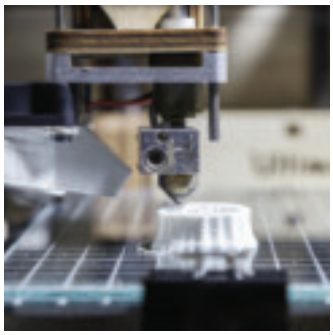
Science & Technology | Lancaster University

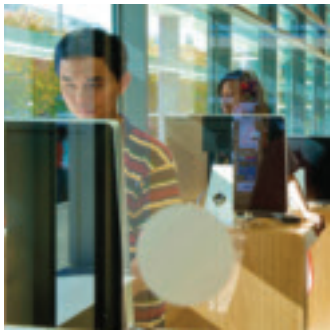
SCIENCE AND TECHNOLOGY
BUSINESS PARTNERSHIPS AND ENTERPRISE ANNUAL REPORT 2013-2014

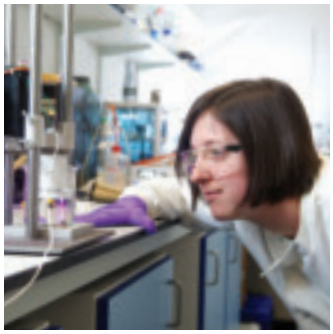


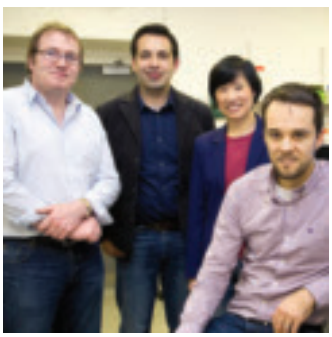











WWW.LANCASTER.AC.UK/SCI-TECH/ENTERPRISE

CONTENTS

INTRODUCTION

Small and Medium Enterprise Strategic Advisory Board

Dr Mark Bacon, Faculty Director, Business Partnerships and Enterprise

Collaborative Research

Over the last year Science and Technology at Lancaster has continued to develop strong and successful partnerships with external partners in the UK and overseas. We supported collaborative projects that addressed specific industrial needs including 68 projects to develop new products and processes (page 6). We formed collaborations with multiple partners, such as the MUMBA project to protect critical infrastructure (page 3) and signed a memorandum of understanding with IBM (page 4).

Facilities for Research and Development

This year we secured funding to develop an £11.4m chemistry facility to bolster high value manufacturing (page 7) which will see a significant expansion of our facilities and equipment. Our resident businesses continue to thrive, four have increased their presence on campus due to expansion (page 7).

Commercialisation of Intellectual Property

2013-2014 saw the formation of two university spin-out companies. A materials-analysis company from our top ranked physics department (page 9), and Novabiomatrix Limited, created to tap into the multibillion dollar cell culture technology industry (page 10).

Student Engagement

During 2013-2014 we launched a £1.7m Engineering Design Academy (page 11) and a Data Science Masters (page 12) both of which offer industry support through student projects. We supported a number of industry-led research collaborations through our postgraduate students including 28 Collaborative Awards in Science and Engineering and 4 Knowledge Transfer Partnerships. In total we arranged 366 collaborations between students and a wide range of organisations, from regional small and medium enterprises to international corporates.

Professional Training

This year we have expanded our portfolio of industry-led professional training with courses in flood risk management designed in collaboration with JBA Consulting (page 13). Our MSc in Cyber Security received full certification from the UK's national intelligence agency (page 13) and we welcomed Unilever to deliver environmental training to our students (page 14).

International Partnerships

2013-2014 saw increased activity with our international partners, including the KARIM project assisting over 1,000 small and medium-sized enterprises in North West Europe. We also took the first 15 businesses to China to benefit from the links developed as part of the £5.1 million Lancaster China Catalyst Programme (both page 15).

Measuring our Performance

In this report we provide some case studies of our work with external partners during 2013-2014. We measure the success of these, highlighting a significant improvement to the return on investment we have realised from public funding over the last three years (page 17).

2014-2015 looks set to be another exciting year for Science and Technology. We look forward to developing collaborative relationships with new partners and have outlined some ways to get involved on page 16.

COLLABORATIVE RESEARCH

NEW CYBER TOOLS TO PROTECT INFRASTRUCTURE

This year Security Lancaster researchers have been collaborating with Airbus UK Limited, Raytheon Limited, and Thales Group (UK) to provide business decision-makers with smarter information about cyber risk. The new software tool will enable business leaders to take more informed decisions about protecting critical infrastructure from cyber attack.

The 'MUMBA' project is focussed on threats to 'industrial control systems', which manage key infrastructure such as manufacturing plants, power stations, electricity grids, and transport networks. These systems are increasingly connected to the internet, which makes them potentially more vulnerable to cyber attack from those with hostile intent.

Professor Awais Rashid, lead scientist on MUMBA and Director of research centre Security Lancaster, said:

"This research is about understanding the cyber security risks at the intersection of people and technology. If you give people lots of technical metrics that they don't understand you get poor decision-making. Risk decisions are made not only at board and management level but also by those working with industrial control systems on a day-to-day basis. Our project will produce a software tool that will allow professionals to more effectively understand and visualise risks to industrial control systems."

The research project, which has received £390,000 funding from the Engineering and Physical Sciences Research Council, will also study the implications of particular security decisions in 20 - 30 years' time given the long operational life of such systems. This will provide information to ensure much needed future-proofing of critical connected infrastructure.

The Lancaster University research forms part of a wider £2.5m research programme in collaboration with Imperial College London, Queen's University of Belfast, the University of Birmingham, and City University London.

www.security-centre.lancs.ac.uk

Contact Daniel at d.prince@lancaster.ac.uk or call +44 (0)1524 510788 to access our expertise and protect your business.

INNOVATION SEMINARS DEVELOP LINKS WITH THE KTN, THE BBC, AND QINETIQ

This year the Faculty of Science and Technology brought senior representatives from the Knowledge Transfer Network (KTN), the BBC, and QinetiQ to Lancaster University to talk about their science and innovation challenges with students, academic staff, alumni, and businesses.

The first seminar took place in October 2013 and was given by Carol Boyer-Spooner, CEO, International Business Leaders Forum and the KTN, chemicals sector.

Carol explained, *"Collaborative partnerships are important, both in Europe and the UK, and we're here to make sure those collaborative partnerships are as effective as they can be."*

The KTN later leant its support to the launch of the new Quantum Technology Centre (page 14) and our new £11.4m chemistry facility (page 7).

The second seminar, 'Leeeeeroooooy Jeeeeeenkins... - The impact of game technologies on how we learn' by Daran Crush, QinetiQ's Simulation and Training Group, took place in November 2013.

QinetiQ are also collaborating with researchers from the Department of Psychology.

The third seminar took place in February 2014 and was delivered by Adrian Woolard, Project Lead at the BBC's R&D North Lab, and Keith Mitchell, Group Engineering Manager within BBC Sport.

Talks covered research challenges and the ways in which Lancaster and the BBC have worked together in the past, such as workshops on the future of news journalism and an internship.

Summaries and full talks from all our innovation seminars are available to watch online: www.lancaster.ac.uk/sci-tech/business/seminars

Contact Becky at b.gordon@lancaster.ac.uk or call +44 (0)1524 510188 to get involved in our events.

IBM AND LANCASTER UNIVERSITY PLAN FOR THE FUTURE

Professor Bill Payne, Vice President of IBM Global Process Services, with Professor Mark E Smith, Vice Chancellor, Lancaster University

In October 2014, building on collaborations with IBM in areas such as cyber-security, smart streets, and smart healthcare, Lancaster University signed a memorandum of understanding with IT and business services giant IBM.

Professor Mark E Smith, Vice Chancellor of Lancaster University, said: *"IBM shares many of our goals and both organisations are deeply focused on developing cultures of innovation. We believe that the common cultural values within our organisations give us a platform that we hope will lead to further closer working and potentially the development of exciting technology solutions."*

The agreement signed by the Vice Chancellor, and Professor Bill Payne, Vice President of IBM Global Process Services, outlined how the two organisations could work together in the future. These included areas such as collaborative research, jointly organising events, curriculum developments, and staff secondments.

Professor Payne said: *"IBM and Lancaster University already have a track record of collaboration and this agreement sets the scene for us to expand into exciting new areas. Joining the best people in IBM with those at Lancaster University is a great opportunity for us to lead the way in the co-operation between business and academia."*

Potential areas of future collaborations include research in areas such as smart cities, big data, smarter commerce, and business analytics.

We also recognised IBM's Professor Nick Coleman for his world-leading expertise in the cyber security sphere and awarded him with an honorary professorship. Professor Coleman, an alumnus of Lancaster University, is IBM's Global Head of Cyber Security Intelligence Services. As an Honorary Professor at Lancaster University, he will engage in a range of activities to add value to security research and teaching.

Contact Steve at s.fish@lancaster. ac.uk or call +44 (0)1524 510784 to find out more.

Image courtesy of Booths

ENCOURAGING GREENER EATING WITH BOOTHS

This year researchers in the School of Computing and Communications led a partnership with resident company Small World Consulting Limited and family-run retailer Booths to try to reduce shoppers' carbon footprints.

Food accounts for more than ten per cent of the UK's carbon footprint. The aim of the £214,455 project, funded by the Engineering and Physical Sciences Research Council, was to look at consumers' buying habits, and develop effective ways of encouraging people to consider the environmental impact of the food they buy.

Over a period of several months, a research team led by Dr Adrian Friday and Dr Mike Hazas from the School of Computing and Communications followed volunteers around the aisles of Booths stores. They examined snacking and take-away purchases to gain a greater understanding of repeated food buying decisions.

Dr Friday explained *"We are trying to encourage people to choose a lower carbon footprint diet and help people reflect on their repeated habits and the impact this is having on the environment."*

Booths also provided access to their buyers so researchers could gain a greater understanding of the restraints retailers face when trying to reduce the carbon footprint of the food they sell.

> *"It's a great pleasure to support Lancaster University in its research."*
>
> Edwin Booth, Chairman of Booths

www.booths.co.uk
www.sw-consulting.co.uk

MAKING THE UK'S STREETS SMARTER

In October 2013 Lancaster University partnered in the launch of the Innovate UK funded Smart Streets Project, an initiative to revolutionise highways maintenance.

Highways maintenance is a £3.9b industry. Smart Streets uses real-time data collated in a Smart Streets data hub to inform management of issues such as gritting, flooding and potholes to potentially save the industry millions.

As part of the project five businesses competed for and won funding to produce ideas of how the hub could be used to transform how we view, and interact with the nations' highways. The hub now has 35 data sets and 4,064 live sensors to date providing information on London transport, UK air quality, roadworks, live traffic information and much more.

"We are working with a whole range of companies to develop solutions in this space to set the UK up as a leader in intelligent highways maintenance," Professor Nigel Davies, School of Computing and Communications.

Smart Streets is led by In Touch Limited and includes a consortia of Amey PLC, Balfour Beatty Mott MacDonald, Carillion PLC, Redcar & Cleveland and Birmingham Councils and the universities of Lancaster and Birmingham.

Contact Steve at s.fish@lancaster.ac.uk or call +44 (0)1524 510784 to find out more about smart streets or our collaboration with Booths.

£600,000 ALLOCATED TO ACCELERATE R&D

£600,000 was allocated to the university by the Engineering & Physical Sciences Research Council Impact Acceleration Account (IAA). This year 68 awards were made to support work with businesses and researchers to investigate new ideas and develop commercial propositions.

Projects included a new water sampler (page 8), image analysis tools for a new university spin-out company (page 9), and the three highlighted below.

Microfab Limited

Additive manufacturing, or '3D printing,' allows increased geometric freedom and is particularly applicable to high-value, low-volume products, where the ability to customise is important. Microfab Limited was created in 2013 to investigate the use of 3D printing to create inexpensive, portable laboratory devices.

Dr Allan Rennie, Engineering Department, helped the company apply for IAA funding to pay for an internship (page 11), materials, and specialist equipment to develop a prototype medical fluidic device.

Nathan Burley, Managing Director, Microfab Limited explained

"The IAA allowed us to take on an intern to research different 3D printing techniques, and develop prototypes and proof of concept for a low pressure pump system and micro fluid incubator which we can now go to industry with. The best thing about the collaboration was the speed that things were turned around. The staff have been fantastic."

Contact Mark at m.rushforth@lancaster.ac.uk or call +44 (0)7964 921891 to find out about IAA funding.

Compound Semiconductor Technologies Limited

Compound Semiconductor Technologies Limited (CST) have been developing a thermophotovoltaic (TPV) cell, conceived at Lancaster University, that directly converts waste heat into electric power. The device could stimulate a valuable new low carbon energy technology which will have a significant impact on the electricity, heat and transport markets.

Professor Tony Krier, Dr Min Yin, Dr Andrew Marshall, and Dr Qian Zhuang, collaborated with Dr Wyn Meredith, Commercial Director of CST, and developed a small TPV generator system that can power a radio or LED display from a flame or hot object, to demonstrate the technology.

Dr Wyn Meredith commented

"I was immediately impressed with the commitment of the team led by Professor Tony Krier, and a real understanding of the requirements of industrial led projects."

www.compoundsemi.co.uk

Process Instruments (UK) Limited

Water and wastewater treatment requires the continuous measurement of the amount of solids in a flowing stream. Measuring and detecting solids in water is very important as these can have a huge impact on our sewer system.

Head of Lancaster University's Chemistry Department, Professor Peter Fielden, has extensive experience with sensor design, characterisation and implementation. He worked with Process Instruments (UK) Limited to develop and test a new proof of concept sensor to extend their measurement range.

"The collaboration will benefit our business by resulting in a world beating sensor that we can couple with our existing electronics to grow the business to the next stage."

Mike Riding, Managing Director, Process Instruments (UK) Limited.

www.processinstruments.co.uk

FACILITIES FOR RESEARCH AND DEVELOPMENT

Artist's impression of the chemistry facility

NEW £11.4M CHEMISTRY FACILITY

In August 2014 the Faculty of Science and Technology won funding to develop an £11.4m chemistry facility to bolster high-value manufacturing. The Collaborative Technology Access Programme (cTAP) will include a purpose-built facility to offer businesses managed access to a suite of cutting-edge instrumentation and facilities worth almost £7m.

The cTAP facility will support both small and large advanced manufacturing companies to develop new products and services by providing equipment and facilities for testing and manufacture of new chemicals, materials, semi-conductor devices and products.

Dr Terry Golding, Chief Executive Officer of US-based Amethyst Research Inc said

"This new investment is exactly the kind needed for overseas companies to realise our commercial objectives in the UK and Europe."

The three-floor building, over 10,000 square feet, will sit alongside our new Department of Chemistry. Facilities will include laboratory and write-up space, meeting accommodation, and rooms for instrumentation. This includes nuclear magnetic resonance spectroscopy worth £1.7m, chromatography and mass spectrometry instruments worth £1.5m, and molecular and material analytical and diagnostic instruments. It also includes a molecular beam epitaxy machine worth £1m which is used to manufacture semiconductor devices, and a next generation 3D microprinting system.

Independent assessments estimate that the investment will enable Lancaster University to realise £90m to £150m in additional value to the economy over the next 15 years. It will also create over 100 jobs. The facility is set to open in autumn 2015 and was part-funded by £9m from the North West Operational Programme for the European Regional Development Fund.

Contact Mike at m.entwistle@lancaster.ac.uk or call +44 (0)1524 510226 to find out about accessing the cTAP facilities.

RESIDENT COMPANIES DEVELOP AND EXPAND

In 2013-2014 we welcomed six new businesses onto campus in bespoke facilities in InfoLab21 and the Lancaster Environment Centre:

- Ahern Ecology Limited
- COGMO Media and Marketing Limited
- Envirofly Limited
- ESGP Limited
- T.E. Laboratories Limited (page 8)
- Xyone Cyber Security Limited

VisionsLive Limited, Tripod Software Limited, and The Reach Centre Limited expanded and took on extra office space. Gaist Solutions Limited (Highway Asset Management & Consultancy) also re-located in August 2014 to InfoLab21.

Our award winning office spaces were highlighted as an exemplar in a government report on universities-business interactions - Sir Andrew Witty's 'Encouraging a British Invention Revolution.'

Stephen Robinson, Director of Xyone Cyber Security, explains why he moved onto campus, *"We have established several strategic relationships with key personnel, helping us to achieve recognition and grow as a company."*

www.xyonecybersecurity.co.uk.

We have hot desks and office space for 2-14 people for businesses.

Contact Helen at h.boulton@lancaster.ac.uk or call +44 (0)1524 510409 to find out more.

NEW SAMPLER FOR WATER INDUSTRY

During 2013-14 chemical analysis company T.E.Laboratories (TelLab) Limited, based in Tullow, Ireland, embarked on a collaborative research project to develop a new passive water sampling technique, and took a hot desk in the Lancaster Environment Centre (LEC).

TelLab was introduced to LEC researchers Dr Andy Sweetman, Professor Hao Zhang and Dr Chang'er Chen through the KARIM project (page 15).

The LEC team had developed a new passive sampling technique, and a 'family' of sampling devices tailored to quantify a specific range of substances. Working with staff from the Product Development Unit in the Engineering Department, and TelLab staff, they adapted the approach in order to use it as an assessment tool for compliance with an EU regulation. The Water Framework Directive WFD2000/60/EC aims to achieve and ensure "good quality status" for all European water bodies by 2015.

> *We decided to take a hot desk in the Lancaster Environment Centre to continue our relationship and make use of the fantastic facilities.*
>
> Mark Bowkett, Managing Director, T.E.Laboratories

Firstly the team identified which substances would be of most interest to the water industry. They then tested a range of diffusive gradient thin-film based samplers and a deployment device ready for testing the potential market for water quality monitoring, and carried out preliminary market research.

"Working with Mark Bowkett from TelLab has established a productive collaboration that not only helps to advance the science of passive water sampling devices, but also to develop a product that is suitable for a wide range of applications in a Europe wide market place," Dr Andy Sweetman.

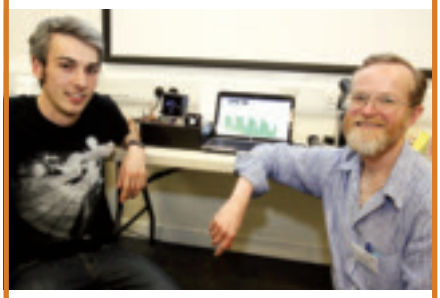
The £40,000 project was part funded through our Impact Acceleration Account (page 6) (£20,000) and match funded by TelLab.

Mark added, *"As well as the hot desk, TelLab and Lancaster University have received funding for a PhD studentship to develop further applications of the sampler and to broaden the range of calibrated priority pollutants and analytical methods. We are also taking part in the Lancaster China Catalyst Programme (page 15) and are collaborating with other companies in LEC."*

www.tellab.ie

Contact Ruth at r.alcock@lancaster.ac.uk or call +44 (0)1524 510285 to collaborate with our environmental researchers.

ALUMNUS SPIN-OUT DEVELOPS APPLICATION AND SCOOPS £0.5M FUNDING



Matt Potts, Co-Director of Tripod Software Limited, and technology consultant Graham Oakes

InfoLab21 resident company Tripod Software Limited had a successful third year, working with Dr Clare Benskin and Dr Eleanor Mackay in the Lancaster Environment Centre to develop a new application, 'Diffuse Pollution.'

Dr Benskin explains, *"Diffuse pollution is closely linked to land use, and concerns the release of potential pollutants that individually may have no effect on the aquatic environment, but combined may have a significant impact. Our work concentrates on reducing nutrient runoff from agricultural land use, and the app enables us to identify 'hotspots' that either increase or reduce diffuse pollution pressures in our catchments."*

Dr Mackay added, *"The app could help the water industry, environmental researchers and consultants interested in recording diffuse pollution pressures associated with agriculture."*

Tripod also won nearly £500,000 to develop an energy saving idea with technology consultant Graham Oakes and formed a new company, Upside Energy Limited.

www.tripodsoftware.com

Contact Helen at h.boulton@lancaster.ac.uk or call +44 (0)1524 510409 for more information.

COMMERCIALISATION OF INTELLECTUAL PROPERTY

Dr Oleg Kolosov, Lancaster Material Analysis Limited

NOVEL ANALYSIS TO REDUCE MANUFACTURING COSTS

This year physicists at Lancaster University have created a spin-out company, Lancaster Material Analysis Limited. The company offers materials analysis services based on a proprietary technique, beam-exit cross-sectional polishing (BEXP), at lower cost than conventional methods such as transmission electron microscopy (TEM).

Developed over four years in the Department of Physics, BEXP could benefit manufacturers of a wide range of high-technology devices, such as lasers, processors, solar cells and LEDs. Rather than producing a conventional cross-section that is perpendicular to the surface of a sample, BEXP uses a modified ion-beam polisher to create a shallow-angled slice through the sample. The cut can be hundreds of micrometres wide, whilst maintaining sub-nanometre roughness right across the area of interest. Adoption of BEXP scanning probe microscopy can reduce the costs of cross-sectional analysis by up to 50%.

> *The introduction of quality control procedures using this technique at early stages of the production process reduces waste and lowers costs. It can also be used in combination with other kinds of analysis, such as X-ray diffraction, to extract even more information.*
>
> Dr Alex Robson, CEO of Lancaster Material Analysis Limited

BEXP was developed by Dr Oleg Kolosov, Dr Manus Hayne, Dr Ilya Grishin and Dr Alex Robson. They have benefited from £10,000 of Impact Acceleration Account (page 6) funding to generate and develop image analysis tools which reduce the cost of services provided by the company and broaden the types of devices they can support.

Contact Mark at m.rushforth@lancaster.ac.uk or call +44 (0)7964 921891 to find out about our work in this area.

> *The university was granted one UK patent, and one US patent, filed applications for 12 new patents, and signed one new technology licence in 2013-2014 as a result of commercialisation activity in the Faculty of Science and Technology.*
>
> Dr Gavin Smith, Intellectual Property Manager, Lancaster University

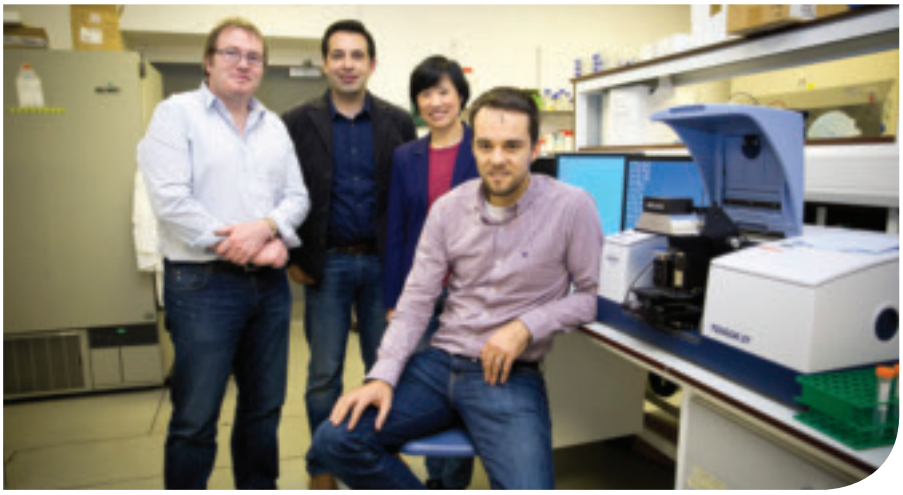
LANCASTER START-UP RECEIVES FUNDING BOOST

Dr John Hardy and Dr Carl Ellis, Hardy & Ellis Inventions Limited

Innovative Lancaster alumni start-up business Hardy & Ellis Inventions Limited beat 100 applicants and won a Technology Strategy Board grant worth more than £70,000 to grow their business.

The pioneering business, based in InfoLab21, was created in 2013 by Dr John Hardy and Dr Carl Ellis to commercialise their PhD research in sensor deployment, 3D mapping, and computer interactions. The prize will allow the company to work with Manchester businesses to install new interactive technology that transforms everyday surfaces and objects into dynamic touch-screen interfaces.

www.heinventions.com



The Novabiomatrix Limited team

NANOBIOTECHNOLOGY SPIN-OUT COMPANY FORMED

In February 2014, members of Lancaster Environment Centre (LEC), Dr Valon Llabjani and Dr Hamid Pouran, formed a spin-out company, Novabiomatrix Limited, to commercialize a new method of growing 3D cells.

Cell culture technology is a multi-billion dollar industry. 3D culture more closely mimics the natural tissues and organs, affords better cell-to-cell communication, and allows multiple cell types to be grown together. However, 2D cell systems are still used routinely for growing cell cultures to help understand diseases such as cancer and to develop new drug treatments. Cells grown on 2D surfaces do not represent the environment of living tissue well, and real-time monitoring of cell changes is difficult, which affects success rates.

The LEC team created a new, cheaper tissue testing device, called 'biovessel'. Instead of growing cells on a 2D surface, they are grown in 3D within a controlled environment - a sealed tube, which can be integrated with existing laboratory devices and allows for real-time live-cell monitoring and measurement of cellular changes and responses. The knowledge gained from the technology could allow for a quicker route to market for medicines, provide better treatment options, and reduce the reliance on animal testing during drug development. It could also provide a different approach for pharmaceutical R&D for human diseases such as Alzheimer's, where animal testing results are not as reliable.

Novabiomatrix Limited, based in LEC, has had additive manufacturing support from the Engineering Department to refine the prototype, a promotional film through a student intern, and ICT consultancy through the School of Computing and Communications. They have also had brand development funded by the Design Council, Technology Strategy Board (Innovate UK) funding for proof of market research, and they are also taking part in the Lancaster China Catalyst Programme (page 15).

"The infrastructure and support given by Lancaster University was critical in getting this project off the ground, helping to translate our laboratory research to develop a device, biovessel, that many are suggesting could be transformative in the area of tissue culture and new medicine development,"
Dr Valon Llabjani, Novabiomatrix Limited.

www.novabiomatrix.com

novabiomatrix

Contact Ruth at r.alcock@lancaster.ac.uk or call +44 (0)1524 510285 to collaborate with our health researchers.

CENTRE FOR GLOBAL ECO-INNOVATION HELPS BUSINESS ENTER US MARKET

InfoLab21 resident company DemoPad Software Limited launched an advanced energy-saving hardware system 'Centro 8' at an electronics fair in Hong Kong in November 2013 thanks to a collaborative research project facilitated by the Centre for Global Eco-Innovation.

Home automation controls business DemoPad is one of 50 companies undertaking three year research projects with the centre, which unites the expertise, resources and global contacts of Lancaster University, the University of Liverpool, and Inventya Limited.

A key part of the development of the 'Centro 8' processor was based on algorithms created by Alex King, Lancaster University graduate researcher from the centre.

DemoPad was also able to open offices in the United States to help promote the Centro 8. Mike Cain, Director, said: *"Our relationship with Lancaster University has been nothing short of transformational."*

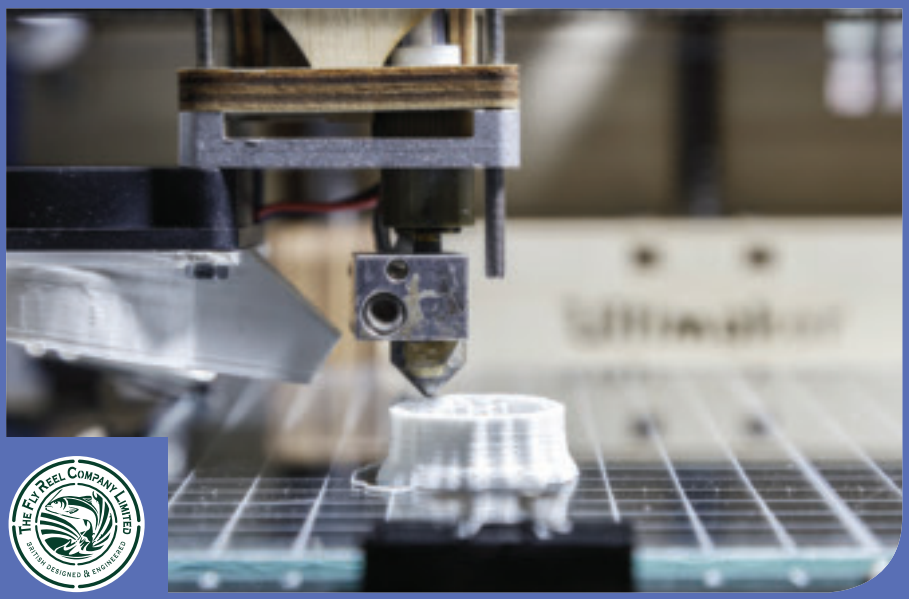
In November 2013, DemoPad received the Judges' Commendation for its ongoing collaboration with the university as a finalist in the Prospect Awards.

The centre, part-financed by the European Regional Development Fund, has assisted 176 businesses in total, including helping ten manufacturing businesses apply for £973,131 funding, and R&D through 65 student projects.

www.demopad.com
www.cgeinnovation.org

Contact Andy at a.pickard@lancaster.ac.uk or call +44 (0)1524 510403 to find out more about the centre.

STUDENT ENGAGEMENT



£1.7M ENGINEERING ACADEMY LAUNCHED

In February 2014, Lancaster University launched the new £1.7 million Engineering Design Academy. The academy was devised to enable small and medium-sized enterprises (SMEs) to access advanced design and additive manufacturing expertise from the Engineering Department.

Shaun Benzon, Mechanical Engineering PhD student and co-founder of The Fly-Reel Company, said:

"We found the conventional route of product development for our RB1 reel was very expensive and time-consuming so we wanted to explore how to develop our latest product in a much quicker and cost-effective way. We were able to use the university's additive manufacturing facilities to produce parts for testing within days, rather than weeks, which is what happens when using traditional machines."

Additive manufacturing or '3D printing' is the term used to describe technologies that build parts layer-by-layer in a variety of materials, allowing increased geometric freedom and customisation. The academy, funded until June 2015, will help to plug skills gaps in the region's engineering sector and boost the performance of more than 128 SMEs, safeguard 90 jobs and help to create 43 jobs in the North West.

To date over 55 businesses have benefited from support from the academy in a range of ways such as accessing students, graduates, engineers, facilities and equipment. Projects included the development of a high end fishing reel with The Fly-Reel Company.

The academy was funded by the European Regional Development Fund, Lancaster University and private sector partners.

www.engineering.lancs.ac.uk
www.theflyreelcompany.co.uk

Contact Chris at c.g.lambert@lancaster.ac.uk or call +44 (0)1524 594383 to develop your products with 3D printing.

"During 2013-2014 we arranged 366 collaborations between students and a wide range of organisations, from regional small and medium enterprises, to international corporates."

Contact Pam at p.pickles@lancaster.ac.uk or call +44 (0)1524 510193 for more information.

INTERNSHIP PROGRAMME ASSISTS 33 BUSINESSES

During summer 2014, 33 businesses benefited from our internship programme. The scheme provides a way for businesses to access students' up-to-date scientific skills and knowledge.

48 students were recruited to work during July-September on a wide range of roles, e.g. database system developer, draftsperson, environmental research consultant, research assistant, ecology consultant and programmer. The majority of internships had all or part of the costs met by funding schemes.

Mark Woodward, Managing Director of The Printed Cup Company Limited, explained, *"We have had several students do great project work for us over the last few years. Computing and communications student Josh helped our business by increasing the functionality of our order tracking system, enabling us to offer a better service to our customers."*

100% of organisations surveyed would recommend the internship programme to other employers. 48% of internship experiences led to further employment for the intern, either with the organisation or with another company. Recruitment is ongoing (page 16).

www.lancaster.ac.uk/sci-tech/internships

Printed Cup Company

NEW SCHOLARSHIPS TO HELP PLUG BIG DATA SKILLS GAP

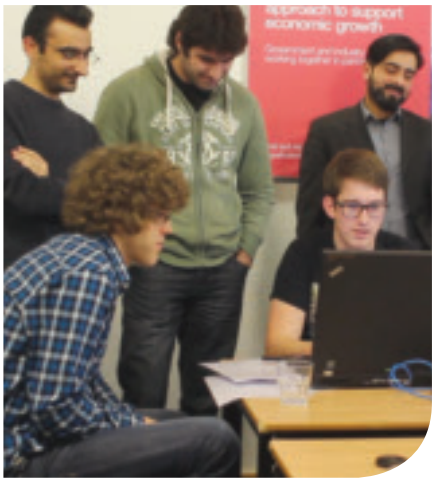
This year the Faculty of Science and Technology at Lancaster launched an innovative data science masters programme to form collaborative partnerships with businesses, transform business data into business advantage, and produce the next generation of data scientists.

The data science team has been recruiting partner organisations to offer business-relevant challenges for 60 Data Science MSc Business Engagement students to address over a three month placement. Each project will be undertaken by an appropriately skilled graduate, supported by experts from the Department of Mathematics and Statistics, the School of Computing and Communications, and the Lancaster Environment Centre. Student expertise includes storing, analysing, integrating and processing complex datasets. £500,000 from the Higher Education Funding Council for England was secured to fund the programme.

www.lancaster.ac.uk/data-science

Contact Simon at s.tomlinson2@lancaster.ac.uk or call +44 (0)1524 510537 to join the programme.

STUDENTS PRODUCE INNOVATIVE CYBER SOLUTIONS



Insider threats and problems associated with policing the Boston Marathon bombings provided tough tests for students from Lancaster University and Newcastle University as part of a special four-day 'Agile Innovation' cyber-security event in February in London.

Rt Honourable David Willetts, Minister for Universities and Science, attended and commented:

"This competition highlights the strength of the UK's academic sector. We have the talent and research capability to solve real-world cyber security problems and produce the technology of the future."

The event was organised by Security Lancaster, hosted by the Department for Business, Innovation and Skills, with input from Raytheon Limited and the Metropolitan Police.

www.security-centre.lancs.ac.uk

Contact Daniel at d.prince@lancaster.ac.uk or call +44 (0)1524 510788 to access cyber security expertise.

RESEARCH TO PREDICT WHEN EMPLOYEES PHONE IN SICK

Researchers in the Department of Mathematics and Statistics embarked on a collaborative project that aims to predict when workers will phone in sick. The work is being conducted as part of a Knowledge Transfer Partnership with risk management company Business Safety Systems Limited. It will result in new models that employers can use to better predict and manage absenteeism in the workplace.

Dr Peter Neal, Department of Mathematics and Statistics, explained, *"We know that by looking at population groups there are key events that can cause greater absenteeism, e.g. large sporting events, flu outbreaks or in bad weather. The modelling of data will allow us to quantify this affect."*

The two-year £136,000 project was part funded by the Technology Strategy Board and Business Safety Systems Limited.

Neil Shotton, Director, Business Safety Systems Limited said: *"We are thrilled that we are able to connect our business creativity with the technical skills from Lancaster."*

www.business-safety.com

Contact Mark at m.rushforth@lancaster.ac.uk or call +44 (0)7964 921891 to work with our mathematicians.

PROFESSIONAL TRAINING AND EVENTS

JBA consulting

NEW COURSES IN FLOOD RISK MANAGEMENT DEVELOPED WITH JBA CONSULTING

In 2013-14 Lancaster Environment Centre (LEC) researchers collaborated with specialist water environment and flood risk management consultancy JBA Consulting to launch a new postgraduate course for water and environmental management professionals.

The demand for specialist flood risk management skills has continued to grow as catchment managers, lead local flood authorities, and other agencies strive to meet their flood risk responsibilities. The new flexible learning programme offers modules on a diverse range of topics. These include 2D flood modelling and hydraulic processes, coastal erosion and flood risk management, forecasting and extreme event response, sustainable floodplain management and sustainable drainage systems design. The majority of modules are delivered at LEC by professional staff from JBA Consulting. Individual modules can also be delivered off-site as short courses to support continuous professional development. The course has been created so that students can work part-time over a maximum of five years towards a Postgraduate Certificate with options to progress to a Postgraduate Diploma.

Dr Nick Chappell, Director of Studies said: *"We are delighted to be able to build on our successful relationships with the UK water sector by offering this exciting new course. JBA and LEC have a long history of working together at the forefront of water research. This partnership will enable students to learn from industry-leading experts in flood risk management within a world class teaching environment."*

Jeremy Benn, Executive Chairman of JBA said:

"By working with LEC, we can offer students a unique opportunity to benefit from LEC's academic excellence combined with the practical experience of JBA staff and the latest industry best practice. We're looking forward to providing flood risk managers with skills and knowledge that can be applied throughout their careers."

www.jbaconsulting.com

Contact Ruth at r.alcock@lancaster.ac.uk or call +44 (0)1524 510285 to find out more.

COURSE CERTIFIED BY UK'S NATIONAL INTELLIGENCE AGENCY

This summer Lancaster University's MSc in Cyber Security became one of only four masters degree courses delivered by UK universities to receive a newly launched 'Full Certification' status by GCHQ. The course is delivered by experts from Security Lancaster, an EPSRC-GCHQ Academic Centre of Excellence in Cyber Security Research.

The certification was announced by Francis Maude, Minister for the Cabinet Office. It reflected the agency's approval of the high standards and abilities with which Lancaster University is equipping its graduates as they help to plug the large skills gap in the ongoing battle against cyber criminals.

Mark Hughes, President of BT Security, said: *"This is a great step forward in developing the cyber specialists of tomorrow."*

Security Lancaster also hosted the annual Cyber Security Conference and created the North West Cyber Security Cluster to highlight the region's technical expertise and raise security standards.

www.security-centre.lancs.ac.uk

Contact Daniel at d.prince@lancaster.ac.uk or call +44 (0)1524 510788 to find out more.

Key speakers at the launch with Professor Mark E. Smith, Vice-Chancellor of Lancaster University

QUANTUM TECHNOLOGY CENTRE LAUNCHED

In May 2014 Lancaster launched the first phase of the Lancaster Quantum Technology Centre (QTC). The centre exploits the behaviour of matter at atomic/sub-atomic levels to create new products for computing, communications, measuring, sensing, and medical diagnostics.

Representatives from government, EDF Energy, BAE Systems, Nokia, NEC Corporation, Alfa Aesar, Avion Oy, e2v and IQE joined academics from Lancaster's UK top-ranked physics department for research quality for the launch conference, exhibition and tour of facilities. Expertise showcased included superconducting quantum circuits, quantum technologies at ultra-low temperatures, semiconductor nanostructures and quantum devices, quantum information, quantum nano-mechanics, and quantum technologies with 2D materials.

Professor Yuri Pashkin, Co-Director of the QTC, said: *"The centre is an important strategic development for the region's economic future through the commercial exploitation of our research."*

www.qtc.lancs.ac.uk

Contact Mark at m.rushforth@lancaster.ac.uk or call +44 (0)7964 921891 for more information.

UNILEVER TRAINS ENVIRONMENTAL RESEARCHERS

Global company Unilever further strengthened its collaboration with the university and taught a masters module to develop the environmental scientists and toxicologists of the future.

The five-week programme on 'Safety and Environmental Impact Assessment: An Industrial Perspective' covered the link between science theory and industry by examining chemical and environmental impact safety assessments. Students were able to receive a unique insight into real-world issues that industry is tackling. The course, organised by Professor Frank Martin in the Lancaster Environment Centre, was delivered exclusively by Unilever scientists who have internationally pioneered state-of-the-art biological approaches that look at the risk from chemical exposures in the environment and in consumer products.

Professor Paul Carmichael from Unilever said: *"We believe this is the first course of its kind. It is a win-win for all involved."*

www.unilever.co.uk

FREE ONLINE COURSE ON FOOD SECURITY

In May 2014 the Lancaster Environment Centre (LEC) launched a new free Massive Open Online Course (MOOC) on Global Food Security which explores how we could feed an extra two billion people by 2050.

Distinguished Professor Bill Davies, CBE, who led the course, along with Dr Jane Taylor, Dr Carly Stevens, and Dr Beccy Whittle, explained *"Food security is one of the grand challenges facing the world today. The whole point of the MOOC is to help people explore some of the interrelationships between the scientific, economic and social considerations that might enable us to feed more people with fewer resources."*

MOOCs are relatively new in the UK and the free eight week online course was only the second created by Lancaster University. Four hundred students signed up on the first day of enrolment and 4,962 people from 115 countries have joined the course so far.

www.futurelearn.com

Contact Ruth at r.alcock@lancaster.ac.uk or call +44 (0)1524 510285 for more information on the course or our work with Unilever.

INTERNATIONAL PARTNERSHIPS


Guangzhou, China

FIRST 15 COMPANIES VISIT CHINA

This year saw the first 15 businesses recruited for the £5.1m Lancaster China Catalyst Programme. The companies operate in a wide range of markets and are looking for Chinese partner organisations for projects as diverse as bio-tech research into pesticides, developing energy storage systems, environmental research for dairy farming and manufacturing of specialist laboratory equipment.

29 MSc International Innovation graduates drawn from science, technology, engineering, design and management disciplines, were recruited to work on these projects.

www.lancaster.ac.uk/china-catalyst

Contact Simone at s.corsi@lancaster.ac.uk or call +44 (0)1524 510799 to develop links with China.

Andrew Walker, Director ADAS added:

"The trip was an excellent first market visit to Guangzhou, which was not only successful from the business point of view, but was also hugely enjoyable from a social perspective, with new contacts and friends made, and genuine prospects of building productive long-term relationships."

www.adas.co.uk

TRANSNATIONAL NANO REGIONS ALLIANCE

The Faculty of Science and Technology at Lancaster is leading UK collaboration in the Nano Regions Alliance (NANORA) a transnational project for nanotechnology small and medium enterprises (SMEs) involving six countries - Germany, Netherlands, Belgium, France, UK, and Ireland.

NANORA was created to facilitate market entrance for nanotechnology SMEs through a transnational linking of regional support schemes and the development of new, transnational support structures and competence pools.

This year the Lancaster team have promoted NANORA across the UK, mapped stakeholders across Europe to build the Transnational Interactive Nanotechnology Competence Atlas (TINCA), and shared relevant regional and national funding schemes across the TINCA.

www.nanora.eu

Contact Martin at m.gilmore@lancaster.ac.uk or call +44 (0)1524 510229 for more information.

KARIM ASSISTS 1,000 SMEs

The Knowledge Acceleration and Responsible Innovation Metanetwork (KARIM) has helped 1,000 small and medium-sized enterprises (SMEs) in North West Europe (NWE) access innovation support and technology.

The KARIM project, which draws to an end in December 2014, linked Lancaster University and eight European business support organisations and universities with businesses across NWE. The project has already supported the development of 110 products, provided access to market foresight information, hosted R&D partnering events, provided innovation and responsible training, supported applications for EU R&D projects which led to €6 million R&D funding leveraged, and facilitated 80 transnational student projects.

"KARIM has enabled SMEs to gain access to knowledge, technology and expertise, not just through their local university but through the wider transnational network across North West Europe. The KARIM network has helped SMEs that want to grow, gain a more competitive edge and helped foster wider developments around responsible innovation."

Dr Ruth Alcock, Lancaster Environment Centre.

www.karimnetwork.com

LOOKING FORWARD TO 2014-2015

Becky Gordon, Operations Manager

DEVELOP A PARTNERSHIP WITH US

Summer internships

Organisations from all sectors are invited to explore the talent of science and technology students and recent graduates through internships between July-September 2015. Students have experience in a range of subjects including chemistry, computing and communications, cyber-security, engineering, environmental science, maths and statistics, physics, and psychology. Some part-funding is available for eligible organisations (page 11).

Additive manufacturing support

Our Engineering Design Academy provides access to advanced design and additive manufacturing technologies to help businesses develop new products and enter new markets (page 11). Support includes funded one-to-one specialist expertise on product development, research and development for prototypes, software/hardware subsidies, and tailored workshops.

Big data opportunities

Use your data to drive better business decisions and gain skills in data mining, programming, statistical modelling, and statistical inference by joining the Data Science Programme (page 12). Our data science students will address your data challenges over a 12-week full or part time placement during June-September 2015.

Access Chinese markets

Join the Lancaster China Catalyst Programme (page 15) to benefit from our links with China and R&D support worth over £70,000 for international development.

EVENTS

Industry seminars

Organisations are invited to hear about science and innovation challenges and network with delegates at our industry seminars. Previous seminars have included representatives from IBM, Unilever, United Utilities, the KTN, QinetiQ, and the BBC (page 4).

InfoLab21 Showcase

Explore cutting edge technology from the School of Computing and Communications research community and resident businesses through seminars, demonstrations and an exhibition on 29th April 2015.

Cyber Security Conference

Increase your knowledge of cyber security on 17th and 18th February 2015 with key representatives from industry and academia in the information security field. Network with like-minded businesses, become more aware of potential threats, and find out about protecting your business.

Catchment Management in Action

This event will bring together a diverse range of scientists, regulators and businesses to understand the challenges of catchment management in practice through field visits around the Eden Catchment in Cumbria. On 5th and 6th March 2015 delegates will explore opportunities for industry and pitch for free summer internships.

"We are always looking to develop new collaborative relationships with external partners. Contact me to explore the different ways we can engage."

Becky Gordon, Operations Manager,
b.gordon@lancaster.ac.uk,
T:+44 (0) 1524 510188

MEASURING OUR PERFORMANCE

In order to measure the success of our strategy for partnerships with business we have developed a series of performance measures. These include the use of qualitative information, for example, case studies such as those featured in this annual report, and quantitative information, for example, independent economic assessments of the impact of our work on individual and groups of businesses, and the wider community.

We also measure the amount of expenditure on our main forms of collaborative activities with business and industry and report this annually on the following activities:

- **Collaborative research** - research undertaken by the university and one, or more, external partners working together. This is primarily supported by public funds but often has cash or in-kind contributions by partners
- **Contract research** - research undertaken by the university which is commissioned by public organisations or business to address a specific research need or outcome
- **Consultancy** - the provision of expert advice by our staff and students
- **Continuing professional development (CPD)** - the delivery of professional training programmes to industry and other users
- **Facilities use** - access to our laboratories, equipment and business co-location facilities
- **Regeneration** - programmes of business innovation support, funded by regional, national and European governments, working with small to medium enterprises to underpin economic growth

The Higher Education Funding Council for England (HEFCE) allocates Higher Education Innovation Funding (HEIF) to fund the university's business partnerships and enterprise activity. Science and Technology was allocated £3.2m of HEIF funding for the period 2011-2015.

Figure 1 reports expenditure as a result of one, or more, business partnerships as a direct result of HEIF investment by Science and Technology.

Figure 2 reports the total expenditure on collaborative activity in the faculty.

By comparing the amount of HEIF funds invested in the previous year against the amount of expenditure on collaborative activities developed using HEIF we can calculate a return on investment. This is shown in Table 1.

Table 2 shows that for 2013-2014 we developed 366 project and placement opportunities for students to work with businesses.

The decrease in the number of student engagement opportunities during 2013/14 was as a result of discontinuing a computing and communications module. Over 1,000 opportunities have been provided to students in the last three years.

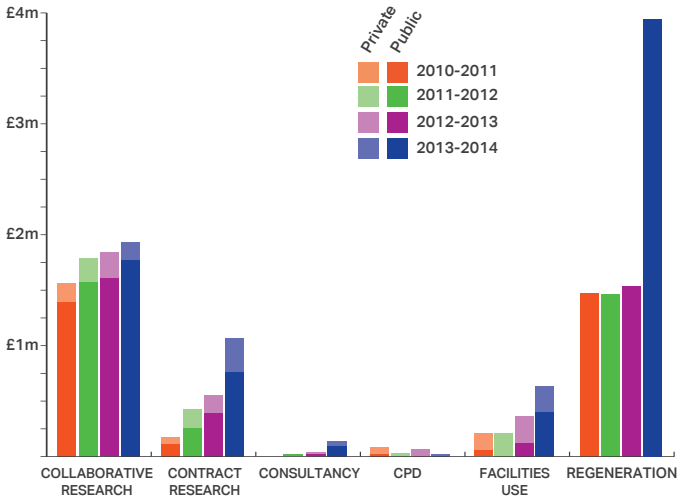


FIGURE 1. Expenditure on collaborative activity from public and private sources as a result of one or more business partnerships developed over the last four academic years.

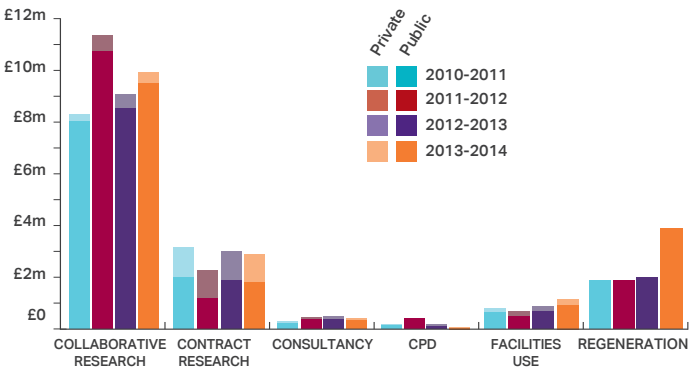


FIGURE 2. Expenditure from public and private sources on collaborative activity with business, industry and other science users over the last four academic years.

YEAR	HEIF EXPENDITURE	INCOME REALISED BY HEIF	ROI
2013-2014	£769,052	£7,726,811	**£10.05**
2012-2013	£665,940	£4,310,152	**£6.47**
2011-2012	£781,733	£3,885,824	**£4.97**
2010-2011	£781,733	£3,415,448	**£4.37**
Benchmark	–	–	**£4.70-£6.70**

TABLE 1. The return on HEIF investment compared to HEFCE-established sector benchmark of smaller, research intensive HEIs. Expenditure on HEIF realised projects is compared with HEIF investment in the previous year to produce the return on investment.

Over the last four years expenditure on business related activities resulting as a direct consequence of one or more business partnerships developed using HEIF funding has increased from £3.4m to £7.7m. A rise in regeneration income plays the most significant part in this increase and remains the major driver of the level of the institution's HEIF allocation. This is most notably due to the Collaborative Technology Access Programme (page 7), the Centre for Global Eco-Innovation (page 10), and the Lancaster China Catalyst Programme (page 15).

An increase in collaborative income during 2013/14, compared to 2012/13, was caused in part by an increase of £112k in the faculty's EPSRC Impact Acceleration Account (page 6), three large scale projects in Maths and Statistics and £164k increase in a low-temperature project in Physics. Contract research and consultancy income has remained relatively steady compared to 2012/13. A reduction in CPD income is due to a reduction of income from short courses in Maths and Statistics and the end of the CCE Heathrow Training in Psychology. Income from facilities use has increased by a third since 2012/13 due to the increased activity from the N8 Industry Innovation Forum and new CPD activity in LEC.

There has been an increased return on HEIF investment from £4 to £10 for every £1 of HEIF funding, compared to 2010/11 (Table 1). This places Science and Technology well above the top end of the sector benchmark for returns on HEIF investment.

HEIF funded activity is estimated to account for up to 42% of the total income from collaborative activities reported in 2013/14 (£7.8m of the £18.4m), up 13% from 2012/13. This level of additionality to income is significantly higher than the top end of the benchmark achievable from HEIF funding reported by comparator institutions (24-33%).[1]

	2011-2012	2012-2013	2013-2014
Computing and Communications	49	79	60
Engineering	69	111	119
Lancaster Environment Centre	124	115	106
Mathematics & Statistics	15	12	18
Physics	0	13	15
Faculty	-	54	48
Total	**256**	**409**	**366**

TABLE 2. Number of individual projects/placements for students working with a business partner.

Reference

1. Public & Corporate Economic Consultants (2009). Evaluation of the effectiveness and role of HEFCE/OSI third stream funding. HEFCE.

BOARD REVIEWS NEW PROGRAMMES

The aim of our Small and Medium Enterprise Strategic Advisory Board is to guide Science and Technology in the progression of its strategy with respect to the development of large scale, often regionally focused, programmes of business collaboration. The emphasis of these programmes is on partnerships with small-to-medium, high growth, science and technology-based companies.

The board met on 17th July 2014 in the Lancaster Environment Centre to review an update on activities over the last year and to discuss the development of new collaborative programmes in Quantum Technology and Cyber Security with industry experts. The board was joined by representatives from Pierre Audoin Consultants Online Limited, Raytheon UK Limited, Veeco Instruments Limited, Thales Group (UK), LCH.Clearnet Group, and Marl International Limited. They also attended the graduation dinner as a guest of the Vice Chancellor.

Members of the board

- **Neil Burns,** Director, Croft Filters Limited, Risley, Warrington, Cheshire
- **Dr Kieth Denison,** Components Business Stream Technical Manager, Oxley Developments Company Limited, Ulverston, Cumbria
- **Dr Amiel Farrington,** Chief Operating Officer, NanoFlex Limited, Daresbury, Cheshire
- **Dr Ben Herbert,** Director of Research & Environment, Stopford Energy and Environment, Ellesmere Port, Cheshire
- **David Hill,** Technical Director, AmDel Medical Limited, Liverpool, Merseyside
- **Dr David Lund,** Head of Research & Development, HW Communications Limited, Lancaster, Lancashire
- **John Walden,** Managing Director, InTouch Limited, Morecambe, Lancashire
- **Paul Wheeler,** General Manager, Isoprime Limited, Cheadle Hulme, Cheadle, Cheshire

The board meeting 17th July 2014

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