

Faculty of Engineering  
The University of Nottingham  
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Nottingham, NG7 2RD

w: [www.nottingham.ac.uk/engineering](http://www.nottingham.ac.uk/engineering)

Faculty of Engineering

## Working with engineers at Nottingham: A guide for industry



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Students outside the Trent Building,  
University park Campus

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Front cover: Postgraduate student Archi Sarroza working on a drop tube furnace in the EFET Centre.

# About the University

The University of Nottingham, described by The Sunday Times University Guide 2014 as 'one of the first to embrace a truly international approach to higher education', has award-winning campuses in the United Kingdom, China and Malaysia and hosts a truly global academic community in all three countries.

The University provides innovative and top quality teaching, undertakes world-changing research, and attracts talented staff and students from 150 nations. Placed 8th in the UK for research power by the latest Research Excellence Framework (REF), Nottingham is a major research institution which delivers work of international significance.

Our research excellence underpins the University's continued success in winning new research awards and in 2013-2014, funding for research at the University reached record levels, with awards totalling £181m.

Our links with industry are well-established and wide-reaching, providing student placements and knowledge transfer partnerships. We engage with businesses on a global scale and have

over 200 industrial sponsors of research. Our corporate partners include Rolls-Royce, Astra Zeneca, Novartis, GlaxoSmithKline, Shell, Ford and E.ON.

Nottingham is a founder member of Universitas 21, an international consortium of leading universities worldwide. This international framework generates exciting research partnerships and continues to show employers and academic institutions across the world that Nottingham produces top-quality graduates with a global outlook.

With established woodland, landscaped gardens and period buildings set around a large boating lake, University Park, Nottingham is widely regarded as one of the most attractive campuses in the UK and has repeatedly been a Civic Trust Green Flag Award Winner since 2003, the only university campus to achieve this status.

"...in each succeeding age the University will spread the light of learning and knowledge and will bind science and industry in the unity that is so essential for the prosperity of the nation and the welfare of our fellow citizens."

Sir Jesse Boot, 1928

# Working with the Faculty of Engineering

The faculty is a dynamic environment and we welcome and encourage industry to engage in both our teaching and research programmes. Our partners range from start-ups and SMEs to major multinationals, with many interactions leading to long-term relationships.

There are many ways we interact with industry including student sponsorship and recruitment, short courses, research to solve technology problems and licensing of existing technologies to name a few.

## Research Excellence Framework

The Research Excellence Framework is the new system for assessing the quality of research in UK higher education institutions.

The Faculty of Engineering is third in the UK for research power. More than 98% of research is of international quality, with 85% graded as 'world-leading' or internationally excellent'.

## Knowledge transfer

Our knowledge transfer offer is comprehensive and focused on nurturing a mutually beneficial partnership.

"The Faculty of Engineering is third in the UK for research power. More than 98% of research is of international quality, with 85% graded as 'world-leading' or 'internationally excellent.'"

Here are some of the ways you can engage and collaborate with the faculty:

- student projects
- course development
- undergraduate student sponsorship
- industrial placement
- Engineering Research Placement scheme (ERPs)
- graduate recruitment
- scholarships and prizes
- industry-led research projects
- scientific research projects
- sponsored PhD studentships
- industrial research fellow
- consultancy
- Knowledge Transfer Partnerships (KTPs)
- knowledge transfer centres
- Centres for Doctoral Training (CDTs)
- supporting innovation
- industry sponsored Research Chairs
- industry secondment
- staff training
- Continuing Professional Development (CPD)

## Technology transfer

- technology licensing
- equipment donation

## Case study Creative Energy Homes

The University's Creative Energy Homes project is a showcase of innovative state-of-the-art energy-efficient homes of the future. It investigates how we can reduce energy in our homes by bringing together industrial partners from across the house-building and energy sector, including:

- E.ON
- BASF
- TARMAC
- David Wilson Homes
- Saint Gobain
- Mark Group

Seven homes constructed on the University Park Campus were designed and constructed

to various degrees of innovation and flexibility to allow the testing of different aspects of modern methods of construction.

The project aims to:

- stimulate sustainable design ideas
- promote new ways of providing affordable, environmentally sustainable housing that are innovative in their design

This multi award winning project has been recognised for its relevance and industrial collaboration. In 2009, it won the Civil Engineering Award at The Engineer Technology and Innovation Awards.

For more information see

[www.nottingham.ac.uk/creative-energy-homes](http://www.nottingham.ac.uk/creative-energy-homes)



Postgraduate student works in front of the BASF house, University Park Campus.

# Knowledge transfer

**There is strong industrial involvement in all the Faculty of Engineering's undergraduate and postgraduate degree programmes and we have close relationships with many organisations. There are a range of opportunities for your business to become involved in order to attract the most able students and generally raise your profile within our student community. Some of the most popular ways to engage with us are described below.**

## Student projects

All undergraduate and postgraduate taught engineering courses require students to complete a research project, either individually or as part of a team. Projects designed by industry provide a real learning experience though no guarantees are made regarding results. The company provides only the resources required for a project and a small amount of direction. Most undergraduate projects begin late September with MSc projects beginning in June. Ideas for projects are welcome a few months before the start of the project.

## Course development

Company staff can be involved in the delivery of modules through guest lectures, case studies or leadership of group work. Industrialists can also volunteer to act as engineering mentors/advisers to students.

In addition, companies are welcome to propose future members of our Departmental Industrial Advisory Boards. Here, industrialists can advise and comment on course developments, skill requirements and organisation.

## Undergraduate student sponsorship

An effective way for companies to work with our students during their studies, as well as following completion, is through undergraduate sponsorship. Typically, individual sponsorship by a business is arranged in return for vacation and/or graduate employment.

Sponsorship may be either for the duration of the degree or the final years of a course after a student has spent a period of time with the company. An example of this is the Department of Civil Engineering industrial sponsorship scheme. New company participants are always welcome.

For further details, please contact our Careers and Employability Service, Engineering Employability Officer (see page 19).

“The most enjoyable project has been designing the real time software. We had to build and create a Bluetooth compatible bootloader that can decrypt and upgrade the firmware of an embedded device from a piece of software on windows.”

Robert Smith, MEng Electrical and Electronic Engineering student on placement at Monica Healthcare

Student Robert Smith on placement at Monica Healthcare.

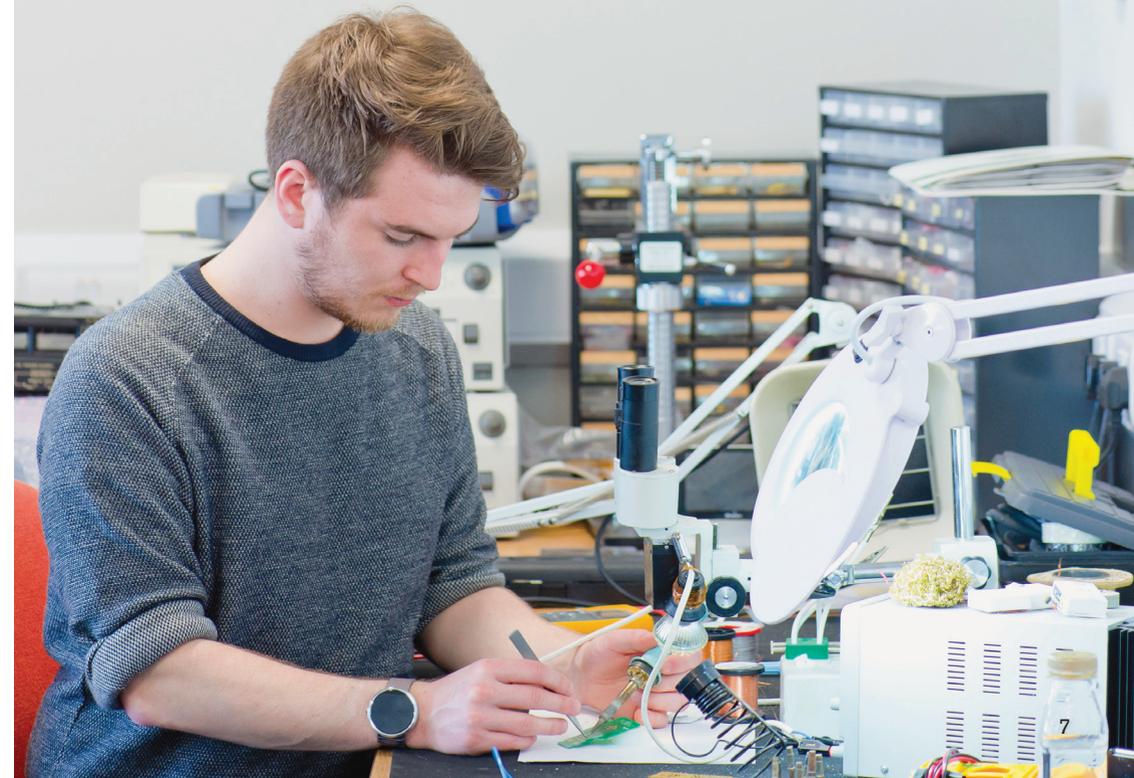
## Industrial placement

Many of our undergraduate courses offer the opportunity to undertake a year in industry as part of the programme and students are also available to undertake summer internships too. This opens up range of opportunities for companies:

- to raise their profile within our student population
- to source high-quality employees to fill short and long term resourcing requirements
- good value for money as student salaries are often less than their graduate counterparts
- the opportunity to bring in employees with fresh ideas and approaches who are supported by the University
- scope for existing staff to develop through managing and mentoring a student
- to build links for further collaboration with the faculty

Our dedicated Faculty Placement Team, headed up by Sarah Shackleton (see page 19), are available to support you in all aspects of recruiting a student including: targeted advertising of roles; collating of applications; scheduling students to attend interviews, either on campus or at employer sites, and making offers. For the year in industry students we also monitor and support them throughout their placement and they submit professional institute aligned reports to support their professional development during the period.

For postgraduate students, placements are typically project-based with students applying their skills to an industry specific problem. Projects usually last four to six weeks with time scales to fit both the company and a prospective intern's schedules.



## Engineering Research Placement scheme (ERPs)

The ERPs was developed by the Faculty of Engineering to provide a simple and effective method of promoting research placement opportunities/internships to our highest achieving undergraduate students. Students can sample the life of a researcher within their chosen engineering discipline, working in a supportive learning environment under the guidance of an academic supervisor. Students undertake placements over the summer vacation, working at the University and/or premises of a company sponsor.

To find out more information on how you can be involved in sponsoring a research placement, please contact [erps@nottingham.ac.uk](mailto:erps@nottingham.ac.uk) or visit [www.nottingham.ac.uk/engineering/StudentERPs](http://www.nottingham.ac.uk/engineering/StudentERPs)

## Graduate recruitment

Graduate recruitment activities are managed by the Careers and Employability Service in a faculty based team. There are a number of options to help employers recruit graduates including:

- advertising vacancies on our website and social media channels
- subject specific recruitment and internships fairs
- arranging employer presentations

For further details please contact Rachel Ramsden (see page 19) or visit [www.nottingham.ac.uk/careers](http://www.nottingham.ac.uk/careers)

## Preferred status for graduate recruitment

Several organisations have agreed that the faculty can include in advertising literature that a degree programme is of 'Preferred Status' and the company has specifically targeted graduates and students as one of a small group of universities.

## Scholarships and prizes

The Faculty of Engineering welcomes a range of industry scholarships to offer its undergraduate and postgraduate students as well as named company prizes.

Awards are usually made at a company or at an Annual Department Prize Day. Typical prizes are up to £500 and this can be arranged annually or by a larger, one-off donation.

For more information please contact Lucy Rose (see page 19).

"It was good fun doing a cross discipline study that opened up new areas of interest.

This meant that I was placed outside my comfort zone and therefore learning new things all the time."

David Hull, ERPs student  
Electrical and Electronic Engineering

The University of Nottingham  
UNITED KINGDOM • CHINA • MALAYSIA

# Sand Particle Trajectories in Upstream Oil Pipeline

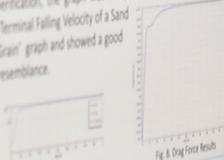
Nadine Hassan  
Supervisor: Dr. Xia Li

## Background

Sand erosion is a main problem facing the oil and gas industry. Sand is produced due to the poor rock cementation and high oil pressure in the oil reservoir. The particles flow through the pipe causes erosion, making it a serious safety risk at high velocities, and with thousands of particles it reduces oil flow and production rates.

## Project Aims

The project uses Computational Fluid Dynamics (CFD) to simulate the sand flow through the pipeline at grain scale and study the drag forces acting on it. Hence, allowing us to understand the fluid-particle interaction and determine the particles' trajectories.

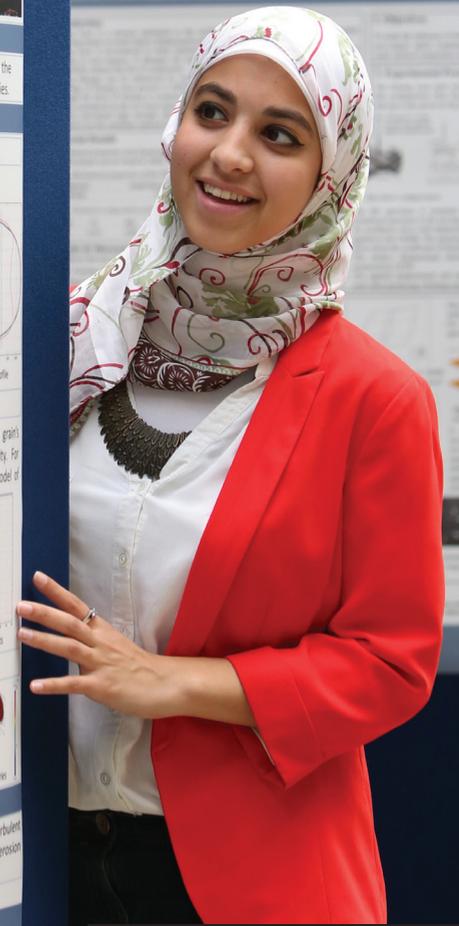
Methodology	Simulation Results				
<p><b>Methodology</b></p> <p>COMSOL Multiphysics is a CFD software that integrates a wide range of physics simulations. For this project, the Particle Tracing Module was implemented in conjunction with the Laminar Single Phase flow to study the flow and trajectories. The results produced were then verified with previous research studies.</p> <p><b>Modeling Parameters</b></p> <p>The model is a time dependent study of steady laminar flow of Sweet Blend type oil in a high strength steel alloy gathering pipe.</p> <table border="1"> <tr> <td>Oil</td> <td>Pipe</td> </tr> <tr> <td>Velocity = 2.22407 m/s Density = 824.8 kg/m<sup>3</sup></td> <td>Length: 3 m Diameter: 0.2 m</td> </tr> </table> <p>The Sweet Blend oil is one of the most traded oils and is allowed for a fully developed flow and its material was found in Edmonton, Canada. Reference values were taken at the typical underground reservoir temperature, which is 40°C.</p> <p><b>Meshing</b></p> <ul style="list-style-type: none"> <li>▪ Extremely fine mesh with a fluid dynamics calibration to ensure that all mesh elements were smaller than the sand grain.</li> <li>▪ Hexa meshing near the pipe-fluid boundary for a more precise simulation and accurate results.</li> </ul>	Oil	Pipe	Velocity = 2.22407 m/s Density = 824.8 kg/m <sup>3</sup>	Length: 3 m Diameter: 0.2 m	<p><b>Velocity</b></p> <p>The velocity profile gradually develops from a straight profile of the steady flow into a more curved one until it finally reaches the parabolic shape when the fluid has a fully developed flow.</p>  <p><b>Drag Forces on Sand Particle</b></p> <p>The graph shows how the drag force increases with the grain's acceleration then becomes constant at terminal velocity. For verification, the graph was compared with COMSOL's model of "Terminal Falling Velocity of a Sand Grain" graph and showed a good resemblance.</p>  <p><b>Sand Particles Trajectories</b></p> <p>Particles near the centre of the pipeline where the velocity is highest are the fastest and as they go further near the walls they're slower and lower in amount.</p> 
Oil	Pipe				
Velocity = 2.22407 m/s Density = 824.8 kg/m <sup>3</sup>	Length: 3 m Diameter: 0.2 m				

## Conclusions and Future Work

COMSOL has proven to give reliable sand trajectories in laminar flowing oil. This study can then be further applied onto a turbulent flow simulator and from a single particle to a real-life multiple particles model. Such results will aid in estimating the sand erosion rate and can be used to further extend to predict the position and shape of the erosion.

EPSRC  
Engineering and Physical Sciences Research Council

Manufacturing and Process Technologies Research Division



Nadine Hassan, the Dean's Award for Outstanding Research winner at the ERP's showcase.

Chris Dodds, Associate Professor,  
works on a Bench Scale Flow Rig.



The faculty has an extremely strong record for collaboration with industry, public bodies and charities to solve specific technology problems and develop new products. There are a variety of ways we provide assistance and work with organisations ranging from short-term consultancy through to long-term research projects. Opportunities also exist to transfer expertise and know-how into a business.

### Industry-led research projects

The most common way the faculty provides technology solutions for industry is via a research project, typically lasting one to four years. This research may be undertaken solely by the University who will employ an appropriate researcher to deliver the project, with regular industrial meetings to update on progress. Alternatively, companies may wish to undertake projects where they use University knowledge to supplement their own in-house expertise, with projects delivered through collaboration between University and company employees.

Funding for a project may come directly from industry, producing specific and confidential results. However, the faculty also undertakes a significant amount of work where projects are subsidised by government funding schemes. Common schemes used for industry-related projects include Regional Grants for Research and Development, the Technology Strategy Board's Technology Programme and the European Framework Programme. Depending on the problem and timescales involved, we can advise on the most suitable source of funding and help arrange this.

### Scientific research projects

The faculty undertakes a substantial amount of research to develop new scientific understanding of materials, processes, equipment and phenomena that may bring changes in industrial practice. All this research aims to be industrially relevant, but is often too early or too risky for industry to fund directly. When this occurs, we are able to apply for public funding, for example to the EPSRC.

Such applications are strengthened by relevant companies inputting into and agreeing to support the proposed research programme manifested through a letter of support, which details their interest in a project and what they intend to contribute. The exact nature of a company's contribution varies between projects and is agreed through discussions between the company and our researchers. However, common examples include:

- staff time for advisory and/or technical meetings
- access to equipment
- software or datasets
- supply of consumables (possibly test samples)
- hosting researchers on-site to test new systems developed

In return, organisations have the opportunity to see research of interest to them carried out and receive early access to results with ramifications that may yield competitive advantage.

### Sponsored PhD studentships

Often, some or all of a research project will be suitable for a PhD programme of study. When appropriate, we will encourage sponsorship of a student as an alternative to employing an additional researcher on a project.

PhD studentships are typically three to three and a half years long and there may be opportunities for companies to partially offset their cost, especially where a UK student can be recruited. The PhD student will work exclusively on your project, typically spending a placement period with the company (usually a minimum of three months).

### Industrial research fellow

A cost-effective method for long-term strategic partners to undertake research with a particular research group is to support an industrial research fellow. Here, the company funds a researcher to undertake various short and long term projects on their behalf without the need to establish multiple research contracts. The advantages to industry include easy access to group resources, including academic expertise, and other sources of project funding.

### Consultancy

Many of our leading academics work with organisations to provide the practical expertise and help they need to develop and grow. Being able to draw upon the experience of some of the country's top academic experts can provide your organisation with the latest knowledge and a clear competitive advantage.

Nottingham University Consultants (NUC), provide valuable expertise in all sectors, from expert witnesses in legal cases, through to businesses which want to call upon the unique insights of some of the UK's leading thinkers in order to develop innovative new ideas or solve specific problems. All NUC consultants are approved by the University and are fully covered by professional indemnity insurance.

### Knowledge Transfer Partnerships

Knowledge Transfer Partnerships (KTPs) are a government mechanism for applying academic expertise to a development project aimed at improving the financial success of your business. Appropriate projects include new product development, improvement of existing products and improving operational efficiency. KTPs work by forming a relationship with a leading academic, defining a project with significant commercial and academic outcomes, and recruiting a bright graduate to manage the work full-time at the company premises. Projects are typically one to three years long.

### Knowledge transfer centres

The faculty has a number of dedicated centres through which it actively engages with businesses in order to support economic growth both regionally and in the UK. The centres can provide the people and facilities to undertake short or long-term research projects, technical expertise for new product or process development, testing facilities and equipment or the development of solutions to comply with changing legislation. Further information regarding these centres can be found at: [www.nottingham.ac.uk/servicesforbusiness](http://www.nottingham.ac.uk/servicesforbusiness)

### Centres for Doctoral Training (CDTs)

The University has won substantial awards from the UK Research Councils (RCUK) to support the training and work of the next generation of elite researchers through our portfolio of Centres for Doctoral Training (CDTs).

These CDTs offer exciting opportunities to tackle significant global issues, with most offering funded PhD opportunities.

For more information please contact the CDT Team (see page 19) or visit [www.nottingham.ac.uk/doctoral-training-centres](http://www.nottingham.ac.uk/doctoral-training-centres)

### Supporting innovation

Our research generates discoveries, many of which can have profound social, economic and cultural benefits and will address major global challenges. That's why we work with our staff and students to help realise the real-world impact of their research.

We do this by developing business ideas and building enterprise skills so that inventions and innovations are developed into successful businesses. The University has been involved in over 40 spin-out and related companies and has a current portfolio of 28 spin-outs, of which 14 have products in the marketplace. Each of these companies has grown from research undertaken at the University.

Our spin-outs benefit from the incubation facilities provided by BioCity Nottingham, of which the University was a founding partner, and The University of Nottingham Innovation Park (UNIP) on Jubilee Campus.

The Sir Colin Campbell Building, which provides a gateway between the University's Jubilee campus and UNIP, opened in 2008 and acts as an incubator for high technology companies, mainly in physical sciences. BioCity, the largest bioincubator in the UK, is uniquely structured to enable a focus on bioscience and healthcare companies.



Postgraduate students sit near the Sir Colin Campbell Building.

### Industry sponsored Research Chairs

Research Chairs are full-time professional appointments with the chair holder expected to develop and lead a prestigious research group. Post holders are expected to seek funds from research councils, industry and other sources as appropriate in order to fund their research.

The benefits of sponsoring an industrial chair include the direct and frequent access to the expertise of a top-class researcher. This strengthens links with academics working in a particular field with a view to enabling generic research which cannot be carried out in-house due to lack of facilities, expertise or resources and benefiting from the results of leading research at a later stage.

### Industrial secondment

An alternative approach to strengthen links with industry is through industrial secondment where an academic researcher works in a company for a short period of time, either on a full or part-time basis, for between three and six months. The main aim of the secondment is for the researcher to gain state-of-the-art industrial experience and update their knowledge of industry's application of technology to their own area of expertise. This is then intended to benefit their research and provide realistic case-study material for lecturing purposes. The main benefit to the host company is that they gain a temporary but highly qualified member of staff. Secondments are typically undertaken with long-term industrial partners and initiated by the academic researcher.

“Our Global Strategy 2020 highlights the need to expand professional development and executive education provision. The Continuing Professional Development Services team are a key resource to support knowledge exchange and partnership-building through highly relevant, professional development courses for individuals and businesses.”

Professor Sir David Greenaway, Vice Chancellor

### Staff training

We offer a range of full-time masters and diploma courses which allow your staff to update their skills over the course of nine months to one year. Alternatively, your company may wish to sponsor an employee to undertake either full or part-time PhD training and generally it can be arranged for research projects to be undertaken in the workplace if desirable.

There are also a range of short courses offered within the University and we will consider requests for bespoke training courses.

### Continuing Professional Development

In business, the learning journey never stops. The global business environment is continually evolving and changing. As your business adapts to these changes, you need to be sure that your staff have the latest skills and expertise to enable them to handle these challenges and take advantage of new opportunities.

At The University of Nottingham, we deliver professional development solutions that meet the needs of your management team and workforce. We can provide the training and expertise that management teams need. Our academic experts will design solutions which are tailored to your organisation's requirements, and for those who want to obtain professional business and leadership qualifications, courses are offered up to MBA level.

# Technology transfer

### Technology licensing

Invention and innovation is at the heart of engineering and our researchers continuously develop new methods and products which present real commercial opportunities. The University has a specialist team responsible for protecting its intellectual property and, where appropriate, offers this for licensing to industry. The nature of university intellectual property is that is it frequently at an early stage and, most often, the University will work with industry to develop the technology in line with the specific needs and requirements of a company. Details of our most current licensing opportunities can be found on the University's research website: [uon.technologypublisher.com](http://uon.technologypublisher.com)

### Equipment donation

As part of a long-term relationship, some companies elect to either fund new equipment or donate their own surplus equipment to a research group or student teaching laboratory. Such donations are acknowledged in an appropriate way and are highly visible to other visitors, for example prospective students, government agencies and other companies.

Donations can be made tax effectively; The University of Nottingham has charitable status under the terms of the 1948 Education Act. Please contact us for further information.

Engineer works in our  
Precision Manufacturing  
Centre.

A patient is examined  
by a nurse.



# Case study: Cadisc

One of the leading causes of disabling back pain is the degeneration of the intervertebral discs, causing pain or rupture of the disc leading to neurological deficit. This costs the UK economy over £12bn every year and nearly a million people will require surgery.

To combat this problem, together with a team from medical device development company Ranier Technology, researchers at The University of Nottingham have developed the Cadisc. The Cadisc is a new type of implant that is unique because of how it is manufactured entirely from elastomeric polymer, and functions mechanically just like a natural disk.

Compared to traditional implants, patient quality of life was greatly increased with Cadisc far outstripping the competition in efficacy. Quality of life was measured at three times that of spinal fusion - the current 'Gold Standard' of care with a 100% operative success rate.

This remarkable achievement is due to the biomechanical ability of Cadisc to mimic the natural disc. This was commended by Dr Hamid Afshar, one of the leading surgeons specialising in this area, who said: "The Cadisc concept is very unique... Conceptually, it's the ideal solution for the spine."

Now in full production, the research has had massive economic as well as clinical benefits - Cambridge-based Ranier Technology has been transformed from a small medical device development company into the only UK manufacturer of total disc replacements. With the spread of Cadisc to Europe, the USA, South Africa, Australia and New Zealand, the implants now have a global reach, improving the lives of thousands all around the world.

"Dr McNally's expertise in the biomechanics of the spine, his facility in collaborating effectively with both Ranier engineers and the other scientific members, and his insistence on scientific rigour have been fundamental to the clinical and commercial success Ranier is now enjoying."

Geoffrey Andrews, founder of Ranier Technology comments on Dr Donal McNally's work

# Contact us

Masters student Mehrnaz Behray uses an Electron Microscope.



## Access to students

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Rachel Ramsden  
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Employability Officer  
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e: Rachel.Ramsden@nottingham.ac.uk

## Research and Business development

### Research Development Office

Rachael Duthie  
Senior Research Development Officer  
t: +44 (0)115 74 84494  
e: engbusinessdev@nottingham.ac.uk

### Business Engagement and Innovation Services

- Corporate Partnerships
- Business and Local Partnerships
- Knowledge Transfer Partnerships (KTP) Team
- Intellectual Property and Commercialisation
- Continuing Professional Development (CPD)

t: +44 (0)115 748 4555  
e: beis@nottingham.ac.uk

### University of Nottingham Innovation Park (UNIP)

t: +44 (0)115 82 32293  
w: [www.nottingham.ac.uk/unip](http://www.nottingham.ac.uk/unip)

## Centres for Doctoral Training (CDTs)

- Additive Manufacturing and 3D printing
- Sustainable Chemistry
- Advanced Therapeutics and Nano medicines
- Digital Economy

t: +44 (0)115 84 66948  
e: DTC@nottingham.ac.uk

## Institutes

- Energy Technologies Research Institute (ETRI)
- Institute for Advanced Manufacturing (IfAM)
- Institute for Aerospace Technology (IAT)
- Institute of Biomechanics
- Institute of Biophysics, Imaging and Optical Science
- Institute of Sustainable Energy Technology (ISET)
- Nottingham Geospatial Institute (NGI)

## Centres

- Centre for Structural Engineering & Construction (CSEC)
- Centre for Innovation in Carbon Capture and Storage
- EPSRC EngD Centre in Efficient Fossil Energy Technologies
- National Centre for Industrial Microwave Processing (NCIMP)
- Nottingham Nanotechnology and Nanoscience Centre
- Nottingham Transportation Engineering Centre (NTEC)
- Precision Manufacturing Centre
- Rolls Royce Gas Turbine Transmissions Systems (University Technology Centre)
- Rolls Royce Manufacturing Technology (University Technology Centre)

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in alternative formats.

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