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The Industrial Doctorate Centre for the UK Water Sector

A Handbook for Research Engineers, Supervisors and Sponsors

Cranfield University

University of Exeter

Imperial College London

Newcastle University

The University Of Sheffield.

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Welcome

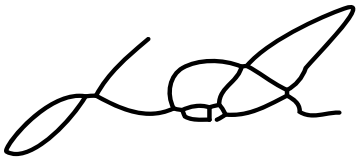
A welcome from the STREAM Programme Manager

STREAM: The Industrial Doctorate Centre for the Water Sector, is supported by the Engineering and Physical Science Research Council (EPSRC) and was formed as a unique opportunity to bring together the five UK major academic centres of excellence in water science and engineering, who are recognised for both their internationally leading research and their steady supply of highly trained engineers to support UK business. The water and wastewater sector in the UK comprises over 500 companies, employs around 80,000 people, generates over £3bn of overseas business each year and, as recently noted in a UK Trade & Investment report, is currently poised to occupy leadership positions in the $300bn global water market.

The STREAM programme's ambitions have been specifically aligned with national requirements for sustainable water management, sectoral requirements to address the expectations of government, regulators, and the public, and employer specific demands for a new generation of technically knowledgeable leaders. We aim to nurture and challenge the brightest and best so that they can be world leaders in industry and academia.

Whether you are a STREAM Research Engineer, a research project sponsor, or a potential collaborator, this handbook provides the information you need to get involved in delivering on this ambition. I would like to take this opportunity to welcome you to the STREAM community and its activities. Our hope is that the programme's structure and people provide you with opportunities to achieve your aspirations.

stream
The Industrial Doctorate Centre for the Water Sector



Professor Simon Parsons
STREAM Programme Director

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Introduction

The purpose of this Handbook is to provide a source of general information for all stakeholders in the STREAM Industrial Doctorate Centre; research engineers, their supervisors, sponsors and potential future colleagues. However, as the programme is collaborative, this handbook should be read in conjunction with the appropriate EngD regulations in force at the university hosting the project or the research engineer.

The information contained in this document is believed to be accurate at the time of publishing. As the programme is under continual development the team reserve the right to alter or amend it as necessary.

Industrial Doctorate Centres

The Engineering and Physical Sciences Research Council (EPSRC) announced a new tranche of Centres for Doctoral Training in early 2009. Launching the initiative, Minister of State for Science and Innovation, Lord Drayson said: “Britain faces many challenges in the 21st Century and needs scientists and engineers with the right skills to find answers to these challenges, build a strong economy and keep us globally competitive. EPSRC’s doctoral training centres will provide a new wave of engineers and scientists to do the job.”

Building on the success of existing Engineering Doctorate programmes, 17 new Industrial Doctorate Centres (IDCs) were announced as part of this initiative. IDCs operate with strong support from industrial project sponsors and provide a supportive and exciting environment for students (called research engineers) who want a career in industry.

Launching the centres, Professor David Delpy, Chief Executive of EPSRC, called for them to “meet the challenges of tomorrow by investing in talented people and inspiring the next generation of scientists and engineers”.

The Engineering Doctorate (EngD) degree

An Engineering Doctorate is a four year research degree awarded for industrially relevant research, based in industry and supported by a programme of professional development courses. It provides an intellectual challenge commensurate with that of a PhD for ambitious and able research engineers within a framework of competence development that prepares them to become future engineering leaders.

The central component of the degree is the undertaking of one or more significant and challenging engineering research projects within an industrial context. Developed solutions must include an appreciation of the business context to the problem.

A broad range of skills and competencies are developed through the EngD experience with most EngD programmes emphasising a common set of attributes expected of a graduating research engineer;

- Ability to design and execute flexible, innovative, R&D activities and programmes that respond to client needs
- Ability to shape, work within, and where necessary, lead research teams with different disciplinary, professional, and perhaps cultural, backgrounds
- Be effective project managers and be familiar with business processes
- Possess expert knowledge in one or more specialist fields and be able to deploy methods and techniques that balance social, environmental, economic, and engineering considerations
- Have excellent written and oral communication skills.

Although the research engineer community spans sectoral, disciplinary and national borders, its members have one thing in common; a desire to use science and engineering to deliver innovative solutions and sustainable futures.


140 mL
±5%
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No. 1000

The STREAM IDC

The UK water sector is entering a period of profound change, requiring evidence-based responses to a host of emerging global, national and regional challenges. The sector is keen to embrace these challenges but requires a new cadre of engineering leader who can not only help to make our society more sustainable and profitable but develop a new suite of goods and services for a rapidly urbanising world.

In response to these challenges, the Engineering and Physical Sciences Research Council (EPSRC) has awarded £5.8 million to establish a collaborative Industrial Doctoral Centre (IDC) for the Water Sector, one of 17 new IDCs funded across the UK in 2009. The STREAM programme is delivered by a consortium of five collaborating universities; Cranfield University (the coordinating institution), Imperial College London, the University of Exeter, the University of Sheffield, and Newcastle University.

STREAM brings together diverse areas of expertise to train engineers and scientists with the skills, knowledge and confidence to tackle today's water sector challenges such as climate change, increasing populations, energy efficiency and pollution control. It will also create new working cultures, build relationships between teams in the collaborating universities and forge lasting links with industry.

The five universities which comprise the STREAM consortium are major centres of excellence in water science and engineering, providing both internationally leading research in their areas of expertise and a steady supply of highly trained engineers to support UK business. The consortium provides access to key skills which will support research engineers in linking the design, technology, and business process dimensions of engineering research and practice in the water sector.

Research engineer progress through the STREAM programme provides the intellectual tools and transdisciplinary training to succeed in the global water career market. Meaningful support from industry and professional associations and collaboration with national and global professional networks ensure that research engineers have every opportunity to make a significant contribution to delivering sustainable water services to our communities.

Project identification and sponsorship

As IDCs are in the business of delivering industrially relevant research, the research themes which research engineers address need to reflect existing and anticipated sector challenges.This ensures that the we are able to attract both direct financial and in-kind support for the research and training components of the programme.

Academics at the five STREAM universities (see page 3 for contact details) are happy to discuss possible research areas for sponsoring through the programme at any time. However, the formal process by which each year's research projects and research engineer sponsorship are secured involves a workshop where technology, process and knowledge challenges facing the sector, are reviewed and potential sponsors are partnered with university contacts to develop full project descriptions.

Consortia-funded projects are encouraged to extend the range of involved companies with one lead company responsible for research engineer hosting / supervision. Proposals are expected to fit with the vision of the IDC as well as with the needs of the industrial sponsor.

Following the workshop, sponsors and academics draw up detailed project specifications prior to a decision being made in February or March regarding which projects are to be funded through the STREAM programme. Research engineer recruitment takes place between April and September with research engineers registering for the STREAM programme at the university where the primary academic supervisor is based.

Project sponsors benefit from:

- Significant leverage on research investment
- Involvement in research engineer recruitment
- High quality researchers dedicated to your organisation's research
- Opportunity to guide research engineer training
- Participation in programme activities such as the Challenge Week and Symposium
- Added value through interaction with other research engineers and their sponsors
- Opportunities to coordinate research efforts across the sector
- Collaborating with leading academic researchers and institutions
- Access to world class research facilities
- A high profile national programme.

Although funding for only a limited number UK research engineers per year is available, fully funded projects where the sponsor covers the full cost of the student's fees and stipend as well as the incidental costs of the research are welcome.

Please contact the STREAM Programme Manager for further details of how industrial sponsorship of STREAM research engineers works or visit the programme website at www.stream-idc.net.

The **stream** Research Engineer experience

Research engineers are recruited onto the STREAM programme by the university hosting the project they apply for. They are registered for a degree at the host university and are subject to the academic and other regulations of the host university.

The STREAM programme (Table 1) comprises three components leading to the award of an Engineering Doctorate degree;

i. acquisition of advanced technical skills through attendance at Masters level training courses
ii. tuition in the competencies and abilities expected of senior engineers through a Transferable Skills and Engineering Leadership (TSEL) component
iii. doctoral level research project(s).

Each new cohort of STREAM research engineers spend the first three months of their programme from October to December attending taught modules at Cranfield. Following this they join their sponsoring organisation to begin work on their research projects. Research engineers are subsequently able to attend Masters level technical modules at any of the STREAM partner institutions.

Specific technical skills training requirements reflect student backgrounds, employer research needs and career development goals. Research engineers, in consultation with their supervisors, assess their technical skills requirements and plan their attendance at additional modules / courses during the progress meetings held in December and July each year.

	Year 1	Year 2	Year 3	Year 4
Technical skills	Oct – Dec at Cranfield • Introduction to the water sector • Water and wastewater treatment principles • Process science and engineering • Principles of hydraulics and water distribution • Engineering sustainability • Asset stewardship • Group design project	At least one additional technical module to be taken at any partner university in each of Years 2 and 3.		
Transferable skills & Engineering Leadership	Cranfield • Philosophy of science • Research methods and research design • Creativity and design • Engineering past, present and future • Health and Safety standards Imperial • Project management for research • Role of research in supporting business functions • Research ethics • Basic presentational, writing and meetings skills • Financial management	Sheffield • Personal effectiveness and time management • Team working and management • Knowledge transfer and research exploitation • Project costing • Business risk	Exeter • Patenting and IPR • Science communication • Negotiation and influencing skills • Writing a business case for investment • Supervision skills	Newcastle • Thesis & Viva preparation • Career planning & development • Entrepreneurship & leadership skills • Writing grant and funding bids • Interview and interviewing skills
Research projects	From January to September	All year	All year	October to March - then thesis write up

Table 1: Overview of the STREAM programme

Induction semester

Each new cohort of STREAM research engineers spend their first semester (Oct – Dec) at Cranfield attending modules on core technical competencies and early stage transferable skills (see Table 2). These first three months provide research engineers with the skills needed to survive within the industry environment (in terms of specialist knowledge and awareness of processes etc.) and to get started on their research activities.

Table 2: Induction semester schedule

Module	Assessment
Engineering sustainability	Written assignment due in November
Water and wastewater treatment principles	Exam in early Jan
Process science and engineering	Exam in early Jan
Asset stewardship	Exam in early Jan
Principles of hydraulics and water distribution	Exam in early Jan
Basic transferable skills	Through GDP and assignments
Research design and group design project	Presentation and report

Lectures and seminars are delivered by staff from the collaborating universities as well as by industry experts where appropriate. A group design project is used as a vehicle for research engineers to gain team working skills and utilise knowledge gained during this first taught element of the programme.

Attendance on the Induction Semester and completion of associated assessments are both compulsory elements of the programme. STREAM research engineers will normally be expected to pass all the module assessments associated with the induction semester programme at Cranfield. Research engineers will receive certificates of attendance or accreditation for each module that they (respectively) attend or pass the assessment of.

Advanced technical skills

Subsequent to the induction semester, research engineers can attend Masters'-level modules offered by the STREAM partner institutions. Modules offered under any of the following recognised MSc courses are open to STREAM research engineers to attend (Table 3).

Table 3: Recognised courses for advanced technical skills

Institution / School	MSc Course
University of Sheffield - Department of Civil and Structural Engineering	• Urban Water Engineering and Management
Newcastle University – School of Civil Engineering and Geosciences	• Sustainable Management of the Water Environment • Environmental Engineering • Hydroinformatics • Applied Hydrogeology
Imperial College London - Department of Civil and Environmental Engineering	• Hydrology and Water Resources Management • Environmental Engineering
Cranfield University – Centre for Water Science, School of Applied Sciences	• Water and Wastewater Engineering / Technology
University of Exeter - School of Engineering, Computing & Mathematics	• Urban Water Systems

Selection of which advanced technical skills modules to attend is determined jointly by the research engineer and their academic and industrial supervisors. Selection of appropriate modules may be driven by competencies required to tackle research challenges or enhance career ambitions.

Research engineers attend a minimum of one advanced technical skills module in their second and third years of study. Formal assessment for these post-induction modules is not compulsory. Where assessment is undertaken it may be in any form agreed to by the primary supervisor. Research engineers will receive certificates of attendance for each module that they attend. Where they successfully pass the normal exam for that module they will be supplied with an accreditation certificate from the institution offering the module.

Transferable Skills and Engineering Leadership (TSEL)

The TSEL element of the STREAM programme comprises five thematic components; Research Skills, Business Environment, Personal Development, Communicating, and Project Delivery with attendance at one course at Cranfield during the induction semester plus one course at each of the other four partner institutions.

Specific components and delivery timings are listed in Table 4. The TSEL components at Imperial, Sheffield, Exeter and Newcastle will take place between January and May in each year so that assessment can take place during the Challenge Week in July. Attendance on STREAM TSEL components and completion of associated assessments are both compulsory elements of the programme.

Table 4: Transferable skills and engineering leadership modules

TSEL module	Host Instiutution	Syllabus
Transferable Skills Unit I	Cranfield	• Philosophy of science • Research methods and research design • Creativity and design • Engineering past, present and future • Health and safety standards
Transferable Skills Unit II	Imperial	• Project management for research • Role of research in supporting business functions • Research Ethics • Basic presentational, writing and meetings skills • Financial management
Transferable Skills Unit III	Sheffield	• Personal effectiveness & time management • Team working and management • Knowledge transfer and research exploitation • Project costing • Business risk
Transferable Skills Unit IV	Exeter	• Patenting and IPR • Science communication • Negotiation and influencing skills • Writing a business case for investment • Supervision skills
Transferable Skills Unit V	Newcastle	• Thesis and viva preparation • Career planning and development • Entrepreneurship and leadership skills • Writing grant and funding bids • Interview and interviewing skills

Doctoral Level Research

Research engineers conduct either a single study or a portfolio of studies to be reported on in a thesis. Examination involves a Viva Voce defence of the thesis with the external examiner drawn from an institution not involved in the STREAM programme. The EngD thesis must include an element of business evaluation (e.g. marketing, finance, investment, management, cost-benefit).

Each research engineer is allocated a primary academic supervisor based at the university hosting the project and a second supervisor from one of the other STREAM partner universities (unless there are commercial constraints on such an arrangement). The supervisory team is completed by a single industrial supervisor from the sponsoring organisation.

Research activities are planned, reviewed, and audited at regular review meetings and a personalised CPD log is used to enable research engineers and supervisors to keep track of progress. The proportion of time spent physically located at the sponsor's premises will vary depending on the specifics of the research being conducted, availability of experimental and analytical facilities etc. but a minimum of 75% of time is dedicated to sponsor driven activities.

Cohort building

A series of events attended by all currently registered STREAM research engineers provide opportunities for cohort and inter-cohort identity building and networking.

i. the initial three-month core competencies programme for each cohort based at Cranfield
ii. an annual STREAM symposium attended by sponsors and featuring research presentations from all cohorts
iii. an annual Challenge Week to take place each summer (organised in rotation by the partner universities with the research engineers).

In addition to providing an opportunity to review the previous year's activities and provide advice and support for the following year, the Challenge Week will include training delivery and evaluations for transferrable skills topics, guest lectures from leading industrialists and scientists (from both water sector and other utility / engineering backgrounds) as well as from technicians and operators from across the industry, design and problem solving challenges, individual and inter-cohort competitions, site visits and a fundraising activity for the charity Water Aid. Advisory, Steering and Management Board meetings will also be held during this week as appropriate.

Developing a professional network

As future engineering leaders, the development of a supportive and career enhancing professional network should be a central ambition for STREAM research engineers. Where appropriate, research engineers are provided with an opportunity to undertake a short study visit to an internationally leading research centre as part of their second or third year calendar. Language training is offered to research engineers who take up these opportunities.

Research engineers are strongly encouraged to submit conference papers and author peer reviewed journal papers. Financial support to attend national and international conferences is available. Where appropriate, supervisory teams will organise opportunities for research engineers to co-supervise placement student projects during their third or fourth year as part of their professional development programme.

To facilitate research engineer engagement with professional associations, the STREAM programme funds student membership of the International Water Association and a relevant professional institution for each research engineer for four and two years respectively. In addition, each STREAM research engineer is automatically registered with the International Water Association's 'Young Professionals' programme.

Research engineer progression

Research engineer performance on all three elements of the programme (Advanced Technical Skills, TSEL, and research) is formally evaluated. Research engineers are also required to demonstrate progress in communication skills through regular assessed presentations (e.g. during the Symposium and Challenge Week). Mid-stage awards are available for those research engineers who, for whatever reason, withdraw from the programme early. All awards are conferred by the university at which the research engineer is registered. All student appeals are handled by the student's host institution.

Progress Reviews

Progress reviews constitute a formal evaluation of research engineer activities and achievements. They provide an opportunity for students and supervisors to review progress and plan the coming year's priorities and actions. Research engineer progress is formally evaluated twice a year: during the Challenge Week in July and again during the symposium event in December.

For the July review research engineers make their learning logs available to their academic and industrial supervisors, produce a 5,000 word progress report, and make a presentation on their activities to date. The report should provide a reflexive assessment of experiences and achievements during the past year. Research engineer progress logs will be used to monitor achievements, record supervisor feedback and formalise plans for the following year.

The Programme Management Group meets at the end of each Challenge Week or soon thereafter to consider research engineer progress and approve progression on to the following year of the programme. Research engineers who fail to demonstrate satisfactory progress are offered the chance to achieve mid-point awards (see below). In coming to a judgement about the adequacy of research engineer progress, supervisors and the PMG have regard to;

a. Records of attendance at advanced technical skills and TSEL components of the programme
b. Exam marks achieved by the research engineer relating to attended taught elements of the programme
c. The quality and content of the written progress report and presentation
d. Advice from the industrial sponsor on student performance

The July reviews happen at the following points in the student's registration period.

- At 10 months after start of registration
- At 22 months after start of registration
- At 34 months after start of registration
- At 46 months after start of registration

Progress Reviews (continued)

Following the second yearly review (to be conducted in month 22 of the research engineer's registration), the STREAM Exam Board will recommend whether the research engineer's registration should be transfered from MPhil/EngD to EngD.

The award of MPhil will be made available to research engineers who either do not wish to pursue the EngD award or who are denied permission to progress following a formal review, and who have met the criteria for award of an MPhil as laid down by the institution they are registered with. This award will be offered by the student's host institution. Individual universities may offer additional early exit awards based on accrued learning or experience. These are evaluated and decided on by the host institution.

The December review takes the form of a meeting between the research engineer and both academic supervisors and will focus on activities and progress since July. For research engineers in their first year the December meeting will review performance on the induction semester's taught courses. An entry into the CPD log will be made by the supervisor following all progress meetings. It is expected that additional progress meetings relating to the research projects undertaken by research engineers will take place in adidtion to these formal academic progress assessments.

Awards and prizes

Excellence within the programme is recognised through a set of sponsored prizes for achievement based awards.

A stable of three sponsored prizes are available to STREAM research engineers at various stages of their training;

- Best student in each cohort
- Best student during induction semester (based on exam marks)
- Most innovative thesis in cohort.

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