

## Building skills for a prosperous nation **EPSRC Centres for Doctoral Training**





# FOREWORD

Professor Philip Nelson  
Chief Executive, EPSRC



Building leadership and skills is a key part of our strategy. We recognise that it is inspirational scientists and engineers who lead excellent research and maximise its impact for the economy. We invest in and nurture the most promising and skilled researchers and innovators, through three doctoral funding routes, Doctoral Training Partnerships, Industrial CASE Studentships and Centres for Doctoral Training. All three doctoral support routes adopt a student-centred approach, enabling them to maximise their contribution within universities, business and other organisations to the creation of a prosperous nation.

In 2013 EPSRC invested around £500 million in 115 Centres for Doctoral Training (CDT), matched by more than £450 million from business, universities and other stakeholders, creating the UK's largest investment in postgraduate training in engineering and physical sciences.

Collectively the centres have brought together diverse areas of expertise to equip engineers and scientists with the skills, knowledge and confidence to tackle current and future challenges.

The CDTs, spread across over 40 UK universities and training over 7,000 students, ensure advances in research in many areas of fundamental science and engineering, as well as providing future leaders in key areas for the UK economy including energy, data science, manufacturing, materials and healthcare technology.

Each Centre trains doctoral students for four years, including technical and transferrable skills training, as well as a research element. They provide a supportive and exciting environment for students, creating new working cultures, building relationships between teams in universities and forging lasting links with industry.

Our engineering and physical sciences Doctoral Training investments are crucial to avoid systemic skills shortages in the UK. Many of the Centres involve research that connects to key industries and important technologies which aid innovation and growth. Over 1,000 industry and charity partners are involved in the Centres, leveraging around £450 million worth of support. A mid-term review of the majority of Centres held in 2017 highlighted the breadth, impact, outstanding best practice and exemplars of the research undertaken so far. The panel said that "EPSRC Centres for Doctoral Training were providing high quality training which was setting the gold standard for cohort-based doctoral training in the UK".

This brochure showcases a selection of research projects being undertaken across EPSRC-supported Centres, from tackling social care challenges using big data (pg 19) to developing innovative applications of DNA sequencing to improve water treatment processes (pg 16). Building on our current investments, we are preparing for a further Centres for Doctoral Training exercise in 2018-19.

## EPSRC Centre for Doctoral Training in Quantitative Non-Destructive Evaluation

Focusing on advanced sensor and imaging technology, the EPSRC Centre for Doctoral Training (CDT) in Quantitative Non-Destructive Evaluation is led by Imperial College London and includes the universities of Bristol, Manchester, Nottingham, Strathclyde and Warwick, with industrial support from large end-users and small/medium-sized enterprises (SMEs). Total planned funding consists of £3.2 million from EPSRC, £5.5 million from industry (cash and in-kind contributions) and £1.4 million from the university partners.

### Seeing Beneath the Sea

- CDT student's work enhances X-ray imaging of subsea pipelines
- Develops faster technique to establish size of pipeline defects
- International collaboration helps build UK capabilities
- Student named one of BBC's 'Women of 2014'

The world's sea beds are home to thousands of miles of pipeline performing a host of vital functions, in conditions that are often challenging and sometimes extremely hostile. The ability to check these pipelines for defects fast and effectively is crucial, especially in a highly competitive sector such as the oil and gas industry.

World-leading oil and gas business BP wanted to improve its capabilities in deep-water digital radiography, specifically to boost the speed and reliability of underwater measurements. This was the trigger for a project undertaken by Misty Haith, a student at the EPSRC CDT in Quantitative Non-Destructive Evaluation.

A significant, unexpected finding was the extent to which seawater and nearby objects 'scatter' the signals and affect the measurements. Not only did Misty discover why this was happening, she also developed a new algorithm enabling the size of pipeline defects to be estimated from relatively small amounts of data – significantly streamlining the whole process.



**“I've been deeply impressed and delighted by the progress that has been made and have very high confidence that this work will have a significant bearing on future inspection of subsea facilities.”**

*BP Industrial Sponsor/Supervisor*

# EPSRC Centre for Doctoral Training in **Bioenergy**

The EPSRC Centre for Doctoral Training (CDT) in Bioenergy at the University of Leeds is addressing the technical, economic, sustainability-related and other challenges involved in generating electricity and heat from biomass and other biological sources. Established in 2014, it is receiving £3.3 million in EPSRC funding and around £0.9 million from the University of Leeds, with just over £0.5 million (plus a similar level of in-kind support) sought from industry and other external sources.

## From Green Verges to Green Energy

- CDT students help confirm energy potential of cut grass from road verges
- Potential new source of income for local authority
- Financial viability and environmental acceptability confirmed
- Options identified to increase financial attractiveness even further

Lincolnshire County Council (LCC) is responsible for maintaining over 6,000km of rural roads, most of which have grass verges currently cut three times a year. In the context of the need to save costs and find new revenue streams, LCC investigated the potential to harvest the cut grass as a feedstock for use in local energy-generating anaerobic digestion (AD) plants.

LCC commissioned the EPSRC CDT in Bioenergy to assess the possibilities. Involving four CDT students – Aaron Brown, Fernando Climent Barba, Judith Ford and Luke Higgins – the project provided two key answers: the proposed operations could be made financially viable; and, with regard to potential environmental contamination, the level of toxins in the cut grass are



Peakhill Associates/Lincolnshire Wildlife Trust

well below required limits. The students presented their conclusions and details of all their analyses to LCC in a comprehensive report.

**Working with Leeds CDT in Bioenergy is providing us with significant research and analysis which is directly informing option development and influencing decision-making for our nationally significant verge biomass project.**

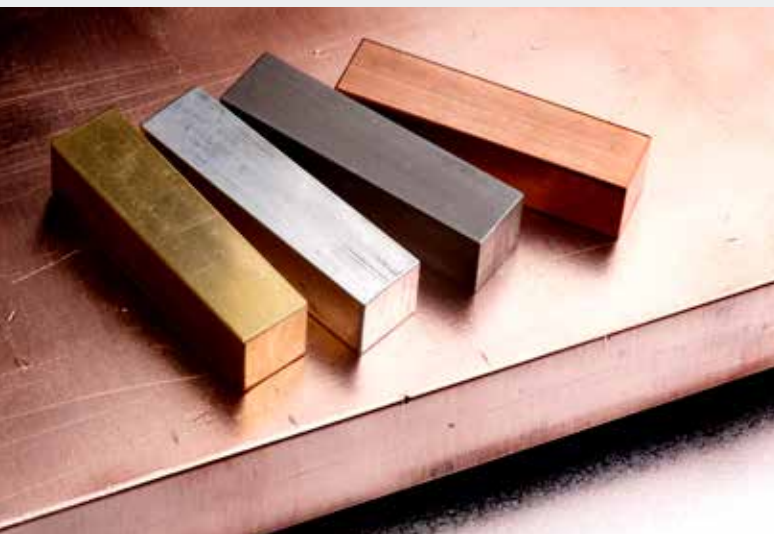
*Douglas Robinson, Lincolnshire County Council*

## EPSRC Centre for Doctoral Training in Industrial Functional Coatings (COATED2)

The EPSRC Centre for Doctoral Training (CDT) in Industrial Functional Coatings (also known as COATED2) at Swansea University is a £6.5 million initiative. This includes £2.5 million in funding from EPSRC, with a range of multinational companies also supporting the centre.

### Waste Coats Solar Cells

- CDT student recovers precious metals from electronic devices
- Metals can be used in vital coatings for solar cells
- Potential solution to problem of precious metal procurement
- Research has fed into Welsh Government policy



Precious and heavy metals such as platinum, palladium, gold, silver and copper are a key component in the coatings that enable solar cells to generate electricity efficiently. They are, however, becoming increasingly scarce as well as more expensive to procure. Pioneering research at the EPSRC CDT in Industrial Functional Coatings has revealed that waste electronic devices (eg laptops, tablets and mobile phones) could provide a viable alternative source of these metals.

In a project sponsored by METech Recycling Ltd, a provider of full-lifecycle electronic equipment management services, CDT student Rhys Charles demonstrated how platinum can be recovered from electronic devices in the form of chloroplatinic acid. This acid is used in solar cell manufacture to deposit a transparent layer of platinum on the cells, which then controls the chemical reactions and enables the cells to produce power. The Welsh Government has now utilised Rhys's knowledge and expertise to inform its policy on the circular economy.

**“ Rhys's time spent with us which had a huge impact on how our business performed. From his analysis of materials we were able to find the right end-process with the maximum financial and environmental return possible. Rhys's research also opened doors for METech to participate in large-scale funded projects run by organisations such as the Waste and Resources Action Programme (WRAP). ”**

*Gareth Liversage, formerly Site Manager, METech Recycling Ltd*

## EPSRC Centre for Doctoral Training in Future Infrastructure and Built Environment

The EPSRC Centre for Doctoral Training (CDT) in Future Infrastructure and Built Environment at the University of Cambridge aims to develop world-class multidisciplinary engineers equipped to face current and future challenges related to infrastructure and the built environment. Its range of industrial partners work closely with the Centre to shape its training programme and ensure this meets the UK's skills requirements. The Centre is receiving EPSRC funding of £4.2 million and nearly £5 million in industrial support.

### The Route to Smart Roads

- Cambridge CDT students evaluate technology to make roads safer
- Highlight potential multi-million-pound business opportunity
- Inform acquisition policy of leading UK engineering company
- Advise company on technology roll-out strategy

Vehicle-to-vehicle and vehicle-to-'cloud' communication will be pivotal to improving traffic management and road safety on the UK's increasingly busy road network. To help inform its entry into this emerging market, construction and civil engineering company Costain asked students at the University of Cambridge EPSRC CDT in Future Infrastructure and Built Environment to assess the feasibility of introducing Radio Frequency Identification for vehicles.

The students advised Costain, a key industrial partner at the Centre, to form a spinout company with a leading UK telecoms firm and a major multinational technology company, and to introduce the technology initially in a 'closed-loop' environment (eg airports) before rolling it



out across the entire UK road network. Their final report formed part of the platform of evidence that, in July 2016, led the Costain board to decide to acquire SSL (Secure Sockets Layer), specialists in the development of traffic monitoring technology.

**“ The teams emerging from the CDT will be the next-generation business leaders who will solve some of the most pressing challenges faced by the infrastructure sector. It's vitally important that industry has a pipeline of innovation emerging from research relationships with experienced people with the knowledge to implement solutions. The CDT is meeting this need.**

*Tim Embley, Innovation Director, Costain*

## EPSRC and AHRC Centre for Doctoral Training in Media and Arts Technology

A joint EPSRC and Arts and Humanities Research Council (AHRC) initiative, the Centre for Doctoral Training (CDT) in Media and Arts Technology at Queen Mary University of London (QMUL) equips its students to become skilled researchers and practitioners at the intersection of science, technology, digital media and the arts. Since its establishment, total Research Council funding/support of £9.9 million has been supplemented by a QMUL contribution valued at £3.8 million, plus China Scholarship Council awards for three students totalling nearly £0.2 million.

### Movie Music Magic

- CDT student develops pioneering technology to enhance mood music in films
- High-tech glove makes it possible to 'feel' music in movies
- Induces simple emotions that tie-in with the action
- Showcased at high-profile international exhibitions and conferences



For the hearing impaired, watching a movie like the 1993 classic 'The Piano' can be very frustrating. Subtitles make it easy enough to follow the dialogue and plot, but the inability to experience the music – often so important to a film – means much of the emotional content is inevitably lost. Antonella Mazzoni, a student at the EPSRC/AHRC CDT in Media and Arts Technology, set out to tackle the problem.

Her 'Feel the Sound' project looked at how music is used in movies to enhance both mood and emotions, and how enriching the musical experience of audiences might also have implications for hearing impaired people, providing them with a new, enhanced emotional experience while watching a film.

Antonella's aim was to find a solution that was not only affordable but also allowed users a degree of freedom of movement and avoided the need to confine themselves to a particular chair. The result was a ground-breaking piece of wearable digital technology – a glove inducing simple emotions (eg calmness, happiness, sadness and alarm) that tie-in with the action unfolding on the screen.

**It's something that I'd like to experience again. In some of the clips it was complementing what I was seeing a lot – it was really interesting to have something which is feeling the way you're feeling and mirroring it.**

*Participant in device trials*



## EPSRC Centre for Doctoral Training in **Medical Imaging**

The EPSRC Centre for Doctoral Training (CDT) in Medical Imaging, managed by King's College London and Imperial College London, provides a comprehensive programme specifically designed to meet key healthcare challenges. Supported by £4.8 million in EPSRC funding and £1.2 million in income from industry, it has links with a range of industrial partners as well as close strategic and geographical links with London's St Thomas' Hospital, where the Centre is based.

### **New Cancer Tracer Promises Fast-Track Production**

- CDT student develops new tracer to help diagnose prostate cancer
- Quick, easy and cost-effective to produce
- Potential to improve patient access to high-quality scans
- First in-body trials produce promising results

The ability to image prostate cancer – the most common form of cancer affecting men in the UK – is a crucial tool in its diagnosis. Supported by UK pharma company Theragnostics, Jennifer Young, a student at the EPSRC CDT in Medical Imaging, is developing novel 'tracers' that will increase both the accuracy and the accessibility of Positron Emission Tomography (PET) imaging used in this application.

Tracers are substances introduced into a patient's body and then tracked as they move through it, and are a key element in many medical imaging techniques. Building on previous collaborative work between King's College London and Theragnostics, and working with her supervisors Phil Blower and Greg Mullen, Jennifer's research has now progressed from lab bench to bedside and resulted in a new PET tracer that accumulates in prostate cancer cells and can be produced very quickly and easily in a radio-pharmacy using a one-step radiopharmaceutical kit. This means production of the tracer need not be confined to leading research hospitals.



**“ The work opens up the possibility of being able to offer high-quality diagnostic scans for prostate cancer using PET without the need for expensive and highly technical cyclotron facilities. This means patients anywhere in the country, not just those near to big centres, could have these diagnostic scans.**

*Dr Maggie Cooper, Chief Radiopharmacist, Royal Liverpool University Hospital*

## EPSRC Centre for Doctoral Training in **Analysis and its Applications (MIGSAA)**

Jointly operated by the University of Edinburgh and Heriot-Watt University, MIGSAA delivers doctoral training in theory, stochastics, numerics and applications to develop skillsets that can tackle sophisticated challenges in industry, commerce and academia. It is receiving total EPSRC funding of £4.5 million and £0.4 million in support from the Scottish Funding Council (SFC). Collaboration with industry is a critical component.

### Maths Adds New Dimension to Tuberculosis Management

- CDT student develops model to monitor tuberculosis (TB) in wild boar
- Model supports pioneering vaccination trial in Spain
- Work will inform policy/practice to reduce threat to farm livestock
- Highlights potential to harness models to manage other diseases

TB is a disease that poses a particular danger to the dairy industry as infected cattle must be slaughtered to prevent transmission. It is much harder, however, to manage TB in wildlife species, which can act as a source of infection and a 'reservoir' enabling the disease to persist. In Spain and other parts of the world, wild boar are a key reservoir species.



Nora Tanner, a PhD student at the Maxwell Institute Graduate School in Analysis and its Applications (MIGSAA) – an EPSRC CDT, is exploring how mathematical models could be utilised to help manage infectious diseases and minimise their impact. Her work has included collaborating with IREC (Spain's National Institute for Game and Wildlife Research) to develop a model focusing on the prevalence of TB in populations of wild boar. The project confirmed the contribution that such models can make to supporting vaccination programmes and to tackling the spread of TB and other infectious diseases worldwide.

**This innovative research has been invaluable in explaining how the prevalence of TB will change in response to vaccination. The work will have practical implications for policy and practice in the management of this important disease.**

*Christian Gortázar, Head of the Health and Biotechnology Research Group, IREC*

# EPSRC Centre for Doctoral Training in Micro- and NanoMaterials and Technologies

The EPSRC Centre for Doctoral Training (CDT) in Micro- and NanoMaterials and Technologies at the University of Surrey sets out to solve academically challenging, industrially relevant problems through a profound understanding of the relationships between materials' microstructure, their properties and the processing techniques used to fabricate them. The CDT, funded in 2014 for eight years, is currently receiving £3 million in support from EPSRC matched by a further £3 million from industry. Originally established in 2009, the Centre has been working with a multitude of industrial partners in different sectors to address industrially relevant challenges through its expertise in materials engineering.

## Detectors with the X Factor

- CDT students help to deliver leading-edge detection technologies
- Key aspects of X-ray detector performance improved
- World-leading range of detectors developed as a result
- UK's position boosted in global scientific instrumentation markets

Detection technologies are a distinctive, defining feature of modern society. At the heart of scientific instruments used in fields as diverse as medical imaging and airport security, they make a critical economic, social and environmental contribution, and the drive to develop improved detectors is relentless. The Science and Technology Facilities Council's (STFC's) Rutherford Appleton Laboratory (RAL) is at the vanguard of this work, developing cutting-edge instruments based on X-rays and other types of ionising radiation and achieving significant improvements to key specifications (eg spatial resolution, energy resolution, signal-to-noise ratio).

Three University of Surrey students from the EPSRC CDT in Micro- and NanoMaterials and Technologies – Steven Bell, Diana Duarte and Sion Richards – have worked within the RAL team, contributing to advances in crucial aspects of X-ray detector performance. This has helped to ensure that, through the EPSRC-funded HEXITEC (High Energy X-ray Imaging Technology) collaboration, RAL has been able to produce a world-leading range of small pixel X-ray imaging detectors, now offered commercially by spinout company Quantum Detectors.



**The CDT has provided our Detector Development Group with three excellent students who have advanced our programme. For example, HEXITEC has benefited from this work and is now delivering detectors to science facilities worldwide and commercialising X-ray products.**

*Paul Seller, Detector Development Group Leader, RAL*

## EPSRC Centre for Doctoral Training in **Neurotechnology for Life and Health**

The EPSRC Centre for Doctoral Training (CDT) in Neurotechnology for Life and Health at Imperial College London is training a new generation of multidisciplinary researchers at the interface of neuroscience and engineering. The Centre, which involves 20 partners from industry and the charitable sector plus satellite research groups at the Crick Institute and the University of Oxford, is receiving £4.2 million in EPSRC funding with Imperial College so far committing a further £2 million and industry £0.4 million, plus total funding to date of just under £0.4 million from a range of other sources.

### Getting a Grip on Stroke Rehabilitation

- CDT student develops key software for ground-breaking gripAble™ device
- Device provides bedside hand and brain training for patients
- Delivers better patient outcomes and valuable savings in healthcare costs
- Start-up company aims to commercialise device in 2017

gripAble™ is a low-cost, easy-to-use device designed to improve arm and brain function for patients with stroke-

related and other disabilities. Developed at Imperial College London with the Royal College of Art and the Imperial NHS Stroke Unit, and measuring grip strength, hand opening and arm movement, it can be used in hospitals, rehabilitation centres or patients' own homes.

Rajinder Lotay, a student at the EPSRC CDT in Neurotechnology for Life and Health, has made a vital contribution by helping to develop and trial software optimising the way that patients using the device learn novel dexterity tasks which improve arm function. He has also developed an automated method of quantifying upper and lower arm function that compares favourably with conventional clinical ratings based on physicians' assessments. A spinout company, gripAble Ltd, has now been set up to take the prototype device through to full commercialisation.

**» The movement of my hand has been a lot better since I've been using gripAble.**

*Barry Wells, stroke patient*



## EPSRC Centre for Doctoral Training in Condensed Matter Physics

The EPSRC Scottish Centre for Doctoral Training (CDT) in Condensed Matter Physics is a collaboration between St Andrews, Edinburgh and Heriot-Watt universities, spanning the full breadth of condensed matter from exotic materials relevant to future quantum computers to liquid crystals used in smartphone displays. Established in 2008, the CDT has current funding of just under £4 million from EPSRC, with commitments (cash and in-kind) from industrial associates and overseas academic partners of around £1.5 million.

### Securing Innovation in Organic Semiconductors

- CDT students boost development of new-generation organic semiconductors
- Theory and experiments combine to drive progress
- Potential applications in healthcare, sensing and electronics markets
- New facility enables fabrication of innovative devices

Easy to fabricate, relatively non-toxic and highly customisable, semiconductors made from carbon-based materials offer huge potential to underpin cheap, flexible solutions for a range of real-world applications – from TVs, smartphones and other electronic devices to fields such as healthcare and sensing. To date, nine students from the EPSRC Scottish CDT in Condensed Matter Physics have worked in this fast-evolving sphere of research, helping to deliver the important breakthroughs needed to unlock the technology's possibilities.

To take one example, the work of five CDT students has substantially strengthened a longstanding collaboration between experimental groups at the University of St Andrews and theory-focused researchers at Heriot-Watt University, with industrial collaborators such as Cambridge Display Technology also contributing. A further dimension to the CDT's work has been provided by a new Atomic Layer Deposition facility, funded partly through EPSRC's CDT capital equipment call, enabling fabrication of a new range of organic semiconductor devices.



▀▀ **Whilst a student in the CDT, I belonged to a research group that commercialised organic semiconductor inventions. I became interested in commercialising research which ultimately led us to found Razorbill Instruments in 2014.**

*Dr Alex Ward, Managing Director, Razorbill Instruments (a graduate and industrial associate of the CDT)*

## EPSRC Centre for Doctoral Training in **Advanced Metallic Systems**

Jointly hosted by the universities of Sheffield and Manchester, the EPSRC Centre for Doctoral Training (CDT) in Advanced Metallic Systems covers all aspects of metallic materials engineering required by advanced manufacturing to deliver high-performance innovative products. The CDT was established in 2009 with a £6.3 million investment from EPSRC, with a further £3.2 million awarded in 2014.

### A public 'Monopoly'

- EPSRC Centre for Doctoral Training students devise Monopoly-style board game about materials
- Raises the profile of materials science and engineering in schools
- Over 750 UK secondary schools already using the game
- First customised Monopoly-style game to be used for educational purposes

To engage and enthuse the public about materials science and engineering, six students at the EPSRC CDT in Advanced Metallic Systems developed 'Monopoly: the Materials Edition'. The game is played just like traditional Monopoly but, as they travel round the board, instead of trading property the players buy materials such as metals, ceramics and composites. Investing in R&D enables them to buy laboratories and research centres to upgrade their materials – for example, turning the steel in paperclips into skyscrapers – while special cards provide information about different materials and technologies.

Following the game's initial showcasing at the 2012 Cheltenham Science Festival, around 1,350 sets have now been distributed to secondary schools across the UK. Each school may request up to five sets. The game is mostly used by teachers of physics, chemistry, design and technology, product design, engineering and resistant materials courses. Feedback has been excellent and has enabled further refinement of the game. Schools in Mexico, Peru, Hong Kong and Australia have also requested sets.



**They love it. Had to kick the Sixth Form out at the end of term because they wouldn't stop playing!**

*Amy Handley, science teacher, North Chadderton School*

## EPSRC Centre for Doctoral Training in Systems Approaches to Biomedical Science

Located at the University of Oxford, the EPSRC/Medical Research Council (MRC) Centre for Doctoral Training (CDT) in Systems Approaches to Biomedical Science is helping to underpin the UK's competitiveness in biomedical technologies. It has received a total of over £10 million in Research Council funding, as well as over £3.4 million committed by industry (plus in-kind contributions) since the programme began in 2009.

### Students' Software Aids Drug Discovery

- CDT students develop innovative software for pharma companies
- Software pinpoints properties of antibodies with therapeutic potential
- Makes drug discovery/development faster and more efficient
- Innovative business model maximises benefits for pharma firms

The race is on to develop new-generation drugs – and the University of Oxford is equipping pharma companies with innovative tools to speed up the process. With key input from students at the EPSRC/MRC CDT in Systems Approaches to Biomedical Science, Professor Charlotte Deane's Protein Informatics Group is developing new ways of probing the structures and properties of antibodies, an important class of proteins of particular interest to drug discovery.

Despite antibodies' huge potential to be harnessed in a variety of therapies, the vast numbers that could be considered for such use make it very time-consuming to identify the most promising. The CDT students have therefore developed (and are continuing to refine) software that models antibodies in three dimensions and predicts their properties. Pharma companies can use the software to prioritise antibodies for investigation, or to design entirely new ones. A former CDT student, Konrad Krawczyk, is now part of the Deane group and is adapting the software to industrial partners' needs.



**■ The Impact Software Engineer Service model is an extremely powerful way to translate innovative science into tangible impact on drug discovery projects. Timely delivery of new capabilities means faster delivery of relief to patients.**

*Jiye Shi, Fellow and Senior Director, UCB Pharma*

## EPSRC Centre for Doctoral Training in Science and Engineering in Arts, Heritage and Archaeology (SEAHA)

SEAHA is an eight-year initiative (2014-22) delivered by UCL, the University of Oxford and the University of Brighton. Addressing challenges set by the heritage sector, industry and government, it is receiving a total of £4.7 million in EPSRC support. To date, this has been supplemented by £1 million from the three partner universities and £1 million from industry and charities, plus an in-kind contribution of £1.3 million from industry.

### A Scent of History

- CDT student boosts understanding of long-gone smells
- 'Odour wheels' developed for public and expert use
- Visitor experience enhanced at National Trust properties
- Work captures imagination of global media

Our interaction with museum exhibits, stately homes and other survivals from the past has always been a largely

visual experience. Yet our sense of smell significantly affects the way we see the world – and that includes our understanding and appreciation of our cultural heritage. Cecilia Bembibre, a student at the EPSRC CDT in Science and Engineering in Arts, Heritage and Archaeology (SEAHA), set out to develop a new framework to identify, analyse, document and archive smells with cultural value, such as that of historic books.



Based at the Institute for Sustainable Heritage at UCL, and in partnership with The National Trust and odour research consultants Odournet, Cecilia harnessed a range of scientific techniques to help unlock the mysteries of historic smells and catalogue current smells as olfactory heritage for the future. She also developed 'odour wheels' that can be used to sample different smells from the past. The National Trust has, for instance, integrated aspects of her project into the visitor experience at Knole House, a 600-year-old property in Kent, in the form of 'smellwalks'.

**Using all our senses is essential to fully understand heritage collections and spaces. Cecilia's project has sparked a huge amount of interest here at Knole and we're using her research in our new interpretation scheme in our Conservation Studio.**

*Siobhan Barratt, Conservation Studio Manager, Knole House*



## EPSRC Centre for Doctoral Training in **Physical Sciences for Health**

The EPSRC Centre for Doctoral Training (CDT) in Physical Sciences for Health (Sci-Phy-4-Health) at the University of Birmingham focuses on research at the interface between chemical, physical, biomedical, engineering and computer science. Accepting its first intake of students in 2014 and funded until 2022, it is receiving £3.5 million in support from EPSRC (60 per cent) and co-funding from the University of Birmingham and 24 project partners, including small and large companies, hospitals and other public sector organisations.

### Fresh Tools for Cleaner Teeth

- CDT student helps to optimise plaque-removal technique
- Highly effective and more comfortable for patients
- New, improved tools for dentists now under development
- Student secures multiple awards for her work

Removing plaque – the biofilm of bacteria that forms on teeth and along gumlines – is vital in preventing cavities and gum disease. Nina Vyas, a student at the EPSRC CDT in Physical Sciences for Health, has generated new insights now being taken forward with instrument manufacturers to produce tools that enable dentists to tackle the problem more effectively.

Working with clinicians at Birmingham Dental Hospital

**►► Nina Vyas's work explains why you must adapt an ultrasonic insert accurately. Ultrasonic scalers produce bubbles which expand and collapse rapidly, creating powerful suction, spiralling the biofilm from the teeth and into the vortex of the collapsing bubble. All this happens without touching the tooth surface!**

*Marilyn Goulding, Manager of Clinical Research, Dentsply Sirona*



and academic colleagues from a breadth of disciplines, Nina's research showed how the use of ultrasonic scalers to remove plaque can be optimised while also making the process more comfortable for patients. Key to this was high-speed imaging of the process at a million frames per second, which made it possible to understand in unprecedented detail exactly what happens around the tips of ultrasonic scalers. The insights generated have been taken to teaching institutes and used to educate clinicians and hygienists on the more effective use of these scalers, while Unilever is supporting further development of specific aspects of Nina's work.

## EPSRC Centre for Doctoral Training in Engineering for the Water Sector (STREAM IDC)

With the goal of improving the water sector's ability to provide safe, efficient water/wastewater services and reduce its carbon footprint, STREAM is coordinated by Cranfield University and includes Imperial College London and the universities of Sheffield, Newcastle and Exeter. Its first tranche of funding has included £6.4 million in EPSRC support and a total of around £4 million in support (cash and in-kind) from 22 companies that have sponsored projects.

### Clean Breakthrough in Water Treatment

- EngD student develops innovative application of DNA sequencing
- Technique enables improvements in water treatment processes
- Can help cut energy use at treatment plants, reducing costs and carbon
- Successful start-up company formed based on the research

A breakthrough in the use of DNA sequencing – a technique that pinpoints the precise order of nucleotides in DNA molecules – is boosting the efficiency and cost-effectiveness of wastewater treatment. Sponsored by Northumbrian Water, Scottish Water, United Utilities and WRc, Gregg Icton, a student at STREAM Industrial Doctorate Centre (IDC) – the EPSRC Centre for Doctoral Training (CDT)

in Engineering for the Water Sector, showed how this approach can help to monitor key sewage sludge treatment processes and track sources of microbes in surface water.

The technique can be used not simply to monitor bacteria more accurately but also to categorise treatment plants as over-aerated, under-aerated or optimally aerated – potentially leading to cost and carbon reductions through lower energy consumption. The three water companies are translating the research into operational use, while Gregg has set up spinout company Prokarya to provide services that enable detection and source-tracking of bacteria from faeces and so help to improve bathing-water quality as well as water treatment processes.



**Gregg's research greatly helped Northumbrian Water's business. He both further developed and improved the sequencing technique so it can be more widely used in the industry, then specifically worked on our bathing-water quality projects, assessing where pollution originated, and assisted in making sure investment was most successfully targeted.**

*Andrew Moore, Wastewater Research Coordinator, Northumbrian Water*

## EPSRC Centre for Doctoral Training in Urban Science and Progress

The EPSRC Centre for Doctoral Training (CDT) in Urban Science and Progress at the University of Warwick trains scientists to harvest and process big data in order to develop a better understanding of the science of cities, and to apply that knowledge to identify smart solutions to urban problems. It is receiving around £4 million in funding from EPSRC and has raised a further £2 million in support from other sources.

### Big Data Boosts Social Care

- CDT students use data analytics to highlight social care challenges
- Europe's largest local authority harnesses findings to tackle areas of concern
- Potential to improve social service delivery for vulnerable adults and children in Birmingham
- Case study highlights use of big/open data to transform public services

With urban populations growing and cities facing financial pressures, local authorities need to find innovative, cost-effective ways to enhance delivery of the services they provide. To help address the challenges facing the UK's second largest city, Birmingham City Council asked the EPSRC CDT in Urban Science and Progress to explore whether, consistent with individual privacy, personal social care records could be analysed to strengthen delivery of services targeting vulnerable children and adults.

The work revealed, for example, that a transition in the contractual framework underpinning provision of home-support services had led to a small increase in service uptake in central Birmingham but a significant drop in the north of the city. The use of personal data attributes

(eg gender, ethnicity) also enabled the research to analyse take-up of services over time to different communities within the city. The overall result was a clear demonstration that, by mining big data, local authorities can more easily pinpoint problems, plan, set budgets and undertake more effective interventions benefiting those entitled to receive social care and other services.



**Using data in this way, to understand trends in the costs of services, has been eye-opening, particularly in understanding the changes over time and the impact of decisions over time.**

*Jon Warlow, Director of Finance, Birmingham City Council*

## EPSRC Centre for Doctoral Training in Virtual Environments, Interaction and Visualisation

The UCL Centre for Virtual Environments, Interaction and Visualisation focuses on projects that advance the science & engineering of computational capture, rendering and simulation in a diverse range of applications. EPSRC has supported over 100 students on its doctoral programmes since 2001, with total funding to date of £7.8 million. A wide range of companies also support the programmes as industrial sponsors, with non-EPSRC support totalling £10.2 million (cash and in-kind).

### Buildings Built on Better Collaboration

- Doctoral student designs game-changing software for architects and engineers
- Software provides access to complex 3D building plans via Internet
- Makes collaboration easier and more productive
- Contributed to new Government mandate on public-sector construction

Ensuring effective control and distribution of different versions of a document is a problem common to many

industries. It is particularly acute in the architectural and building design sector, where 3D architectural and engineering plans have to be accessed and edited in real-time by professionals with different skills and qualifications, using different tools.

Working closely with UK-based multinational Arup and with UCL's Professor Anthony Steed, Jozef Dobos – an EPSRC-funded doctoral student at the UCL Centre for Virtual Environments, Interaction and Visualisation – has developed 3D Repo to tackle the problem. This open-source software stores multiple versions of 3D models and enables different versions to be accessed, compared and marked-up via the Internet.

It has already had a huge impact on the sector and helped to shape a Government mandate on the modelling of building information for all public-sector construction projects from 2016. Jozef has won many awards for his work and has now launched spinout company 3D Repo Ltd, which has already worked on assignments for Crossrail, Highways England and Canary Wharf, for example.



**Version control isn't the limit of 3D Repo's potential value. Currently, the building design process is desktop-based, which makes collaboration with project stakeholders cumbersome. With the process online, fluid and well-informed contributions from all stakeholders can deliver better designs.**

*Alvise Simondetti, Global Leader Virtual Design, Arup*

## EPSRC Centre for Doctoral Training in **Cloud Computing for Big Data**

The EPSRC Centre for Doctoral Training (CDT) in Cloud Computing for Big Data at Newcastle University is tackling an acute global skills shortage by training the next generation of experts in the analysis of big data using advanced statistical methodologies and cloud computing technology. With total funding of £5 million, it is receiving £3.4 million in EPSRC support and £1.6 million from Newcastle University, with additional sponsorship from Microsoft, Red Hat, AkzoNobel and the Savas Parastatidis Foundation.

### Harnessing a Sea of Data

- CDT students help multinational company mine value from big data
- New insights generated into shipping sector
- Combination of computing and statistical methods utilised
- Visualisation and animation techniques make data more comprehensible

Major multinational AkzoNobel operates in a range of markets, including decorative paints, performance coatings and speciality chemicals. To explore how the huge data mountains generated by the company could be exploited to support its activities in the ship paint sector, AkzoNobel approached the EPSRC CDT in Cloud Computing for Big Data.

The aim was to assess the feasibility of extracting value from data on the position of every ship worldwide (information collected every 15 minutes) and on which ships were coated with AkzoNobel paints. A team of four CDT students undertook the project, analysing the data in the 'cloud' over an eight-week period. This produced valuable findings that the company could harness



to inform its commercial strategies and help shape its decision-making as it sought to expand its share of the ship paint market. As well as producing insights into vessel movements over time, the students developed a clear understanding of the skills needed to tackle data cleansing/modelling and of different challenges and priorities relating to the utilisation of data resources in future.

**» The CDT in Cloud Computing for Big Data helped us understand the kinds of skills we need in order to obtain value from our data, as well as providing actionable insight for us to prioritise. We're already investing in the Centre and hope this is the start of a long and fruitful relationship.**

*Richie Ramsden, Section Leader Functional Surfaces – Data Insight Team, AkzoNobel*

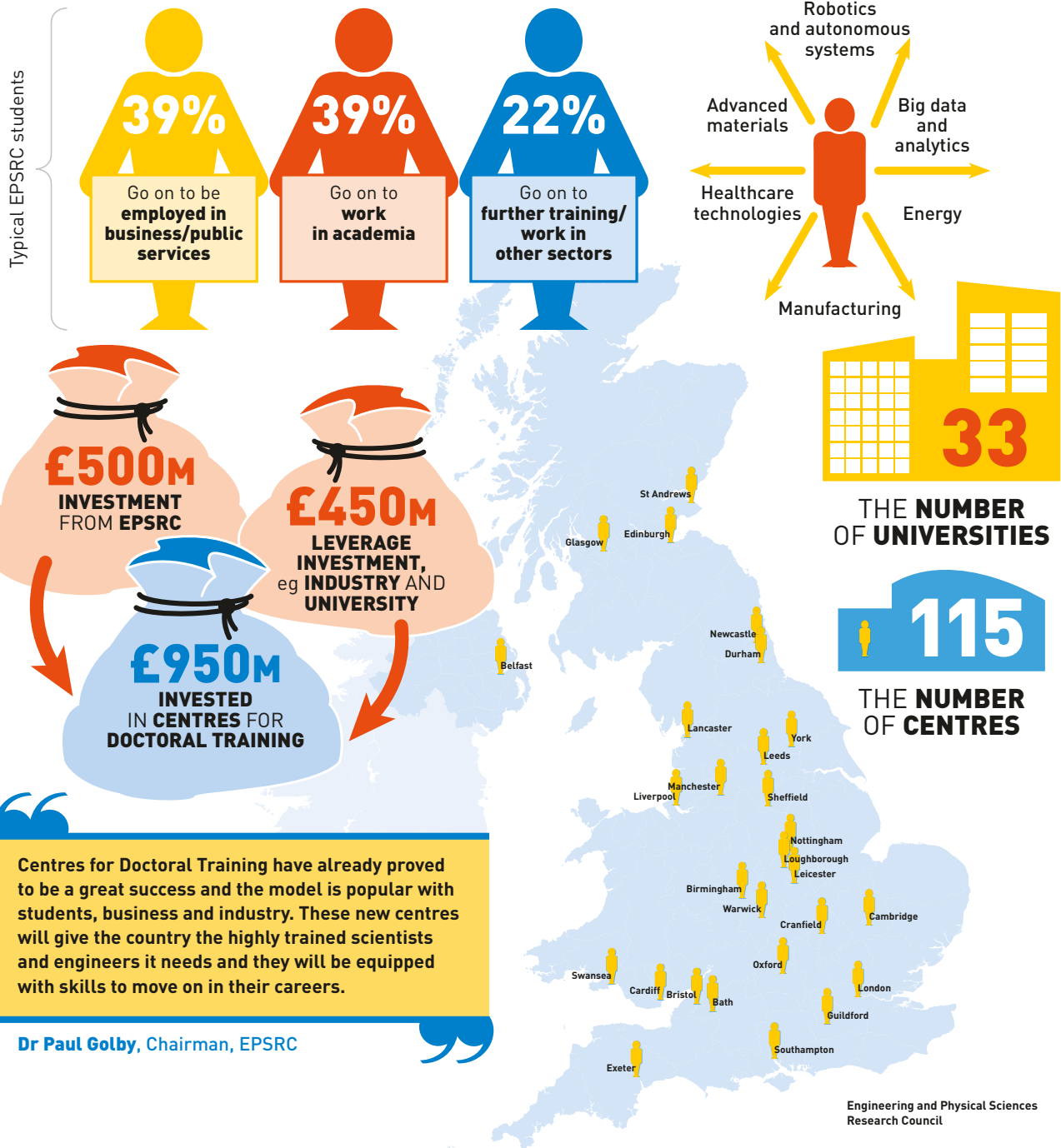
# EPSRC Centres for Doctoral Training – the facts

**7,000+**  
THE NUMBER OF STUDENTS THAT WILL BE TRAINED IN THE CENTRES

Scientists and engineers are vital to our economy and society. It is their talent and imagination, as well as their knowledge and skills, that inspire innovation and drive growth across a range of sectors, from manufacturing to financial services.

Rt Hon David Willetts

**1,100**  
NUMBER OF PARTNERING COMPANIES



Centres for Doctoral Training have already proved to be a great success and the model is popular with students, business and industry. These new centres will give the country the highly trained scientists and engineers it needs and they will be equipped with skills to move on in their careers.

Dr Paul Golby, Chairman, EPSRC

Engineering and Physical Sciences Research Council



