broad term covering scientific discovery to daily incremental improvement of business processes. Scotland’s discovery record is second to none with James Clark Maxwell as one of the greatest.

Present day applications of his discovery – that light behaves as an electromagnetic wave – are all around us – in televisions, mobile telephony and WiFi. Maxwell’s discoveries paved the way for behaviour-changing technology we accept as commonplace today.

Turning knowledge into wealth does require a great deal of energy, but it has huge rewards for the individuals at the heart of the discovery or innovation, and if captured locally in the Scottish economy, to all the people of Scotland. Knowledge creation by itself is only part of the process of taking discoveries, distilling the new learning and turning it into a new product or service.

Edinburgh Research and Innovation (ERI) has a focus on the commercialising part of turning knowledge into wealth. From collaborative research to consultancy projects, from licensing to spin-out and start-up companies, ERI is the door to the knowledge at the University of Edinburgh.

The breadth and range of research and innovation at the University of Edinburgh is truly impressive – from food technology to energy and climate change, carbon storage, carbon capture and intelligent light bulbs to clinical imaging.

But what is really impressive about Edinburgh is the exploitation of knowledge. Nobody should have any qualms about exploitation – what is the point of knowledge generation if it is not used for the benefit of humankind?

Read on and see how Edinburgh Research and Innovation is turning knowledge into wealth.

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How an algorithm originally developed for astronomy research is finding new uses in medical imaging.
With the current difficulties facing world economies, the tasks of generating new research income and commercialising new discoveries from the University’s world-class research base have presented even greater challenges – yet our commercialisation results for the past 12 months have again grown substantially.

Company formation is one of our key contributions to both the University’s strategic goals and the country’s economic development. We have had a very successful year and have seen a record 40 new companies being formed at the University (an increase of 54 per cent on the previous record total of 26 created last year). Our Licensing Office concluded a record 75 new licence deals in the year, an increase of 98 per cent on the previous 12-month period.

Student enterprise is taken very seriously at the University, and is well supported through the excellent work undertaken by our team that leads the LAUNCH.ed initiative, providing high-quality support to help students start their new companies. University of Edinburgh students have won the national student business plan competition run by the Scottish Institute for Enterprise three years in a row, highlighting not just the quantity but the quality of the businesses started at the University.

Our Consultancy Office has once again generated significant growth for the University in the past year from consultancy and service work, with a 5 per cent increase in consultancy income to £4.9 million.

Our Research Support and Development team has processed more than 2,300 research applications and almost 1,000 research awards worth almost £209 million, at the same time as working closely with the Vice Principal International and the International Deans to develop new sources of research funding from across the globe.

ERI staff across all of our six divisions (Business Development, Commercial Development, Company Formation and Incubation, Research Support and Development, Legal and Finance) have continued to work extremely hard in increasingly difficult economic times to help increase the University’s research and commercialisation activities. Our excellent results are a credit to their collective ability to help generate research income and to then help translate the excellent research undertaken by our University colleagues into commercial outcomes.

Over the next 12 months, ERI will continue to maximise our efforts in these challenging financial times to ensure that Edinburgh maintains its position as one of the world’s most innovative universities.
Investors show confidence in drug technology

Actual Analytics Ltd, a recent spin-out from the University of Edinburgh, has secured an investment of more than £900,000 to enable the company to develop and take its first product to market.

Actual Analytics uses cutting-edge video analysis technology to automatically analyse sequencing behaviour in drug trials, which is a crucial step in the development of new drugs treating disorders of the nervous system such as Alzheimer’s and Parkinson’s. With the cost to take a new drug to market estimated at more than US$800 million, Actual Analytics’ ‘ibehave’ product will help the pharmaceutical industry cut costs and remove a significant bottleneck in the drug discovery pipeline.

The technology has been validated with some of the world’s leading pharmaceutical companies and academic laboratories across North America, Asia and Europe.

It is expected that these organisations will become early customers for the new product.

The spin-out of Actual Analytics is the culmination of more than five years of research within the University’s School of Informatics, with support through the Scottish Enterprise Proof of Concept programme. The consortium of investors is led by Discovery Investment Fund and includes Highland Venture Capital, TriCap and the Scottish Enterprise Co-Investment Fund.

James Heward, Actual Analytics’ Chief Executive Officer, said: “This is an exciting milestone for the company – it allows us to commercialise this groundbreaking research, creating a product that will make a significant difference to organisations around the world working hard to develop revolutionary drugs.”

Partnership

University start-up signs major Chinese deal

Burdica Biomed Ltd, a start-up company through the University’s Edinburgh Pre-Incubator Scheme, has reached a partnership agreement with Sinopharm, China’s largest pharmaceutical and medical device distributor, to sell its products in China.

Under the terms of the ten-year deal, Sinopharm will seek regulatory approval in China for Burdica’s products, with revenues from sales in this region expected to be more than £50 million.
In November 2009, Edinburgh Research and Innovation and the University marked 40 years of research and commercialisation success since the launch of its first industrial liaison office in 1969 with a celebratory event at the University’s Playfair Library.

The University Chancellor, HRH the Prince Philip, Duke of Edinburgh, opened an exhibition highlighting the University’s range of achievements through the 40 year timeline, as well as current initiatives to help aspiring entrepreneurs get their business ideas off the ground.

Derek Waddell, Chief Executive of Edinburgh Research and Innovation, said: “Our commercialisation successes are not only in the past; we are also looking very much to the future.”

Famous US film critic Roger Ebert has been given his voice back, thanks to text-to-speech technology developed at the University of Edinburgh.

Mr Ebert lost the ability to speak four years ago after undergoing life-saving cancer surgery. However, University start-up company Cereproc Ltd used its speech technology software to reconstruct Mr Ebert’s original voice from previous TV/DVD recordings.

He can now communicate, using a laptop, to convert typed sentences into the sound of his own voice.

Petrobras S.A., Brazil’s national energy company, and BG Group plc have signed a major £1.8 million agreement over three years with the University of Edinburgh and Heriot-Watt University to apply their world-class expertise to the challenges of extracting oil from carbonate reservoirs in offshore fields.

More than 60 per cent of the world’s oil reserves (equivalent to three trillion barrels) are contained in carbonate reservoirs. With the recovery rate for oil found within carbonate rocks as low as 20 per cent, this provides distinct challenges for the oil industry in reservoir characterisation and reservoir simulation. Naturally, therefore, the demand for expertise in understanding carbonate systems is very high.

The International Centre for Carbonate Reservoirs is a unique initiative, combining geoscience expertise at Edinburgh with petroleum engineering expertise from Heriot-Watt, to address the significant operational challenges facing the oil industry in maximising the potential of carbonate reservoirs. The Centre – the first of its kind in the UK – will develop advanced techniques and modelling capabilities to improve the recovery of hydrocarbons from complex and challenging carbonate environments.

Dr Rachel Wood, from the University’s School of GeoSciences, said: “We are delighted that Petrobras and BG Group are collaborating as industrial partners. The input we received from Scottish Development International and UK Trade & Investment also played a key part in establishing this centre by giving us opportunities to visit key personnel and to strengthen relationships.”

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Students dominate new venture awards

For the third year in a row, a University of Edinburgh student has won the Scottish Institute for Enterprise (SIE) New Ventures competition – a clear sign of how Edinburgh is leading the way in supporting student enterprise.

Informatics graduate Flaminia Cavallo won the overall competition in March 2010 for TheoryMine Ltd, an e-commerce site that allows you to ‘discover’ a mathematical theorem and have it registered in your name. This is also the first student spin-out company created at the University, and will license technology based on 20 years of research in the School of Informatics.

University of Edinburgh students dominated this year’s new ventures competition, claiming wins in three of the categories. In addition to Flaminia’s win in the E-commerce/Retail Business category, Edinburgh students won in two other categories.

In the Social Enterprise category, Jonathan Millin won with Zoomatelo Enterprises Ltd. The company offers transport solutions to large corporates through a carpooling website that has already launched at Standard Bank’s HQ in South Africa. It plans to expand across Africa within a year.

In the Science, Engineering, or Technology Business category, last year’s runner up, Richard Burton, won with Nudge, a software idea that spun off from his already successful start up Hoodeasy Ltd.

Biochar facility first in the world

The UK Biochar Research Centre (UKBRC), based in the University’s School of GeoSciences, is building its own facilities for biochar development and production, the first installation of its kind in the world.

The pilot-scale biochar production research unit is being developed thanks to financial support from the School and a private benefactor.

When installed in October 2010, the facility will strengthen the UKBRC’s position as a world-leading centre in biochar research and development.

Biochar is a stable charcoal-like material that is suitable for long-term storage of carbon, with several potential benefits to soils and crop growth. Biochar research worldwide is in its infancy and a major problem for the rapidly expanding research community is the difficulty in sourcing research grade biochar.

The UKBRC’s Dr Ondrej Masek said: "The significance of the unit extends well beyond the immediate Edinburgh-based team, as we envisage interest from colleagues from different universities and research organisations undertaking research in this area and interested in using research-grade biochar. We are open to any potential collaboration which makes use of the new facilities, its products and by-products, as well as data generated."

Beside the use of biochar, collaborations could include, among others, work on cost-effective utilisation of syngas and pyrolysis liquids, for example, as a fuel for combustion engines, and on sustainable use of waste streams.
Recession and economic turmoil are universally unsettling, but this inevitable phase of the economic cycle also produces business opportunities. The desire to cut costs breaks up established supply chains, and creates market gaps where innovative companies can gain a foothold.

And the unfortunate demise of established companies forces customers to seek out new solutions, often involving novel and previously untried technologies. Innovative technology companies formed during this otherwise troubling time are often the ones that progress fastest and furthest.

So it is pleasing, to say the least, that 2009/10 has seen a record level of company formation from the University of Edinburgh. Forty companies emerged during those record 12 months, far surpassing the previous high of 26 companies achieved in each of the previous two years. With that volume of company formation, and the qualities of propositions, the University is unique in Scotland and at the top table in Europe.

The Edinburgh Pre-Incubator Scheme (EPIS), which the University runs in partnership with Scottish Enterprise, continues to produce impressive companies, but is now entering its final phase with the final cohort of entrepreneurs graduating in autumn 2010. However, the impact of EPIS will live on. It has changed the way universities in Scotland approach company formation.

There has also been a shift in the nature of the University’s deal flow, with more and more high-growth potential companies being formed. The launch of the Accelerator Pipeline for research students reflects this shift, which to some extent followed developments in the Scottish investment scene. Fewer investments are being made; only the very best propositions are backed, and multiple funding rounds are in the past.

The University’s high-growth potential deal flow is evolving in two ways. On the one hand, many propositions are looking to rapidly achieve revenue sustainability off the back of modest investment (perhaps, from founders, friends and family). Scottish Enterprise’s Seed Fund, SMART and the Investor Readiness programme are critical to such propositions. These companies are lean and market-focused. Their ambition, to see out the current downturn, may appear
modest, but they are ideally placed to grow rapidly on the back of the economic upturn when it comes.

A second subset, however, is aiming high. Pursuing substantial investments above the so-called ‘equity gap’. Seven figure investment round targets are the norm for this group of companies. It is a high-risk strategy that involves substantial effort in business planning, corporate finance, market modelling and building management teams. Investors of this scale are often outwith Scotland, and sometimes outwith Europe, but the upside to success is substantial.

So, there are high hopes for the companies in the ‘Class of 2009/10’. The recession has not put off the University’s entrepreneurs and will provide their companies with many opportunities. And their success is sure to spur more of the University’s students and staff to launch their own companies.

Edinburgh’s entrepreneurial class of 2009/10

> 2d-code Ltd
> 376 Promotions Ltd
> Actual Analytics Ltd
> Angelfish Microfinance Ltd
> Blackford Analysis Ltd
> Bright Side FX
> Carbon Masters Ltd
> College Connections
> Contemplate Ltd
> Euan Lind Design Ltd
> Eyes on Edinburgh

> Gomy Photography Ltd
> Go Car Share Ltd
> Gymetrix Ltd
> Heads Up Development Ltd
> Inprisys Ltd
> Interface3 Ltd
> Kitt Up Ltd
> Low Price Lessons Ltd
> M Power World Ltd
> Mobius Digital Ltd
> Musemantik Ltd

> NGenTec Ltd
Through cheap and reliable wind turbine technology, it could transform the market
(See page 15)

> NMS-IR Ltd
> Peekabu Studios Ltd
> ProInnovate Ltd
> Pursuit Trade Ltd
> Read4Sure Ltd
> Recomino Ltd
> Restored Hearing Ltd
> RossWrite Ltd
> SATSIS Ltd

It is set to bring vastly more accurate location technology to mobile devices
(See page 32)

> Shyrdak Rugs
> Sindre Thorsen
> Skoogmusic Ltd
It is marketing an innovative music device for severely disabled children
(See page 17)

> Spatialle Ltd
> Start Up Café Ltd
> Synthetic Nanomachines Ltd
> UnderageGigs.com
> Wingfield Digby Interiors and Gifts
> Zoomatelo Enterprises Ltd
Student enterprise is taken very seriously at the University. Over the last four years, the University’s LAUNCH.ed initiative has supported the formation of more than 50 new businesses that employ over 100 people, the majority of which are graduates.

Whether you are a researcher, scientist or student entrepreneur, it’s not always easy getting investors and other business backers interested in your ideas. In 2010, LAUNCH.ed stepped up a gear, launching the Accelerator Pipeline programme, which offers a higher level of support for students with high-growth potential business ideas at the University.

The Accelerator Pipeline programme offers a series of workshops and mentoring for students to conduct an opportunity assessment of the idea or technologies that they would be interested in taking to market. Students are also offered one year of mentoring from an experienced business professional. This is supplemented with support from a business advisor to help complete grant award applications such as the SMART:SCOTLAND award.

The programme also offers pre-seed awards of up to £5,000 to help fund initial patenting, legal or accountancy fees or other start-up costs that students cannot afford to finance themselves or access through formal investment routes.

One student on the programme is Engineering graduate Brendan Corkery, who is developing a new draft beer monitoring system to help bars and pubs keep more accurate records of their stock and reduce waste. Brendan was awarded a £20,000 Innovation Fund loan from the Prince’s Scottish Youth Business Trust (PSYBT) to conduct field testing of the hardware and to develop the software package.

The programme also runs an annual Innovation Cup competition with a top prize of £5,000. In the 2010 Innovation Cup competition, two awards were made. The first was to Informatics postgraduate Michael Berger and researcher Gregor Hofer for the “Business most likely to have a quick and lucrative exit opportunity”. They are seeking innovation grant funding for their speech to graphics technology targeting the gaming industry.

The second was to Alex Cole, an MSc graduate in Arts, Culture and Environment, for the “Most disruptive technology”. He is seeking innovation grant funding and...
Alex Cole is seeking investment to back his company, Peekabu Studios Ltd, developing low-cost gestural interfaces for home computing.

Also, University of Edinburgh students have won the national student business plan competition run by the Scottish Institute for Enterprise three years in a row, highlighting not just the quantity but the quality of the businesses started at the University.

The third annual Informatics Ventures’ Engage, Invest, Exploit event (EIE’10) took place in May 2010, offering investors the opportunity to meet 50 high-potential business start-ups from across Scotland in one place – the University’s Informatics Forum, one of Europe’s most dynamic and award-winning physical environments.

EIE’10 attracted a record 48 investors from across Europe, including TTP Ventures, Silicon Valley Bank, Partech International, Balderton Capital and Amadeus Capital. Corporate venturing guests included Scottish Water, IBM, Google, EADS, Cisco and BSkyB.

The day featured a panel discussion on “Commercialising Scotland’s Science: From the Cool Comfort of the Laboratory to the Cruel Crucible of the Marketplace”, moderated by Professor Donald MacRae, Chief Economist at the Lloyds Banking Group Scotland. The panel members were: Anne Glover, Co-founder and Chief Executive of Amadeus Capital; Professor Anne Glover, Chief Scientific Advisor for Scotland; Ann Budge, former Chief Executive Officer of Sopra Group; and Anne Johnson, an early stage investment advisor based in Silicon Valley.

Six companies were given the opportunity to pitch to the audience of two hundred guests. These companies were Factonomy Ltd; Inquisitive Systems Ltd; Mobile Acuity Ltd; SATSIS Ltd; Spinsight Ltd; and M Power World Ltd.

Over lunch, a $1 million investment was signed between Edinburgh start-up vibio.com (who pitched at EIE’09) and Archangel Informal Investment. Meanwhile, Actual Analytics Ltd, a School of Informatics spin-out company that also pitched at EIE’09, celebrated its formal launch and a £900,000 investment led by the Discovery Investment Fund.

Anil Hansjee, European Head of Mergers and Acquisitions for Google, Inc, and a University of Edinburgh Informatics alumnus, commented on the event: “When I was a student here we didn’t have anything like this. It’s a great showcase for young entrepreneurs to really show their wares to the people who matter, to try and get out there and get validation from the ecosystem, let alone funding.”

The event attracted a record 48 investors from across Europe to hear six pitches.
Consulting the experts

Expert consultancy services from the University are helping businesses deliver better commercial success...

Game plan

Top of the inbox: with the help of the School of Informatics, one Edinburgh company is seeing better results with its email management software solution

An innovative Edinburgh-based company, which has developed a software service to help customer contact centres manage high-volume email enquiries, is working with the University’s School of Informatics to tackle research and development challenges.

Logicalware Ltd faces a market that has many large providers offering standard platforms for clients. It is important for the company, as a niche player, to maintain a competitive edge through their technology. Their system used a keyword search and selection system, which, while functional, was not the most effective solution. After an approach by the company, the School of Informatics commercialisation team was able to match its requirements with expertise within the Institute for Communicating and Collaborative Systems. The team also assisted the company in applying for funding from the Scottish Funding Council’s Innovation Voucher Scheme.

As a result, Logicalware engaged the expertise of Dr Victor Lavrenko, a specialist in statistical text processing, who offered a new approach to their developmental challenges. Dr Lavrenko has developed a solution based on statistical pattern recognition, which improved the system and made the categorisation of incoming mail much more effective. Dr Lavrenko’s experience in applying the latest statistical text processing techniques to a range of ‘real-world’ applications allowed him to deliver a solution to Logicalware. These were ready for integration into its turnkey service and easily extensible by its own newly trained developers as its client base grows. It has resulted in improvements to their service, which will give it an edge in the marketplace.

“Victor’s expertise has enabled Logicalware to produce a flexible solution for its clients. The system continuously learns by observing the actions of customer service agents. The clients also control the tolerated level of errors, allowing them to balance customer satisfaction against operating costs.”

The success of this collaboration has led to identification of other opportunities, and a subsequent funding application to extend the collaboration has already been submitted.

Dr Lavrenko explained.

Donald Cameron, Logicalware’s Chief Executive Officer, said: “Victor’s expertise has enabled Logicalware to produce a flexible solution for its clients. The system continuously learns by observing the actions of customer service agents. The clients also control the tolerated level of errors, allowing them to balance customer satisfaction against operating costs.”

The solution has resulted in improvements to Logicalware’s service, which will give it an edge in the marketplace.
Food for thought: expertise from the University has given Macphie of Glenbervie valuable insight into emulsion products

Macphie of Glenbervie Ltd is the UK’s largest independent food ingredients manufacturer. A key part of Macphie’s product portfolio is aseptic food emulsion products, such as dairy cream alternatives, sweet and savoury sauces and desserts.

A key ongoing technical challenge for Macphie to create new and improved products is to better understand and control emulsion physical properties. The group of Professor Wilson Poon and Dr Paul Clegg in the University’s School of Physics have expertise and active research interests in this field. With funding support from the Scottish Funding Council’s Innovation Voucher Scheme, Macphie and the Soft Matter group in Edinburgh are now working together to explore whether the latest academic research on the physics of ‘emulsions’ could indeed make a difference to a key industrial technical R&D focus area.

The prospective benefits for Macphie through this collaboration are to strengthen its understanding of emulsion physical chemistry and turn this understanding into new, practical product propositions. Within the Scottish economy, the food sector is a key area.

Ashley Baker, Head of Research and Development at Macphie, said:

“The research collaboration between Macphie and Edinburgh University has been a very positive experience. Innovation is the engine for our business growth, and accessing cutting-edge academic research and expertise, as this project is allowing us to do, will strengthen our new product development portfolio.”

Professor Poon commented: “The collaboration with Macphie has given the group valuable insights into how our knowledge of fundamental emulsion and colloid physics may be applied to foods. The project also gave one of the postdoctoral fellows in the group, Dr Tiffany Wood, a welcome taste of industrial research.”

Through the success of this initial project, future joint research and development collaborations into food technology are envisaged between Macphie and the University.

Macphie of Glenbervie Ltd is the UK’s largest independent food ingredients manufacturer. A key part of Macphie’s product portfolio is aseptic food emulsion products, such as dairy cream alternatives, sweet and savoury sauces and desserts.

“Science is helping food manufacturers find new solutions to production challenges”

GET IN TOUCH WITH...
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Consulting the experts

As the leading supplier of geographic data for Great Britain, Ordnance Survey creates and maintains the geographic framework of the entire country, underpinning about £100 billion of business. Keeping this data current and flexible is a task of great complexity.

In 2007, as the Ordnance Survey started a programme of new product development to produce more flexible, scalable information products, they turned to the University of Edinburgh’s School of GeoSciences to find the world-class expertise they needed.

Professor William Mackaness, who specialises in digital mapping and data modelling, saw the opportunity to apply his research in the field through this collaboration with the Ordnance Survey.

The Knowledge Transfer Partnership (KTP) programme offered the ideal framework to share expertise for the benefit of both partners. The project built upon previous collaborations between Professor Mackaness and the Ordnance Survey.

The goal of the University’s KTP with the Ordnance Survey was to develop an enhanced data model and automatic tools to create multi-representations of features for output in products at different scales. By producing a ‘toolbox’ of algorithms that could be flexibly configured, the KTP project has allowed Ordnance Survey to reduce the development time for its products and develop more automated production systems so that a wider range of information products could be created.

Developing a wider range of products would not previously have been financially viable for the Ordnance Survey without the input of the University’s expertise through the KTP programme.

Professor Mackaness said: “The project fell naturally from a desire to translate theory into meaningful products and services. With a highly motivated, bright KTP Associate, Omair Chaudhry, and the right resource commitment from the Ordnance Survey, this desire to translate knowledge became a reality.”

Lay of the land: a Knowledge Transfer Partnership with the University made new product development viable for Ordnance Survey

The KTP project has allowed Ordnance Survey to reduce the development time for its products.

KNOCKNOWLEDGE TRANSFER PARTNERSHIPS

The Knowledge Transfer Partnership (KTP) programme is a UK-wide initiative to encourage business/knowledge base collaborations. KTP projects of up to three years can help businesses and organisations improve their competitiveness and/or productivity through the use of the knowledge, technology and skills that reside within the University. A KTP Associate is embedded within the company to work on the project, with academic supervision from the partner University and access to wider University resources. Typically, an SME is expected to contribute about a third of the costs involved in the project, with the balance funded by a Government grant.

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KNOWLEDGE TRANSFER PARTNERSHIPS

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A greener future

In November 2009, a new company, NGenTec Ltd, was spun out from the University’s School of Engineering to commercialise a green technology that is set to make wind power cheaper and more reliable.

The revolutionary C-GEN technology replaces the complex gearboxes in existing wind turbines with a lightweight, direct drive system that is easier to manufacture and cheaper to maintain. Dr Markus Mueller, who jointly developed the new technology with Dr Alasdair McDonald in the University’s Institute of Energy Systems and with support from the Scottish Enterprise Proof of Concept programme, believes it will be as much as 50 per cent lighter than current direct drive generator systems, leading to significant savings in manufacturing and operating costs.

Dr Mueller said: “Generating renewable energy is increasingly important as countries seek to reduce their greenhouse gas emissions. The wind energy market worldwide has grown by 28 per cent per year over the past decade, and continued rapid expansion is expected as more countries seek to harness the benefits of environmentally friendly wind power. “We now have two C-GEN generators built – a 20kW (kilowatt) prototype working in the laboratory at the University and a 15kW prototype running on a wind turbine in the TUV NEL test site in the west of Scotland.”

Derek Shepherd, Chairman and acting Chief Executive of NGenTec Ltd, said: “Our technology has the potential to revolutionise the renewable energy industry by making wind power cheaper and more reliable, greatly increasing the efficiency of wind turbines for electricity companies.”

The spin out of NGenTec Ltd was managed by Edinburgh Research and Innovation, the University’s successful research and commercialisation office. Under the exclusive licensing deal for the C-GEN technology rights, the University has a minority stake in the company.

In July 2010, NGenTec was awarded £800,000 from the Department of Energy & Climate Change (DECC) to take forward the development of their C-GEN technology. Speaking on behalf of the company, director Derek Douglas said: “This is great news for NGenTec and helps us with the funding required to commercialise our world-leading British generator technology developed at Edinburgh University. With the support of DECC, this will help us create a large UK-based business taking advantage of the huge growth in the offshore wind market initially in the UK.”

The company is at an advanced stage of fundraising and is seeking to raise £4 million in investment funding to develop the C-GEN technology for commercial markets.

NEED MORE INFO? LOG ON TO... www.ngentec.com
The University has successfully completed a worldwide exclusive licence agreement with US-based engineering firm, Geosyntec Consultants, Inc, to bring an innovative tool for the remediation of soil and groundwater at industrial sites to the commercial marketplace.

Self-sustaining Treatment for Active Remediation (STAR) is a revolutionary adaptation of smoldering combustion, whereby common sources of contamination to soil and groundwater, such as coal tars, solvents, oils, and petrochemicals, are subjected to a controlled, slow-burning process.

The STAR technology was developed by Professor Jose Torero and Dr Jason Gerhard from the School of Engineering, with support from the Scottish Enterprise Proof of Concept programme.

Results of laboratory and field demonstrations indicate that the STAR process overcomes barriers that hinder many current clean-up operations to destroy these sources of contamination.

Professor Jose Torero commented: “STAR is very efficient and safe because it takes advantage of the fact that burning these fuels within soil traps and reuses the generated heat and does so without flames. The process self-terminates when the contaminant has been used up.”

Jose’s co-inventor and colleague Dr Jason Gerhard added: “STAR promises to be technically effective, since it is able to overcome barriers to remediation success that hinder many current approaches and promises to be particularly cost effective by avoiding ongoing energy provision and treatment of produced water or contaminants.”

Geosyntec provides consulting engineering and science services internationally and is known for its technology leadership and practice innovation in the areas of geotechnical and environmental engineering.

“We are excited about the opportunity to bring STAR technology to sites with challenging remediation issues,” said Dr David Major, Geosyntec principal. “We see STAR technology as a significant advancement — a real ‘game-changer’ for certain types of sites that will provide similar benefits to hazardous waste site owners and responsible parties. Using a number of hazardous waste sites in North America for field demonstrations, we have replicated the technical performance successes our University of Edinburgh colleagues have seen in earlier laboratory and field work tests. Also there have been significant cost savings to site owners — as much as 50 per cent when compared with current commonly used remediation strategies.”

David added: “We are committed to making this technology available worldwide, and especially in establishing a Scottish operation to serve the European marketplace.”
A new musical instrument has been developed as part of an interdisciplinary project at the University of Edinburgh that will enable severely disabled children who cannot use traditional instruments to play music in an expressive way.

The Skoog is sensitive to the slightest touch, yet robust enough to resist strong handling. It is a colourful, squeezy cube that uses technology within a soft, tactile surface, linked to a computer, to generate the sound of different instruments, such as flute, trumpet or marimba. Children are able to play a variety of sounds on the Skoog, altering pitch, timbre and volume with a very small range of movement.

The Skoog was developed by researchers within the School of Music, the Perception Movement Action Research Centre and the School of Physics & Astronomy. The work to develop the device is part of a project led by Professor Nigel Osborne, renowned composer and Reid Professor of Music, that aimed to make music more accessible and help severely disabled children improve their communication and concentration skills.

Dr Benjaman Schögler, a psychologist and musician, and Dr David Skulina, a physicist and musician, received funding support from the National Endowment for Science, Technology and the Arts (NESTA), to help with the development of a prototype Skoog.

Dr Schögler said: “Making music can be a huge help in a child’s development through boosting learning and creativity, but many children are unable to use conventional instruments. The Skoog can be used by anyone, of any age or ability, to make music.”

A new company, called Skoogmusic Ltd, was spun out of the University to commercialise the instrument. The spin-out has been supported throughout this process by Edinburgh Research and Innovation, the University’s research and commercialisation office.

Ian Murphy, Head of Commercial Development at Edinburgh Research and Innovation, said: “The Skoog is an excellent example of how innovative thinking can be turned into a useful and exciting product that could improve peoples’ lives.”

Skoogmusic Ltd has successfully completed its first round of funding, attracting investment from Barwell Plc, Daedalus Capital and the Scottish Co-investment Fund. The investment was facilitated by LINC Scotland, the national association for business angels, allowing the company to begin manufacturing and supplying the instrument.

The Skoog has been commercially available since March 2010 and has received widespread interest from the education community.
The success of a unique University programme that helps young rally drivers step up a gear to become world class could be extended to other motorsports.

Racing ahead

In international-level sports competitions, small factors can determine success. That is why sport science staff from the University are working with local Scottish business Elite Sports Performance Ltd to provide a programme for the Federation Internationale de l’Automobile (FIA). The aim is to help young competitors in the World Rally Championship (WRC) learn how to enhance their performance and fulfill their potential to become world-class rally drivers of the future.

When Italian tyre manufacturer Pirelli won the contract to supply all tyres for the WRC from 2008 to 2010, part of the agreement required them to fund a development programme for potential star rally drivers of the future. Having worked with Elite Sports Performance on a similar programme for UK rally drivers for the previous five years, Dr Tony Turner and Hugh Richards, from the University’s Institute of Sport, Physical Education and Health Sciences, were invited to co-ordinate the sport science education for the participants of the Pirelli Star Driver programme.

Ten young talented drivers and co-drivers, whose ultimate aim is to become world-class drivers for one of the manufacturer teams, were selected following a rigorous process in each of the five FIA regions. The PSD programme gives them the

[Image of a rally car]
perfect opportunity to compete and get experience in the WRC, combined with a comprehensive training and development programme – a unique experience at an early stage of their career.

Phil Short, FIA Supervisor for the Pirelli Star Driver programme, said: “It’s important for our project that we have the University of Edinburgh involved, because the sports science department has the experience, knowledge and facilities to teach, train and develop our young drivers. After the guys completed their three-day training session back in March, they came away surprised at what they learned, but happy that they now had a direction for them to progress within the sport, perhaps better than their peers who did not have the benefit of such training. It was the same with our 2009 group of young drivers also.”

Dr Turner added: “Edinburgh’s work also piqued the interest of the FIA Medical Commission and resulted in a meeting with representatives of the organisation, including WRC Medical Delegate for the FIA, Dr Jean Duby, to discuss our findings and ideas for the future. The FIA is now recognising the importance of driver development and safety. These are both areas that Edinburgh is establishing a strong profile in, through high-visibility work at the top level of rally motorsport.”

Tony and Hugh are working with colleagues on the Pirelli Star Driver initiative to establish another FIA-funded driver development scheme across different motorsports under the auspices of the FIA Institute for Motorsport Safety and Sustainability.

The Edinburgh Experience

The Pirelli Star Driver programme started with a residential workshop in Edinburgh to develop a wide range of knowledge and skills to become a top rally driver, from handling media relations to sport science.

The workshop reflected the schedule of a WRC event, which starts with three days of preparation followed by the rally itself. For example, in the 2010 Rally de Portugal, drivers raced in the heat on 18 stages, covering a total of 1,223km over four days. This presents considerable physical and mental challenges. The drivers will not have competed at this level before, so they need to be prepared for maintaining concentration and endurance for that length of time.

Robert Reid, Director of Elite Sports Performance Ltd and a former WRC world champion co-driver, explained: “At the top level of rally driving everything matters, from what you eat and drink to how quickly you can adjust to avoid an obstacle that has appeared in the road.”

Hugh Richards (right) and Dr Tony Turner are now looking at other motorsports for the Pirelli Star Driver programme after their success with rally driving.

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Hugh Richards and Tony Turner are lecturers in Sport Physiology and Sport Psychology, respectively, and are interested in how the two subjects come together in elite performance. Hugh Richards said: “We drew a lot of analogies with the cars themselves. The mechanics make sure that all bits are in place and it is filled up – so do you make sure drivers are the same? Take, for example, fatigue. This is not just a physical manifestation, but a composite of a number of different signals coming to the brain that say ‘I don’t want to carry on any longer’, some of which are to do with nutrition and hydration, but some which can be overridden by mental strategies.”

Hydration is also crucial, partly because rally competitions are such long events, but also because several of the WRC competitions are in hot climates. With participants coming from various FIA regions around the world, there are individuals with different familiarity of performing in the heat. The heat chamber exercise in Edinburgh was aimed at losing 2 per cent of body weight through sweating to demonstrate the effects of dehydration on cognitive performance.

At the WRC Rally de Portugal, Hugh and Tony also monitored the changes in core body temperature, heart rate, hydration status and attention occurring through a day of competing and compared this with an earlier day of making pace notes. The ten
drivers and co-drivers swallowed a transmitter pill, wore a chest strap with receiving device, provided urine samples and completed various visual, auditory and sustained attention tests. They also reported on food and fluid consumption.

Dr Turner explained: “The temperature in Portugal was about 33°C in-car, but core body temperature, inside fireproof clothing and helmet, got as high as 39°C. In these environments, and more so in much hotter events, keeping hydrated is vital, but the amount somebody has to drink can vary. The results from in-competition testing allowed us to be definitive and let a performer know whether what they drank was good enough or not.”

The project gave personalised feedback and recommendations to change behaviour to all ten of the programme members during these events and for future competitions.

Jon Williams was one of the 2009 Pirelli Star Drivers. He said: “The programme was great. It really made a big difference and opened my eyes to the fact that it’s about the whole package as a driver. I will never forget all that I have learned.”

**WHAT DRIVES YOU TO SUCCEED AS A RALLY DRIVER?**

“It is a sport that I am very passionate about and enjoy every minute of it. But I want to be a world champion as I believe that I can be the best.”

**WHAT QUALITIES DO YOU THINK ARE IMPORTANT IN A SUCCESSFUL RALLY DRIVER?**

“I think you have to be focused, driven and patient. To get to the top of rallying takes many years, many sacrifices and many ups and downs. You have to learn from it all to come out the other end better. It is a never-ending line of learning and I am consistently developing my driving and analysing how to make it better. There is no room for standing still.”

**WHAT CHALLENGES HAVE YOU FACED THIS YEAR IN THE WORLD RALLY CHAMPIONSHIPS AND HOW HAVE YOU OVERCOME THEM?**

“To date, we have done two rounds of the World Rally Championship and have retired on the first day of each event, rejoining for the remaining two days. This is hard, as the amount penalised puts you out of the running for a good result. When you are competing for nothing it is hard to get your mind on the job, compared with if you were in the heat of the competition. In this case, it is a matter of reminding yourself that you are still learning. Every event we do this year is new to us, and with a new event we face new roads, new terrain and new challenges. The more homework we do, the better prepared we are mentally.”

**WHAT ADVICE WOULD YOU PASS ON TO FUTURE DRIVERS ABOUT THE PROGRAMME?**

“To really grasp the opportunity with both hands and not think you already know everything. At this level it is a whole new ball game, and as stated within the programme you have gone from being a big fish in a small pond to a small fish in a big pond. So be open-minded and get as much experience out of it as you can.”

**HOW DO YOU THINK THE PROGRAMME IS HELPING YOU TO IMPROVE AS A RALLY DRIVER?**

“First and foremost it is the experience of driving in the World Rally Championship. It is also having access to a lot of experienced and specialist people to help make us better drivers and better prepared for world championship rallying.”

**HOW DID YOU ENJOY THE STINTS IN EDINBURGH?**

“It was very beneficial and a real eye opener to the elements outside of the car that can affect our performance. Just like we would in the preparation of the car, our preparation is just as crucial to ensure that we are on top of our game every time we get in the car. The training of our body and mind is pivotal towards that.”
From collaborative research programmes to licensed technology, the University of Edinburgh is having a major impact on business and industry around the globe...

**SOUTH AMERICA (BRAZIL)**

The University’s School of GeoSciences has secured a major research partnership with Petrobras S.A. (Brazil’s national energy company) in a £2 million agreement. They will launch the International Centre for Carbonate Reservoirs with Heriot-Watt University that will address specific industry challenges in extracting oil from carbonate reservoirs in offshore oilfields.

**NORTH AMERICA (USA)**

The University’s Centre for Infectious Diseases provided internationally recognised microbiological facilities for multinational clinical trials with US biopharmaceutical company, Transave Inc. The trials were for the formulation of ARIKACE™ (liposomal amikacin for inhalation) for treatment of lung infections in Cystic Fibrosis patients.
EUROPE (FRANCE)
The University’s School of Engineering is working with French tyre manufacturer Michelin on a long-term research collaboration to develop better rubber compound and tread pattern solutions and make their tyres grip better on snow and ice covered roads.

AFRICA (UGANDA)
The University’s Centre for Infectious Diseases has played a major role in the successful design and implementation of a research and education programme, in collaboration with CEVA Santé Animale, aimed at eliminating the spread of Sleeping Sickness in Uganda.

ASIA (SOUTH KOREA)
The University’s Institute of Molecular Plant Sciences and South Korean biotechnology company, Unhwa Biotech Corporation, are collaborating on a research programme to identify new ways of enhancing the production of a potent anti-cancer therapeutic drug, Paclitaxel.
The University’s Medical Research Council Centre for Regenerative Medicine (CRM) is home to one of the largest groupings of stem cell researchers in Europe. World-leading researchers based at the Centre are focused on developing and applying the latest advances in stem cell research to improve human and animal health.

In 2011, a new £59 million research building for the Centre for Regenerative Medicine will be completed, containing state-of-the-art laboratory facilities and a clinical translation unit – enabling the production of cells at GMP (Good Manufacturing Practice) grade, suitable for future therapeutic applications. The new Centre will be part of the Edinburgh BioQuarter development at Little France. This location, with a large advanced teaching hospital, the University’s world-renowned medical school and bespoke biomedical research and development facilities all on one site, will provide a unique operating environment with substantial collaborative opportunities.

The research of the centre is currently organised into five themes:

- **Pluripotency and induced pluripotent stem cells:** understanding the molecular mechanisms which give stem cells the ability to self-renew indefinitely and to differentiate into mature specialised cells.
- **Lineage and cell specification:** research to understand and characterise the growth cues and signals that control the specialisation of stem cells into particular cell types.
- **Neural differentiation and tissue repair:** the specific mechanisms that control the growth and development of neurones and how this can be applied to understand and treat diseases like motor neuron disease or multiple sclerosis.
- **Haematopoietic stem cell biology and regeneration:** understanding how the blood system develops and how these mechanisms can be manipulated for clinical purposes.
- **Liver stem cell biology:** mechanisms that underpin the growth and differentiation of mature liver cells and how this can be applied to drug discovery, toxicology testing and ultimately liver regeneration.

The centre is committed to seeing the outputs of its research translated into new technologies and stem cell therapies. A number of patents have been filed on technologies for manipulating, handling and culturing stem cells and on protocols that permit the production and expansion of defined human cell populations. These are available for licensing with commercial partners interested in developing new products and therapies.
NOVEL POLYMERS FOR CULTURING LIVER CELLS

Production of large quantities of high quality human liver cells (HLCs) for research and therapy is a key goal for stem cell researchers. Scalable and reproducible generation of HLCs have applications in drug discovery and toxicology testing, functional regeneration of damaged livers in transplantation and for ‘fuelling’ bio-artificial liver devices which support critically ill patients.

Human embryonic stem cells (hESCs) can be used to generate a population of HLCs. Unfortunately, current cell culture methods for growing HLCs result in poor quality cells that lose their liver-like characteristics when grown for extended periods of time.

In collaboration with Professor Mark Bradley from the School of Chemistry, Dr David Hay has identified a novel polymer which provides a solution to these culture problems. hESC-derived liver cells grown on this polymer show much more consistent liver-cell like features over prolonged periods – they are the correct shape, express the correct cell markers, and have the functional enzymes present in adult HLCs.

The team is interested in a collaborative research programme with cell therapy companies. However, a number of companies have already shown interest in evaluating the polymers.

In 2011, a new £59m research building for the Centre for Regenerative Medicine will be completed, containing state-of-the-art laboratory facilities.

GLIOMA-DERIVED NEURONAL STEM CELL LINES FOR SCREENING

Stem cells offer significant advantages in drug discovery as they offer more realistic and representative models that more accurately reflect the disease under study. An example of this is a set of unique neuronal stem cell lines which CRM researchers, led by Dr Steve Pollard, have isolated from diverse adult and childhood brain tumours.

This new method to produce these glioma neural stem cell lines from tumours is simple, efficient and reproducible. The derived cell lines retain the characteristics of the original tumour providing a powerful model for further study. These cells can be used to develop screening assays to identify potential therapeutics, to identify genetic markers for diagnosis and to improve selection of appropriate therapeutic regimes for patients with brain tumours.

Discussions are under way with a number of pharmaceutical and biotechnology companies to license these cell lines for internal research and drug discovery purposes.
Anterior definitive endoderm (ADE) is the most anterior derivative of the mesendoderm and gives rise to a number of gut-associated organs, including the liver, thymus, thyroid and pancreas.

Previously, mesendodermal and mixed heterogeneous cell populations have been used for the production of these specialised anterior endoderm derivatives. This approach is inefficient and has significant limitations, including formation of non-ADE cells (mesoderm and posterior endoderm) and teratomas.

Research by Dr Josh Brickman’s laboratory has solved this problem by producing an efficient and effective culture method for purifying intermediate in vitro-derived ADE cells from embryonic stem cells. This new method recapitulates the stepwise process of natural embryogenesis and focuses on purification of an intermediate in vitro-derived ADE cell from embryonic stem cells. The method is serum and feeder cell-free and works with cell monolayers. Once isolated, these ADE cells can serve as a source of foregut-derived cell lines, such as liver or pancreas, which can be used for research, toxicology and compound screening.

The methodology is currently available for licence to companies interested in developing and selling a defined media or in creating and developing cell lines for toxicology and compound screening.

Bone marrow is composed of haematopoietic stem cells (HSCs), which give rise to all types of blood cells, including erythrocytes, lymphocytes and platelets. These are the crucial cell types required by patients whose own bone marrow system has been ablated by disease or cancer treatment.

However, sufficient numbers of HSCs of suitable quality and regenerative capacity is lacking. Therefore, the number of bone marrow transplant procedures which can be carried out is limited.

Research within the laboratories of Professor Alexander Medvinsky could provide a solution. His team is developing a novel method of culture and differentiation of embryonic stem cells that will enable the derivation and expansion of HSCs in vitro. Data acquired to date demonstrate that this method enables regeneration of a complete and functional haematopoietic system in a mouse.

If applicable to the human system, it could have a significant impact on current clinical transplantation protocols.

Having a plentiful supply of these HSCs could improve the efficiency and success of bone marrow transplants in cancer/leukaemia patients after high dose chemotherapy or radiotherapy and improve treatment options for patients who have anaemia or immunodeficiency diseases.
USING EMBRYONIC STEM CELLS TO GENERATE RED BLOOD CELLS FOR CLINICAL TRANSFUSION

There is currently a shortage of blood donors and the recipients of blood transfusions are at risk of transmission of infectious diseases and incompatibility with the donor’s blood.

These problems could now be solved thanks to a collaborative research project, led by Professor Marc Turner’s laboratory, to stimulate human embryonic stem ES cells to generate a limitless source of mature, oxygen-carrying red blood cells.

The researchers are developing human embryonic stem cells to Good Manufacturing Practice (GMP) standards, preferably of the ‘O-negative’ blood group, which is the universal donor group whose blood can be transfused into anyone without fear of tissue rejection. This work raises the prospect of generating unlimited quantities of blood from embryonic stem cells because of their ability to multiply indefinitely in the laboratory.

A £2.9 million Wellcome Trust Strategic Translation Award is being used to optimise the production of red blood cells from human ES cells, to test whether they function properly and to scale up production so that they can be used in clinical trials.

Professor Turner said: “Some two million units of blood are transfused each year in the UK and we are reliant on donors to meet the demand. With stem cells we have the potential to create unlimited supplies of infection-free blood, which would address the issue of a shortage of donors both in the developed and developing world.”

The collaboration involves the Scottish National Blood Transfusion Service and the University of Glasgow, working with NHS Blood and Transplant, the Irish Blood Transfusion Service and Roslin Cells Ltd.

SAFELY CREATING INDUCED PLURIPOTENT STEM CELLS

Scientists are trying to identify efficient methods that enable the developmental clock of adult cells to be turned back – effectively ‘reprogramming’ them to induce the pluripotent characteristics, which give them the potential to make any cell type in the body. If this can be achieved, it creates the possibility of having a population of patient-specific cells that can be directed to grow into any cell type or tissue the patient requires.

Dr Keisuke Kaji, in collaboration with Professor Andras Nagy of Mount Sinai Hospital in Canada, has developed a way to create induced Pluripotent Stem Cells (iPS) by introducing the appropriate genes using a non-viral plasmid-based method, which can be removed once the pluripotent cells are generated.

This technology is attracting interest from life science research reagents companies developing kits and reagents to market and sell to research scientists.

Human and murine stem cell lines generated using this technique are also available to companies interested in accessing more representative cell line models for drug discovery. These lines can be used to generate desired cell types, such as heart or liver, for drug development and toxicity testing. The ability to use human iPS cells in this way should help to speed up discovery of safer and more effective drugs.

The work should help to speed up the discovery of safer and more effective drugs.
For the past 20 years, Professor Mark Bradley has been addressing biomedical issues with commercially focused solutions.
Professor Mark Bradley has been pioneering research at the chemical-biomedical interface for almost 20 years, using a multitude of high-throughput (HT) approaches driven by the underpinning desire to apply the tools of chemistry to address and solve biomedical questions and problems.

Mark received his doctorate from the University of Oxford in 1989, followed by post-doctoral studies at Harvard Medical School. He returned to the UK as a Royal Society University Research Fellow at the University of Southampton in 1992. In 1997, Mark was appointed to the Chair in Combinatorial Chemistry at the University of Southampton and established the Combinatorial Centre of Excellence. As its director, Mark built extensive collaborations with all major pharmaceutical companies in the combinatorial arena. Mark also established a major collaboration with Asahi Kasei and was involved in integrating combinatorial and HT techniques into their materials discovery programmes.

These activities were all associated with the development, patenting and commercialisation of a range of new technologies and products. The HT approaches developed by Mark, including polymer array screening, have resulted in patents and products for leukocyte depletion and corneal bandages, which helped lead to the establishment of Ilika Technologies Ltd in 2004. Ilika employs more than 25 people and was launched on the Alternative Investment Market in May 2010.

Mark moved to the University of Edinburgh in 2005 to become Professor of High-Throughput Chemical Biology in the School of Chemistry, where the interdisciplinary nature of biomedical research in Edinburgh offers the perfect environment for promoting Chemical-Biology. Since arriving here, Mark has continued his entrepreneurial activities, with numerous patent applications filed by the University on diverse technologies, from polymers for hepatocyte/drug toxicology screening to innovative biodegradable materials for tissue engineering.

Mark is, clearly, not just an academic with an outstanding research pedigree; he is truly a serial inventor and entrepreneur.

The Scottish Enterprise Proof of Concept programme has provided invaluable support to Mark’s research and will see his academic endeavours result in the formation of new companies, providing job opportunities for future entrepreneurs.

**BIODEGRADABLE TRANSFECTION REAGENTS**

Novel biodegradable transfection reagents, useful for in vitro studies and in vivo for gene therapy, will be commercialised through a new University spin-out company called Deliverics Ltd. The company will specialise in transfection technologies and cellular delivery products, both in the reagent (SAFEctin™) and therapeutic markets.

**ENZYME-FREE SNP ANALYSIS AND DNA SEQUENCING**

Mark and his team have developed novel chemical reagents and, using a process known as ‘dynamic chemistry’, in a world first, have performed human genotyping (SNP analysis), replacing the traditional enzymes used with chemical reagents, leading to a more flexible and faster detection. The commercialisation is being undertaken by a University spin-out company called DestiNA Genomics Ltd, which will enter traditional markets and expand into the rapidly growing ‘personalised medicine’ diagnostic market.

**BIODEGRADABLE MATERIALS FOR TISSUE ENGINEERING**

The team have just initiated a new project under the Scottish Enterprise Proof of Concept programme that will further develop a raft of safe bio-compatible and biodegradable materials for use in tissue engineering, including bone repair.
Spotlight: Professor Mark Bradley

WHAT DRIVES YOU?
“The boundless energy and enthusiasm of a vibrant young research group, tied in with the fun of driving world leading science, in association with translational outcomes that offer the promise of improved quality of life and a real buzz of seeing our chemistry applied in potentially life-saving products.”

WHAT QUALITIES DO YOU THINK ARE IMPORTANT IN A SERIAL INVENTOR SUCH AS YOURSELF?
“To think outside the box, collaborate broadly and in a cross-disciplinary manner. Inventions often come about through collaborations; typically in association with the world of medicine, which require the inventive application of chemistry to provide and enable solutions outside the direct world of chemistry per se. In this regard, Edinburgh is superb, with a world-class medical school, with active research-based clinicians, seeing a direct clinical need with the chemist being able to provide a solution.”

HOW DO YOU TURN YOUR IDEAS/RESEARCH INTO A COMMERCIALLY VIABLE OFFERING?
“This is always a major collaborative undertaking, involving committed research workers who share the vision, Edinburgh Research and Innovation (ERI) to provide the support in patenting and commercialisation, funders who are convinced of the business case and the belief that it will make money. Most importantly, it is the team who work together to make the vision happen.”

WHAT SUPPORT HAVE YOU RECEIVED TO HELP YOU ACHIEVE THIS?
“Support from the University and ERI has been amazing and played a pivotal role in the success story. As an experiment, ERI assigned Dr Keith Finlayson directly to a number of research groups in Chemistry and Biological Sciences. This has created a close working relationship between the Bradley group and Dr Finlayson, enabling rapid identification of translational opportunities and associated funding solutions, with co-written translational grants of more than £4 million over the past three years.”

WHAT CHALLENGES HAVE YOU FACED IN ALL THIS AND HOW HAVE YOU OVERCOME THEM?
“There have been, and always will be, a number of major challenges and balancing acts that must be tempered. For example, there is the often-held belief by many academics that translational research has no place in academia. There is a need for a balanced portfolio of research activities within the group to ensure future translational ideas are grown and developed; as well as the realisation that patents are worthless unless they can be applied, developed or licensed.”

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reagents for DNA sequence analysis. Mark’s commercially focused research has received funding in excess of £4 million from a plethora of industrial and translational awards.

The major focus of Mark’s current research activities are in areas such as microarrays for HT protease and kinase analysis and polymer arrays for stem cell enrichment and cell capture and release. This has led to patents covering surfaces to grow human hepatocytes essential in drug development, polymers for bone repair and thermally sensitive cell-specific polymers (ideal for use in general cell culture).

There are a range of projects focused on cellular delivery (transfection for gene therapy, small-molecule mediated protein and nucleic acid delivery) and cellular labelling (live time in vivo bedside imaging, personal cell-based therapies, fluorophore synthesis), many of which will be the subject of future patent filings. The group also has major interests in DNA sequencing. Mark is, clearly, not just an academic with an outstanding research pedigree; he is truly a serial inventor.
The lighting industry is deep in the middle of a major revolution with the incandescent lightbulb being phased out and banned across the globe within the next ten years. LED (Light Emitting Diode) lighting is currently leading the list of alternative energy-efficient technologies looking to replace incandescent lightbulbs as the lighting industry standard.

A so far untapped advantage of LEDs is that they can be used for high-speed data transmission, whereby communication is piggy-backed on top of illumination. Visible Light Communication (VLC) is a highly energy-efficient wireless transmission technology, sending data through subtle, imperceptible variations in the luminous intensity of the LED. Since the visible part of the electromagnetic spectrum is used for communication, there is no radio frequency (RF) or microwave radiation. This enables wireless communication in areas that are sensitive or exposed to electromagnetic interference or where conventional RF communication fails, such as underwater.

Professor Harald Haas and the D-LIGHT (Data-Light) team within the University’s Institute for Digital Communications have developed a visible light communications module which can be integrated into, for example, LED-based lightbulbs, traffic lights, street lights, as well as head lights in aeroplanes, trains and cars. The advantage of the Edinburgh technology is in the utilisation of novel digital and spatial modulation techniques for higher data rates and lower energy consumption. Computer simulations show that digital data transmission at speeds in excess of 100 Mbps (twice as fast as a standard wireless broadband router at home) are feasible with off-the-shelf LEDs and in real-world deployment scenarios.

Potential applications range from wireless data distribution in hospitals and aircraft cabins to intrinsically safe environments and wireless broadband router replacements at home. Moreover, the potential application of the technology in the defence and homeland security sector is currently being discussed with an industrial partner.

Professor Haas said: “With a miniaturised VLC communication module that can be incorporated into new LED lightbulbs or as an attachment to existing fixtures, VLC technology will join the solid state lighting revolution and usher in a new era of pervasive networking and communication.”

Professor Haas has received funding support from the Scottish Enterprise Proof of Concept programme to build and further develop a prototype for commercialisation through the formation of a new University spin-out company during the last quarter of 2011.
With the mobile communications industry facing huge challenges, the growth of ‘mobile apps’ is presenting new opportunities for equipment manufacturers, operators and software authors. A particularly exciting sector of this market is location-aware applications, which create new ways to use a mobile phone, taking it beyond its role as a communications device and casual gaming platform.

Location-based services on mobile phones presently suffer from a major drawback. Most systems rely on the phone’s GPS receiver – a great location tool when outside with a clear view of satellites, but ineffective indoors or in heavily built-up areas. In these locations, GPS typically provides coverage between 30-70 per cent of the time and your GPS position will degrade to ‘Cell ID’ (within 300 metres proximity).

A radical new positioning system, developed at the University with the assistance of proof of concept funding from Scottish Enterprise, is now being commercialised through spin-out company SATSIS Ltd. The product, known as Loc8R, uses a combination of GPS and signals from a variety of radio sources such as cell towers, WiFi and Bluetooth to quickly and accurately determine a location, even when the user is indoors. Loc8R does not replace GPS, rather its unique positioning algorithms assist existing GPS to make it work better indoors and provide pinpoint city centre and in-building positioning.

Loc8R enables network operators and device manufacturers to supply mobile devices with accurate indoor positioning capabilities, so greatly improving a user’s navigation and location experience on that device. Loc8R also provides an accurate indoor positioning platform for developers to design next generation applications on top of, for example, augmented reality and location-based games.

Professor Tughrul Arslan said: “We’ve developed innovative crowd-sourcing

“Soon your phone will know your exact location, to within one metre accuracy”

Professor Tughrul Arslan

Highly accurate location technology for mobile phones could deliver major benefits to network operators, device manufacturers and application developers.

Make your position very clear
WHAT MAKES SATSIS’ TECHNOLOGY DIFFERENT AND SO SIGNIFICANT IN THE MARKETPLACE?

Loc8R is innovative and cost effective software using a new hybrid approach to achieve fast and highly accurate positioning data in urban and indoor areas where GPS is less accurate. It is based on ‘patent applied for’ University of Edinburgh technology. The SATSIS product has been demonstrated in trials to provide a fast ‘time-to-first-fix’ of less than one second and to achieve correlations between measured and actual position of under five metres, in up to 99 per cent of locations. All of this is delivered with a fraction of the computational power required for competing techniques, leading to power savings, which make Loc8R ideal for portable and handheld devices.

FOR MOBILE NETWORK OPERATORS
- Enables operators to deliver mobile devices with cost-effective accurate indoor positioning capability.
- Improves user experience from performance and application diversity perspectives.
- Improves the operator’s developer community offering.
- Provides an indoor positioning platform for next generation applications.

FOR DEVICE MANUFACTURERS
- Provides a growing list of applications across the different customer markets that require location data and the majority of these would benefit from increased accuracy.
- Is an opportunity to enhance the appeal of smartphone product ranges.

FOR APPLICATION DEVELOPERS
- Is an enabling technology that will enhance online applications and social networking sites looking to expand into the mobile market.
- Could enable the next big differentiator for social networking services, allowing consenting members to meet up safely by using high-accuracy location to support any mobile-to-mobile communications.
- Expands ‘augmented reality’ applications by allowing the overlaying of digital data onto the real world with consistent and accurate indoor location fixing, such as in coffee shops, libraries and car parks.

technology that records data as the consumer uses our applications. Soon your phone will know your exact location, to within one metre accuracy.

"From providing augmented reality for tourists to social networking applications, we’re going to think less of the mobile phone as a communication device and more as a tool to help make our lives better – and more fun."

The Intel Corporation has recently completed a trial with Loc8R at its Swindon facility and is now promoting the technology to internal business units, quoting Loc8R as ‘best in class’. Intel will be carrying out further tests on the latest version of Loc8R during the year.

Loc8R is currently available on Symbian and Microsoft Mobile, with other operating systems coming shortly. SATSIS has also published its own app ‘PinPointer’ on Nokia store Ovi.

SATSIS is looking to license Loc8R to mobile phone manufacturers, mobile network operators and application developers. Loc8R enables SATSIS partners to offer next generation location-based services that require hyper-local positioning.
French tyre manufacturer Michelin has been working with the University on a research collaboration since 2006 to gain a better scientific understanding of the underlying mechanisms of friction of rubber on ice and snow. The aim is to make their tyres grip better on snow and ice covered roads.

For more than ten years, Dr Jane Blackford in the School of Engineering has been undertaking research on ice friction, including a successful collaboration with the Great Britain women’s curling team that won the gold medal at the 2002 Winter Olympic Games. Research in Dr Blackford’s group is based on ice ‘as a material’ and draws on approaches from materials science and metallurgy to understand large-scale behaviour from knowledge of the fine-scale structure.

From a technological perspective, tyres need to perform a variety of functions, such as grip, wear resistance, low noise and reduced fuel consumption. While the UK uses tyres designed to operate in all weather conditions, virtually all other countries in Northern Europe, as well as North America and Japan, use tyres designed specifically for winter.
Jane Blackford and her team are working on developing a tyre that works better in ice and snow conditions. This means there is a huge market for winter tyres. Working with Michelin, Dr Blackford’s research group test the friction of rubber on snow and ice, looking at factors that influence performance such as temperature, velocity, load, ice or snow characteristics, rubber compound properties and tread patterns.

The results identify which rubber compounds and tread patterns have the highest friction under specific conditions. This data in itself is useful for Michelin. However, with deeper analysis, the group aims to understand why the friction varies, which will enable Michelin to develop better tread pattern solutions and tyres in the future.

This winter, the group tested model rubber blocks with simple treads on its linear friction tester, based within a multi-chamber cold room, which typically maintains temperatures down to -15 °C. Michelin then tested tyres made from the same rubber with the same tread pattern on a regular car with ABS brakes at their test centre in Finland. The agreement between the two test methods was excellent.

“The experimental expertise about ice and snow of our partners at the University helped us significantly in the development of efficient testing methods,” explained Joël Foucard, Manager of Michelin’s Tyre Performance Analysis Department. “The facilities of the University also give us great opportunities to understand the complex interactions occurring in the contact patch with various rubbers and tread designs. This joint research effort is contributing to the acceleration of our R&D on ice and snow grip.”

Dr Blackford said: “It is great to work with a company that has such excellent strategic vision and a solid belief in the importance of doing things properly: making difficult careful measurements and analysing the results deeply.

“The work we’re doing is intended to be seen in tyres in about five to ten years time.”

“The experimental expertise about ice and snow of our partners at the University helped us significantly in the development of efficient testing methods.”
Research is currently aiming to unlock the key to new therapies for both humans and animals that could treat conditions ranging from cancer to heart disease.

Human health and animal health are inextricably linked. We suffer from many of the same diseases as our livestock and pets, including osteoporosis, cancer and heart disease, and we are susceptible to similar pathogens, such as influenza, which can be transmitted between species.

As more species and individual genomes are sequenced, the high similarity and conservation of sequence between humans and domesticated animals is becoming apparent. In addition, companion animals, such as dogs and cats, are also exposed to many of the same environmental stimuli as man and suffer from the same lifestyle and age-related diseases.

The University’s Roslin Institute and the Royal (Dick) School of Veterinary Studies are working to accelerate the development of novel therapies and to enhance our understanding of mechanisms of disease for the benefit of both people and animals.

Companion animals, such as dogs and cats, are exposed to many of the same environmental stimuli as man and suffer from the same lifestyle and age-related diseases.

Professor Brendan Corcoran and Dr Anne French are studying heart valve disease in dogs. The predisposition to mitral valve disease in dogs is strongly dependent on the breed, indicating a genetic cause. Fifty per cent of Cavalier Spaniels suffer from heart problems, making them a powerful natural model for identifying genes of therapeutic interest for both dogs and man. Such studies could support the development of novel therapeutics for treatment of heart disease in both species.

Cancer is another disease where pets could pave the way towards new therapeutic approaches and accelerate drug development.

Nearly one in three dogs and cats develop cancer spontaneously as man does and the tumours share similar pathology and biological behaviour; examples of such spontaneous tumours include lung, breast, skin and bone cancers.

Professor David Argyle is studying these natural model systems to answer specific questions regarding genetic and environmental risk factors, the value of new therapeutics, and to improve our understanding of cancer biology, which could benefit both people and animals with the disease.

Livestock can provide a valuable insight into human disease. For example, the sheep lung is similar in both size and shape to the human lung. Dr David Collie and Dr Gerry McLachlan have been using a sheep model to develop new gene therapy treatments for cystic fibrosis.

The key issue with gene therapy has been drug delivery, a problem which can be studied and addressed using the sheep model. Dr Collie also sees the sheep lung as a useful model for studying treatment for other respiratory disease such as asthma.
The University’s Roslin Institute held their first human health-focused industry event, “One Medicine – From Farm to Pharmaceuticals”, in June 2010, to promote the application of a comparative medicine concept across academia and industry. The event provided an opportunity to meet the researchers and hear about novel animal models and comparative medicine and how they can help inform and benefit human medicine. Delegates attending this event included representatives from large pharmaceutical companies and SMEs.

Professor David Hume, Director of the Roslin Institute, said: “The event provided an excellent forum for discussion with potential new partners and several new opportunities presented themselves. With the comparative medicine concept launched, we'll be working hard to help it reach the many different targets it is aiming at.”

Dr Anne French and Professor Brendan Corcoran are studying heart problems in Cavalier Spaniels to benefit both dogs and humans.
Aberdeen-based biotechnology company Antoxis Ltd, which specialises in the design and synthesis of novel antioxidant molecules for therapeutic and stem cell applications, is set to collaborate with Dr Tilo Kunath from the University’s Centre for Regenerative Medicine. The research project will look at the potential for the company’s proprietary compounds to be used in treatment approaches for Parkinson’s disease.

The project is funded through BioSKAPE, a joint Scottish Funding Council and BBSRC initiative, to drive collaboration between business and the life sciences research base in Scotland. The scheme will support a PhD student to work with Antoxis on a programme of collaborative research with Dr Kunath.

Although the cause of Parkinson’s disease is unknown in most cases, there is evidence that some form of oxidative stress initiates the gradual and substantial loss of neurons that produce dopamine, a key chemical in the brain which is important for movement, control and mood.

The goal of this project is to develop novel antioxidant compounds that protect human dopamine-producing neurons from this stress, providing a potential treatment to slow down or prevent their loss in Parkinson’s disease.

Donald McPhail, Chief Scientific Officer at Antoxis, said: “We are delighted to have received funding from the BioSKAPE programme.

“This provides an excellent opportunity for the company to accelerate development of its neuroprotective compounds by working in collaboration with Dr Kunath and the novel stem cell approaches to Parkinson’s that he is developing in the Centre for Regenerative Medicine.”

Slowing down or preventing the loss of neurons that control movement and mood in people with Parkinson’s disease is the aim of current university research.

Brain gain
Improving health

Over forty years of pioneering malaria research at the University of Edinburgh is being consolidated into a unique and valuable repository of malaria materials and reagents, which will be made accessible to the malaria research community.

Sequencing of malaria parasite genomes has enabled researchers to make rapid progress in understanding the basic biology of the parasite that causes the disease, and to develop tools to elucidate the cellular mechanisms and immunological niches they exploit within the host. This work is accelerating the identification of suitable targets for vaccine development and drug discovery.

This scientific progress is being matched by initiatives which are seeing pharmaceutical companies, biotechnology firms, governments and philanthropic organisations collaborate to translate these basic findings in malaria science into clinical applications.

In the School of Biological Sciences, Dr Jana McBride and Dr David Cavanagh are currently working to preserve and catalogue these valuable resources and create a repository of good-quality malaria reagents, which will include:

- Recombinant plasmodia proteins, which can be used for immunological studies, and potential inclusion in diagnostic testing kits
- Monoclonal antibodies against a range of *P. falciparum* antigens for potential use in diagnostics, vaccine development and quality control testing of antigen production
- Characterised Plasmodium cell lines, which can be used for vaccine and drug testing, immunofluorescence assays and growth inhibition assays.

Dr Cavanagh explained: “The repository will have a fully digitised searchable database that will include background information and quality control data, giving access to the key materials needed to develop new diagnostics, vaccines and drug treatments against this deadly disease.”

A repository of four decades of pioneering work at the university aims to help researchers battle malaria

Goldmine of resources

A database will give access to the key materials needed to develop new diagnostics, vaccines and drug treatments against this deadly disease.
Medical imaging facilities and expertise at the University are being fully exploited to progress cutting-edge research.

The big picture

At the University of Edinburgh there is a wide base of world-class medical imaging and image analysis expertise working on innovative and leading-edge research projects.

Medical imaging research facilities and expertise at the University are based around the Scottish Funding Council (SFC) Brain Imaging Research Centre at the Western General Hospital and the Clinical Research Imaging Centre at the Royal Infirmary Edinburgh. These centres give researchers access to a range of imaging systems, supported by image analysis labs and radiochemistry labs.

The medical imaging and image analysis research is multidisciplinary, covering radiology, physics, chemistry, computer science, mathematics, psychology and more. Hence, research collaborations extend across colleges at the University – for example, radiologists and scientists in the College of Medicine have joint research projects with computer scientists and chemists in the College of Science and Engineering.

The provision of imaging at Edinburgh and the links across the Scottish Imaging Network – A Platform for Scientific Excellence (SINAPSE) provides academic and commercial researchers with access to state-of-the-art facilities, plus experienced senior staff (clinical and scientific) to help design, set up, implement and run imaging trials.

The University is a partner in SINAPSE, a strong, dynamic network funded by the SFC that pools imaging facilities and expertise across Scotland’s universities. This creates an optimised environment for research, education and knowledge transfer and provides commercial and academic researchers with access to larger patient cohorts and standardised imaging and quality assurance protocols and improved data management.

Knowledge transfer activities in imaging at the University have recently been boosted by an SFC grant awarded to SINAPSE in April 2010 to fund 12 joint industrial studentships, six based in Edinburgh, covering research and development in MRI, functional MRI, Positron Emission Tomography radiochemistry and image analysis.

The industrial partners for the Edinburgh studentships are GE Healthcare, Varian, Propeller Media, Toshiba Medical Visualisation Systems Europe, NHS Lothian and Molecular NeuroImaging.

Dr Janet De Wilde, SINAPSE Executive Manager, said: “Some of these partnerships are new and some build on existing collaborations. However, they will all give students invaluable industrial experience. These students will be part of the SINAPSE growing student cohort, giving them access to a second supervisor in another institution. Edinburgh Research and Innovation has been central to enabling contracts with the other participating universities and the companies that are liaising with the imaging researchers in Edinburgh.”

Dr Janet De Wilde believes partnerships will give students invaluable industrial experience.
The University’s Clinical Research Imaging Centre (CRIC) aims to advance medical imaging, translate new imaging techniques into clinical applications, and to use imaging for improving the understanding as well as the quantification of diseases through collaborative partnerships.

Located within the Queen’s Medical Research Institute, the Centre forms a unique bridge between the University and the Royal Infirmary of Edinburgh, allowing for advanced imaging – both clinically and for research purposes – of human subjects. The Centre is host to state-of-the-art medical imaging equipment, including:

- **Siemens Verio 3T-MRI scanner**: offering advanced functional MRI brain studies, spectroscopic imaging and advanced cardiac and vascular applications
- **Toshiba Aquilion ONE 320-MDCT scanner**: has the largest volume coverage currently available, with a 16cm axial FOV volume scan and comes with a calibration control system giving access to bone mineral density, coronary calcium scoring and aortic calcium scoring
- **Siemens mCT PET-CT scanner**: allows high-resolution anatomical imaging, using a 128-MDCT system combined with high-resolution quantitative 3D PET capability
- **GE 16MeV cyclotron**: allows the production of PET radionuclides for the synthesis of routine 18-F based radiopharmaceuticals and other tracers, including 11-C and 15-O.

The Centre is able to work with commercial entities on clinical trials and is also looking to use imaging in non-medical applications. Dr Craig Buckley, UK Scientific Support for MR Systems at Siemens Healthcare, commented on the research partnership: “This is a fantastic collaboration for both of us to advance imaging innovation and move forward the prevention, detection and understanding of clinical conditions and disease.”

Hisashi Tachizaki, Senior Manager of CT engineering at Toshiba Medical Systems Corporation, said: “The close proximity of our European research centre, Toshiba Medical Visualisation Systems Europe, based in Edinburgh, allows us to work closely with this centre of scientific excellence.”

The centre is able to work with commercial entities on clinical trials and is also looking to use imaging in non-medical applications.

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**Scanning far and wide**

A new imaging centre is setting up partnerships to improve the understanding of diseases and beyond...
A new super-fast microscopic camera is helping to providing scientists with answers

In the frame

A European interdisciplinary collaboration involving the University of Edinburgh has realised an exciting new camera system. It is very fast and sensitive, capable of video-imaging up to a million times per second with detection down to single photon levels, and time resolution better than a tenth of a billionth of a second.

MEGAFRAME was a three-year research project, part-funded by the European Commission’s 6th Framework Programme (Information Society Technologies). This successful project has put Europe in a leadership position in high-performance time-resolved imaging.

The European research consortium, co-ordinated by the Ecole Polytechnique Federale de Lausanne, comprised experts in the field of vision systems (University of Edinburgh and Fondazione Bruno Kessler, Italy), semiconductor CMOS image sensors (STMicroelectronics) and optical systems (University of Pavia). At Edinburgh, the Institute of Micro & Nano Systems (IMNS) and the Collaborative Optical Spectroscopy, Micromanipulation and Imaging Centre (COSMIC) have collaborated to produce a laboratory microscopy demonstrator. IMNS provided expertise in system modelling and fast on-chip signal processing, while COSMIC provided applications know-how to steer the design and laboratory evaluation of the imager prototypes.

Dr Robert Henderson, Principal Investigator on the engineering side of the project, said: “The MEGAFRAME camera is providing unprecedented performance in the capture and processing of single photons measured in terms of giga photons per second and time resolutions down to 50 picoseconds. The cameras are already providing scientists with insights into cell biology, genetics and biochemistry and are set for deployment in laboratories around Europe.”

MEGAFRAME was selected as one of 12 outstanding European Commission-funded Future Emerging Technology projects at the European Parliament in Strasbourg in April 2010.

The consortium is now seeking development partners to apply this new camera in further diverse applications such as biomedical screening, neuroscience, drug discovery, ophthalmology and cell sorting.

GET IN TOUCH WITH...

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limited to astronomy and could be applied to sectors where processing large amounts of data is routine, including seismic interpretation for oil and gas surveying, and fast image analysis for defence.

Blackford’s initial focus has been in medical imaging, where its technology can improve the diagnostic process for MRI and CT scans by automatically preparing images for radiologists.

The group teamed up with Dr Mark Bastin of the University’s Brain Imaging Research Centre in a collaboration that provided the basis for a Scottish Enterprise Proof of Concept project to demonstrate that the technology could be applied to medical imaging.

This project – coupled with winning the 2008 Research Councils UK (RCUK) Business Plan competition and further funding from a Science and Technology Facilities Council Follow on Fund grant – led to the formation of Blackford Analysis Ltd with an initial six-figure investment and a SMART:SCOTLAND Feasibility Study award.

Dr Panter, Blackford’s Chief Executive Officer, said: “We are extremely excited to be building our first product, and are grateful to the University and our funders for enabling this technology to be developed to the point where we could raise investment. We have discussed further application of this technology with companies in the oil and gas and security sectors, and look forward to raising a second, larger round of finance in the next year to capitalise on opportunities in these markets.”

Dr Panter won the THALES Scottish Technology Prize in 2009 for the application of this technology to Improvised Explosive Device detection, one of the many avenues where this technology could prove useful.

Blackford Analysis Ltd is a new company that has spun out from the University’s School of Physics and Astronomy to provide real-time solutions to large data processing problems, using an algorithm that has a large number of potential application areas.

The technology was originally developed by Professor Alan Heavens to increase the image processing speed in astronomy research, and was used by Professor Heavens and Dr Ben Panter to determine the star formation history of the Universe. However, they could see that the capabilities of the algorithm were not...
Success in securing research funding and bringing innovations to life...

RESEARCH AWARDS

2005/06
- UK Research Councils: £139.6m
- Government & Public Sector: £56.3m
- Charities: £31.4m
- Business & Industry: £8.4m
- Other: £4.1m

2006/07
- UK Research Councils: £209.7m
- Government & Public Sector: £39.3m
- Charities: £45.2m
- Business & Industry: £14.2m
- Other: £6.0m

2007/08
- UK Research Councils: £212.2m
- Government & Public Sector: £34.7m
- Charities: £67.5m
- Business & Industry: £8.1m
- Other: £8.2m

2008/09
- UK Research Councils: £249.0m
- Government & Public Sector: £55.2m
- Charities: £54.0m
- Business & Industry: £11.2m
- Other: £5.1m

5 year total: £1,018.9m

COMMERCIALISATION

2005/06
- Technology Disclosures: 103
- New Patent Applications: 80
- Licence Agreements: 31
- Total Companies Formed: 24
- Start-up Companies Formed: 21
- Spin-out Companies Formed: 3

2006/07
- Technology Disclosures: 120
- New Patent Applications: 77
- Licence Agreements: 66
- Total Companies Formed: 16
- Start-up Companies Formed: 11
- Spin-out Companies Formed: 5

2007/08
- Technology Disclosures: 121
- New Patent Applications: 82
- Licence Agreements: 47
- Total Companies Formed: 26
- Start-up Companies Formed: 20
- Spin-out Companies Formed: 6

2008/09
- Technology Disclosures: 205
- New Patent Applications: 89
- Licence Agreements: 38
- Total Companies Formed: 26
- Start-up Companies Formed: 25
- Spin-out Companies Formed: 3

2009/10
- Technology Disclosures: 150
- New Patent Applications: 111
- Licence Agreements: 38
- Total Companies Formed: 40
- Start-up Companies Formed: 32
- Spin-out Companies Formed: 8

5 year total
- Technology Disclosures: 709
- Licence Agreements: 257
- Total Companies Formed: 132
- Start-up Companies Formed: 109
- Spin-out Companies Formed: 23

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