ROYAL ACADEMY OF ENGINEERING

Visiting Professors scheme

Case studies

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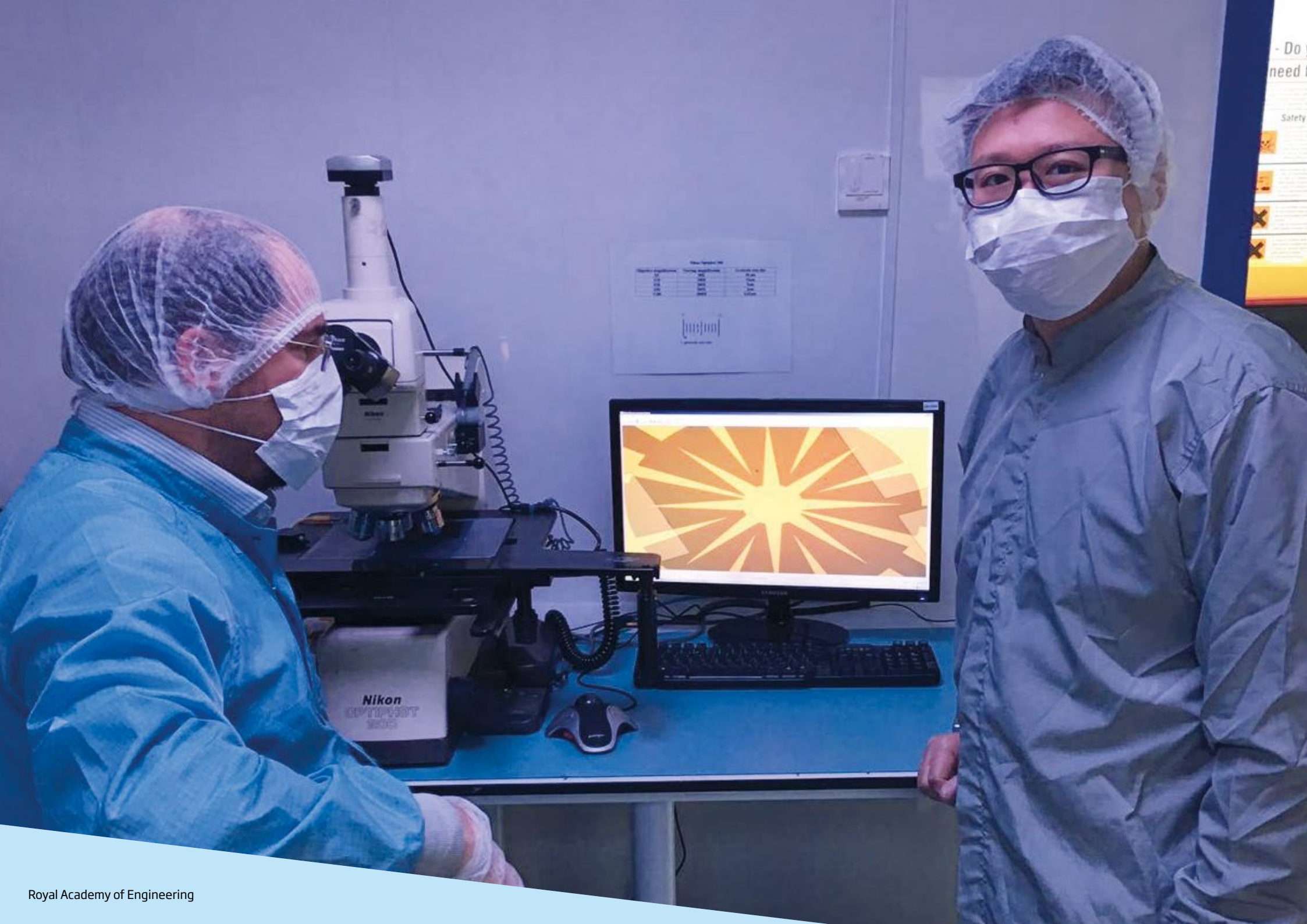
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Introduction

The Royal Academy of Engineering's Visiting Professors (VP) scheme is an industry-into-academia initiative that funds professional engineers working with UK universities.

At any one time, there are more than 70 VPs working with students at universities around the UK.

These case studies show how UK universities use the knowledge and skills of senior industry practitioners to help engineering students become more employable, better understand how to apply what they learn, and contribute as professional engineers in industry and commerce more rapidly.

The case studies describe how, during their three-year tenure, VPs contribute and add value to the student experience through course development, face-to-face teaching, mentoring and other related activities. They cover a wide range of engineering sectors, from nuclear engineering to medical device design and diversity and inclusion, at universities across the UK.

VPs are professional engineers who have a vision, act on that vision and make a lasting difference to universities, individual students and their employers, and the profession.

If you share this vision and think you could make a difference, find out more by visiting the Academy website (www.raeng.org.uk/grants-and-prizes/schemes-for-people-in-industry/visiting-professors-in-innovation). Applications must be made jointly by a host UK university and a prospective VP, so those not already in contact with a university that could use their skills should start by making contact and establishing a relationship.

Please contact the Academy's higher education team with any questions:
highereducation@raeng.org.uk

> *A 2007 Royal Academy of Engineering publication,* Educating Engineers for the 21st Century*, reported that industry seeks engineering graduates who have 'practical experience of real industrial environments'.*
>
> *Specifically, 'industry ... regards the ability to apply theoretical knowledge to real industrial problems as the single most desirable attribute in new recruits ...'*

Ruth Allen

Visiting Professor in Infrastructure Engineering

University of Exeter

Summary

Ruth Allen was appointed as a Visiting Professor (VP) in infrastructure engineering at the University of Exeter to enrich students' experience, hone their engineering skills and prepare them for their future careers.

The need

The University of Exeter strives to be a sustainable global 100 institution. When reviewing its teaching programmes, the College of Engineering, Mathematics and Physical Sciences believed a VP could impact key objectives. These include developing relationships with organisations operating internationally, enriching student experience through input from professionals, creating new student placements, strengthening links between research and teaching, and enhancing local industry relationships.

The solution

The university has benefited from its collaboration with Ruth Allen for many years. Ruth has been a College Industrial Advisory Board member and currently sits on the Advisory Board for the Centre for Doctoral Training in Water Informatics: Science and Engineering (WISE CDT). While these roles have been crucial in influencing strategy, the VP scheme allows Ruth to contribute directly to teaching and learning on the university's engineering programmes.

As a chartered civil engineer, Ruth has over 35 years' experience providing management and technical consultancy to regulated industries, both in the UK and internationally. She is Managing Partner of RSKW Ltd and is a specialist in water, rail, energy and highway infrastructure management. Ruth's VP role aimed to:

- help students and academic staff understand the links between the theoretical subjects being taught and best practice as applied in industrial settings
- improve students' employability by developing their appreciation of professional practice, enhancing transferable skills, and offering mentoring and careers advice
- facilitate students' engagement with industry networks and development of placements
- be a role model for female engineering students.

The role

Ruth's VP role at the university is wide ranging. Input to first and second year modules aims to improve students' engineering design skills and engender key transferable skills such as teamwork, presentation, ethics and professionalism.

Specialist teaching input to third and fourth year programmes incorporates real design case studies to help students and academics better understand the links between theoretical subjects and applied best practice. Best practice lectures incorporate case studies and roleplay exercises and explain the role of chartered engineers in delivering projects to clients.

Contributions to students' individual and group projects include introducing project management concepts and skills, acting as nominated advisor on projects, setting design briefs, and involvement in project presentation and evaluation activities.

The experience

Ruth was appointed in September 2017. In her first year, she has engaged widely with engineering academics and students at all levels of education. Ruth has also contributed to discussion on the department's strategic direction via the Engineering Industrial Advisory Board and to gender equality advancement.

Significant activities include:

- Engineering eXfactor: an employability workshop for all first-year engineers.
- Careers workshop: A Life in Water: an event for WISE CDT and master's students in association with the Institute of Water.
- Preparing for the workplace and professionalism: a presentation and interactive session for second-year students.
- Drop-in surgeries: mentoring and career advice for small groups or individuals.
- Drop-in surgeries for female engineers, as small groups or individuals.
- Client engagement session: flood wall design: a presentation on the tendering process and competitive roleplay exercise.
- International Women in Engineering Day 2018: a presentation and networking session.

The future

Ruth's activities for the remainder of her tenure will continue and advance the agreed objectives. The University of Exeter is keen to secure the long-term impact of this Visiting Professorship by ensuring that activities and best practice are promoted and disseminated beyond the students and staff directly involved. Lasting sustainability will be safeguarded through Ruth's planned appointment as a university honorary VP following her Academy professorship. This will enable the collaboration to persist and should ensure that the university's engineering programmes continue to engage, develop and inspire students and prepare them to meet the needs of industry.

> ***All parties involved in this collaboration – the university, the students and Ruth – have found the initiative stimulating and richly rewarding. The plan is to ensure that this fruitful relationship persists, which should ensure that the University of Exeter's engineering programmes continue to engage, develop and inspire students and prepare them to meet the needs of industry.***
>
> University of Exeter

Dawn Bonfield MBE

Visiting Professor in Inclusive Engineering

Aston University

Aston University
Birmingham

> *"In her first academic year as a Visiting Professor Dawn spent a total of 45 days at the university – more than double the number envisaged originally."*

Summary

Dawn Bonfield was appointed a Visiting Professor (VP) in 2017 to use her diversity and inclusion experience in STEM and expertise to help students develop their skills as they progress towards employment and professional registration. Her goal was also to position Aston University as a UK leader in embedding inclusivity into the engineering curriculum.

The need

One way to address the engineering profession's well-documented skills shortage is to encourage a greater number of underrepresented groups into the profession. There is also a need to ensure that the profession that these new recruits are attracted into is fully inclusive. Biases exist in all walks of life and the perpetuation of these will be harmful to a future that is so very dependent on technology. An inclusive profession will produce inclusive products and services that have great potential to enhance productivity and creativity in the sector.

While diversity and inclusion has become more important throughout all professions in the UK over the past 20 years, progress within engineering is slow. More work is needed to embed the competence and practice of inclusive engineering into all aspects of the profession, starting at undergraduate level.

The solution

Aston University was keen to be at the forefront of understanding and embedding inclusivity into the engineering curriculum as widely as possible. Central to the plan was to use the experience that Dawn developed in her time working with the Women's Engineering Society.

Dawn developed new material for incorporation into the curriculum across multiple programmes of study. Students learned how to recognise and alleviate bias in their attitudes as well as their work, leading to a more equitable workplace that is safer, more innovative, productive and profitable. This gave students an advantage when it came to employment and professional registration. If, as was hoped, inclusivity was embedded into the next iteration of UK-SPEC (the UK Standard for Professional Engineering Competence), which sets out the standards of competence required for registration by professional engineers and technicians in the UK, Aston students would be the first to graduate demonstrating this competence. They learned the value of inclusive leadership, how to ensure an inclusive culture exists within the workplace, and why these skills are important not just on a personal level but to the productivity, safety and profitability of their future employer.

The role

This strategic appointment was to embed inclusive engineering as a subject within the undergraduate curriculum and develop a series of masterclasses, workshops, mentoring and a final year module option. Over the three years, Dawn aimed to spend 15 to 20 days a year at the university. She worked closely with academics who deliver engineering and product design modules to develop material that can be used across multiple study programmes.

By embedding examples of inclusivity into the taught engineering curriculum and helping in the development of seminars and modules, Dawn helped ensure that inclusive approaches and competence were sustainable and properly integrated into the future of STEM education beyond her tenure. Where possible, case studies were used to develop short media clips that could be widely shared. The ultimate goal was to develop a collection of materials to be used at Aston, as distance learning and more widely in the community. Collaboration with the postgraduate certificate delivery team and the Aston

STEM Education Centre ensured a longlasting legacy since the concepts were embedded in Aston training and educational research.

The experience

In her first year, Dawn spent 45 days at the university – more than double the number originally envisaged. She made significant progress in embedding inclusion into the engineering curriculum and into the university more generally.

Key to this was her work to engage heads of department and programme directors of all engineering and applied science schools at Aston University. Dawn explained inclusive engineering and sought ways to influence the academic staff to develop the competence of inclusion. Over the same period, she delivered inclusivity content to two student groups and had advanced bookings to present to around 250 engineering students in the second year of her tenure.

Through a website (www.inceng.org) that was developed as a resource for both staff and students, Dawn explains more about inclusion, provides industrial case studies and content developed during her tenure.

Dawn's work with the Centre for Learning Innovation and Professional Practice, resulted in inclusion being included in postgraduate certificate training. She was also a founder and steering group member of Inclusive Aston, which aims to bring together the various inclusion strands to maximise their impact across campus, and was instrumental in setting up the Women's Engineering Society student group. To promote inclusion and influence the engineering education community more widely, Dawn:

- worked with the Engineering Council to produce guidance on inclusive engineering, with intentions that the next iteration of UK-SPEC would take this into account and all UK universities seeking accreditation for the engineering programmes would be expected to embed inclusion into their curriculum
- engaged professional institutions, through the Institution of Engineering and Technology and the Joint Board of Moderators, to promote inclusion within current degree accreditation processes.

The future

Dawn developed a half-day training course on inclusion for final-year students, which was delivered from November 2018. Other plans for her second year included the development of materials for students, covering:

- inclusive product design
- current legislation, standards and codes of practice
- inclusion as part of a safety critical culture
- strength-based diversity
- inclusive engineering tools and practices (such as BIM, Lean, TRIZ, Offsite Manufacturing, Factory re-engineering)
- stereotypes versus archetypes
- diversity benchmarking, measures and targets
- case studies with industrial speakers.

With Aston staff, she aimed to deliver two masterclasses, a final year option for engineering and applied science, and to incorporate inclusivity material into three modules.

Longer term, Dawn is keen to ensure that inclusion is understood and promoted throughout the engineering profession, based on it being embedded in engineering education.

> ***"There is also a need to ensure that the profession that these new recruits are attracted into is fully inclusive. An inclusive profession will produce inclusive products and services that have great potential to enhance productivity and creativity in the sector."***

Dr Caspar Clark

Visiting Professor in Functional Thin Film Materials and Applications

University of the West of Scotland

UNIVERSITY OF THE WEST of SCOTLAND
UWS

> *"This experience, in particular of adapting to disruptive technologies, gives Dr Clark an excellent insight into the skills that graduates and entrepreneurs require; he was very well positioned to help enhance the quality and capabilities of the university's engineering graduates."*

Summary

Dr Caspar Clark was appointed as a Visiting Professor (VP) in 2016 to play a formative role in incorporating current and future industrial practice into the University of the West of Scotland's engineering curriculum and to facilitate innovation education. His role was to enrich the engineering curriculum with the latest industrial technology and practices to enhance the quality and capabilities of the university's engineering graduates.

The need

The University of the West of Scotland sets out to ensure that its graduates are 'work-ready' and prepared to make a positive contribution locally and globally. Appointing a VP intended to support that and to continue to improve student quality and capability, to strengthen links with industry. The university saw a need to incorporate current and future industrial practice into the engineering curriculum and to facilitate innovation education.

The solution

Dr Clark was appointed as a VP in September 2016. He had co-founded two engineering-based companies. He remains technical director of one, a nanotechnology company, and engineering director of the second, an instrumentation company. He had also provided consultancy to an advanced sensor company. This experience, in particular of adapting to disruptive technologies, gives Dr Clark an excellent insight into the skills that graduates and entrepreneurs require.

Appointing a VP allowed the university to develop its undergraduate teaching in three ways:

- Direct involvement in several modules that aligned with Dr Clark's experience, through teaching and improving the industrial relevance of current laboratory-based teaching.
- Providing bespoke seminars to third and fourth year undergraduate students to highlight the relevance of engineering and innovation to industry, and to emphasise how engineering benefits society, the economy, and the environment. Opportunities were also available for Dr Clark to contribute to seminars for postgraduate students and staff.
- Contributing to a review of undergraduate module content. Dr Clark identified and suggested engineering trends to include in module material to help enrich the engineering curriculum and enhance engineering graduates' understanding and capabilities.
- During his tenure, Dr Clark helped evaluate the engineering curriculum with a view to improving its industry relevance. His experience of multidisciplinary approaches and teamworking enabled him to contribute to industry-based project work within undergraduate and postgraduate teaching, reinforced by company visits facilitated by his extensive industry connections. His experience of entrepreneurship and innovation in engineering also enabled him to contribute to strategic curriculum development.

Dr Clark's experience aligned with a new master's programme in advanced thin film technologies and it was anticipated that he would help enhance the programme. Further, he could provide industrially based projects relevant to students' master's dissertations.

The experience

In his first year, Dr Clark spent on average three days each month at the university, contributing to undergraduate and postgraduate teaching modules. He lectured on the industrial applications of module content and evaluated laboratory-based teaching to enhance its industrial relevance. He used two-thirds of his time to prepare for undergraduate teaching, enhancing existing modules, and developing project work and external connections; the remainder focused on preparing postgraduate teaching modules for the new master's programme in advanced thin film technologies.

His role as chair of the Industrial Advisory Board (IAB) within the School of Computing, Engineering and Physical Sciences supplemented his work as a VP. A key IAB aim was to organise placements for interested undergraduates.

During his second year Dr Clark engaged at all levels of student activity. As chair of the IAB, he helped implement a new module for third-year undergraduates, which included visiting lectures, hands-on, industry-relevant experiments, and placements within companies. The module also involves students in writing a technical business plan and makes them aware of funding routes for innovation within science and engineering. Dr Clark secured a small funded prize from an industrial sponsor for the best project each year for the first three years.

Dr Clark delivered two lectures on the new master's in thin film technology, both developed in the previous year.

His involvement brought other, unplanned benefits for Dr Clark, his company and the university. He was involved in two joint Innovate UK projects, generating funding and several areas of novel collaboration. His interactions with engineering disciplines at the university resulted in the creation of an advanced robotics Knowledge Transfer Partnership project between the university and his company, which involved a university chemical engineering graduate.

The future

In his third and final year as a VP, Dr Clark will continue to contribute to improving teaching quality, maximising student capabilities and employability, and introducing the importance of innovative engineering. Students will benefit in the longer term as his new material will be hosted on the university's virtual learning environment. His work with staff will have improved their understanding of industrial applications, innovation and entrepreneurship, to the benefit of students in the long term. Master's students will have an opportunity to visit his company and work on joint projects.

Similarly, his strategic involvement in undergraduate and postgraduate module content review, focused on industrial applications for module material, will be captured for ongoing use within the university's review system. Dr Clark's involvement in establishing industrially relevant experimental projects for both undergraduate and postgraduate courses will be embedded within current experimental project work ensuring sustainable future use. Similarly, the external connections established with industry will be embedded into the university system with permanent university teaching staff establishing direct relationships with appropriate industry contacts.

> ***"[Dr Clark] helped implement a new module intended to expose third-year undergraduates to industry through a combination of visiting lecturers and practical hands-on, industry-relevant experiments and also securing placements within several companies."***

Dr Paul Davies

Visiting Professor in Risk Assessment and Marine Technology

Liverpool John Moores University

Summary

Dr Paul Davies was appointed as a Visiting Professor (VP) at Liverpool John Moores University in September 2016 to offer industrial insight about a changing industry. The aim was to make the bachelor and master's in engineering and master's in science programmes in marine engineering, naval architecture and engineering management better reflect the maritime sector, which would, in turn, significantly enhance the employability of the university's marine and offshore engineering students.

The need

The complexity of ship design and operations has increased as new technologies have arisen and been adopted. To manage this change, new regulations are increasingly goal-based, causing the need for risk assessment to demonstrate that aims have been met. This has encouraged further innovation and led to the rapid development of technologies to tackle safety, security, environmental and business challenges. It is therefore necessary to reflect such developments in contemporary programmes in marine engineering, naval architecture and engineering management.

The solution

To ensure that engineering teaching reflects new developments in regulation, ship design and operations in marine and offshore engineering, the university needed new modules and for existing modules to be updated. The appointment of a VP would help achieve this and significantly enhance the employability of the university's marine and offshore engineering students by providing:

- industrial skills input on the commercial aspects of research ideas, appreciation of real-world problems and entrepreneurship
- tailored careers training enabling students to better identify and reflect on their personal strengths, to develop entrepreneurship skills, and to plan effective job searches and applications
- links between students and industry, ship builders and ship operators
- input to students' projects to help them demonstrate learning and research skills
- enhancement of a marine risk assessment module to provide students with the ability to recognise and address safety risk issues in marine technology
- industrial insight and vision to student mentees, for improved employability.

> *"Dr Davies extensive industry background proved valuable in enabling him to contribute more generally to the university."*

Dr Davies was an ideal candidate; he had technical and managerial experience and expertise at a number of recognised industrial organisations, including Lloyd's Register, ERM and DNV. As a technical manager for risk assessment within Lloyd's Register Marine, he has led and developed practitioners in the application of risk assessment, provided oversight of projects involving risk assessment justifications, and led the revision of ships' rules for liquefied natural gas and alternative fuels. This experience and expertise allowed him to benefit engineering students by working towards the achievement the specific objectives.

Dr Davies' appointment improved the training of students for improved employability, increased the understanding of interdisciplinary engineering subjects in industry, helped develop a teaching and research culture based on creativity, scholarship, interdisciplinary cross-fertilisation and industrial relevance, and ensured that curricula were informed by employment/industrial developments.

The experience

In his first year, Dr Davies made progress on the objectives. Specifically, he:

- outlined a new industry-driven BEng module in risk assessment for mechanical and marine engineering, and maritime operations. Discussion about creating content for the module, with an emphasis on industrial case studies, had started. In December 2016, the key contents were tested and delivered to students in engineering disciplines
- reviewed and updated, in co-ordination with relevant academic staff, modules in marine design engineering, ship propulsion and design, and maritime and offshore safety analysis to reflect latest industry terminology, approach and regulatory focus. Dr Davies also delivered three hours of lectures in two of these modules, with particular emphasis on industrial applications
- provided industrial guidance, careers advice and coaching to two master's project students alongside the host academic. He also delivered two industrial training/careers workshops on risk assessment in the maritime and industrial workplace
- joined the department's industrial advisory committee where he contributed to the organisation of a joint research project, planning student placements, curriculum development and transferable skills development, as well as improving links between the university and industry.

In the second year, Dr Davies made further progress in areas initiated previously. The three modules started in the previous year were further reviewed and updated to reflect latest industry terminology, approach and regulatory focus. Dr Davies also delivered six lectures within these modules, with emphasis on industrial applications. His responsibilities for mentoring students continued, with attention paid to providing students with industrial guidance, industry contacts and on facilitating discussions with industry. For example, Dr Davies established contacts for a research survey for artic shipping and helped source industry data for lifecycle analysis.

As an attendee of the faculty's Research and Scholarship Committee, Dr Davies contributed to the development of a proposed Training and Research Centre for Risk Assessment. His contributions included expanding the pool of externals to present to students and staff on alternative fuels, ship building and risk assessment.

Dr Davies continued to help supervise students at all levels alongside the host academic. His extensive industry background proved valuable in enabling him to contribute more generally to the university. For example, he promoted the university by developing and delivering a module on risk assessment for the master's degree at the University of Trieste, and authored an article for *The Conversation* entitled 'Greener fuels may not make shipping safer – here's why'.

The future

In his third and final year as a VP, Dr Davies will continue to deliver the planned activities. His contact hours with engineering students at bachelor's and master's levels will increase, including delivery of lectures and mentoring project students. He will also help develop the university's e-learning and distance learning curricula.

The university wishes to continue working closely with Dr Davies beyond his VP placement and will seek funding to support him for a further three years, so that the students, staff and department continue to benefit from this partnership.

> ***"[Dr Davies] contributed to the organisation of a joint research project, student placement planning, curriculum development and transferable skills development, as well as enhancing links between the university and industry."***

Steve Franklin

Visiting Professor in Bioengineering Industrial Innovation and Exploitation

University of Sheffield

The University Of Sheffield.

> *In his first year, Steve undertook a range of activities, focusing on his contribution to the undergraduate teaching and learning.*

Summary

The University of Sheffield has introduced new multidisciplinary undergraduate degrees and master's courses. In 2016, the university appointed **Steve Franklin** as a Visiting Professor (VP) to help stimulate growth in student numbers in these areas, as well as ensure that modules delivered are high quality, have the relevant content to form the programmes' structure and are industrially relevant.

The need

Bioengineering is a recent area of focus for the university. It introduced new multidisciplinary undergraduate degrees, both cross-faculty (bioengineering) and in individual departments (such as mechanical engineering with biomechanics), along with master's courses (such as medical imaging in the Department of Electrical and Electronic Engineering).

The university is keen to stimulate growth in student numbers in this area and steer the modules that form the programmes' structure to ensure that they, along with the wider curriculum, are industrially relevant. A portfolio of engineering interdisciplinary programmes exists as a platform for undergraduate teaching and research in this discipline and the university was keen to consult an industry representative on the plans.

The solution

Bioengineering and affiliated subject areas are key areas of planned growth. The university aimed to ensure that, as undergraduate and postgraduate student numbers grew, the teaching quality, industrial content and relevance, professional and transferable skills, and employability of undergraduate students was of the highest standard. A target exists to ensure that over 90% of graduating students are in graduate-level employment or higher degree study within six months of graduation.

The university wanted Steve, who was Chief Technologist/Principal Scientist at Philips Research in Eindhoven, to help develop the academic-industry interface in tribology, bioengineering and surface coatings with Philips. It consulted Steve about the strategic development of bio-related subjects across the Faculty of Engineering. His expertise in bioengineering strengthened the industrial content and relevance of programmes for students and, when his contribution was effectively disseminated, provided the basis for achieving the university's targets. Beyond his Philips connections, Steve offered a wider industrial and university network through which to foster a sustainable network of collaborators.

The university's view was that students with industrial experience during their degrees vastly increase their employability. Philips had an established industrial placement scheme with the Department of Materials Science and Engineering, and Steve was keen to expand this to other departments, starting with bioengineering and mechanical engineering.

Steve has contributed to undergraduate teaching and its further innovation by delivering lectures and developing module plans and degree programme specifications. It was expected that he would also contribute to the development of existing modules related to his areas of expertise: tribology of machine elements, innovation management, design skills, surface processing of materials, and project management in industry. He was particularly keen to focus on case studies related to industrial application of theory that students are taught. This was considered to be an area where he could make a sustainable impact.

Beyond his contributions to traditional engineering modules, Steve has become involved in teaching innovation and business planning – a response to increasing student interest in enterprise and related topics, with an interest in setting-up businesses. Steve is well-placed to teach students about the design and development of new products, about how to manage innovation and intellectual property in industry, and to provide examples from his own experience at Philips. He typically mentors one or two final year project students each year with an emphasis on technical guidance and industrial links.

Steve's experience was such that the university asked him to contribute to teaching master's students. He led the taught elements and provided briefings and mentoring for the student's individual and group mini-projects.

Steve is also contributing to mechanical engineering and materials science and engineering undergraduate careers days, as well as wider faculty and university activities. The university engages in STEM outreach, with an emphasis on embedding equality, diversity and inclusion for school students when considering engineering as a degree subject. Steve contributes by illustrating how engineers directly influence the activities of daily living and make a real impact in the world.

The experience

In his first year, Steve's activities focused on his contribution to undergraduate teaching and learning. In particular, he developed and delivered lectures as part of seminars on project management in industrial research and development and tribology industrial case studies.

Steve was involved in running the Project Presentation Day for students on the materials science and engineering master's degree who were undertaking five-month industrial placements, at which he helped assess the student presentations. Similarly, he assessed undergraduate student project posters of bioengineering and mechanical engineering final year undergraduate students, which also involved discussions with students.

At postgraduate level, Steve prepared and delivered two masterclasses for tribology students from Sheffield and Leeds through the Centre for Doctoral Training in Integrated Tribology (an EPSRC-funded joint venture between the universities of Sheffield and Leeds). He also provided coaching for a master's degree student project.

Steve also actively contributes to the industrial advisory boards for bioengineering and mechanical engineering, has met staff to discuss a new collaboration between biomedical science and the school of dentistry, established an EPSRC project sponsored by Philips, and held networking discussions with representatives from the chemistry and materials science and engineering departments.

The future

In his second year Steve plans to continue lecturing to undergraduates. He is also continuing to deliver masterclasses to postgraduate tribology students and arrange industrial placements for students, as well as investigating the possibility of sponsorship for a PhD student. The university is planning measures to ensure that Steve's work has a long-term impact, specifically:

- exploring funding mechanisms to ensure that Steve can maintain activities at the university beyond his tenure as a VP
- making sure that Steve's lectures are recorded and available online for future use and that his case studies are packaged and available for teaching staff to use
- training and educating academic staff in areas where industrial experience is key, such as how innovation is managed in industry, IP, commercialisation routes and industrial design.

> ***"... as undergraduate and postgraduate student numbers grow, the teaching quality, industrial content and relevance, professional and transferable skills, and employability of undergraduate students is of the highest possible standard."***

Pierre French

Visiting Professor in Innovation and Employability in Automotive Powertrain Systems

University of Huddersfield

University of HUDDERSFIELD

> *Having access to Pierre's wealth of knowledge and turbocharger related skills would give students a clear advantage when applying for employment in this important industry.*

Summary

Pierre French was appointed as a Visiting Professor (VP) in 2015 to help develop a greater understanding of real-world issues, including how learning is applied in industry, engineering's impacts on society, and professional and ethical issues. The overall intent was to help graduates develop more realistic expectations and appropriate attitudes, and to prepare them to transition to work more effectively.

The need

The School of Computing and Engineering at the University of Huddersfield identified a need to provide students with a greater insight into real-world issues, to help graduates be more 'work-ready'.

The solution

Pierre French, a well-known, senior and respected figure in the turbocharger industry, was appointed as a VP. Cummins Turbo Technologies and BorgWarner Turbo Systems were major employers in the university's vicinity and the reason that it has a Turbocharger Research Institute. Having access to Pierre's wealth of knowledge and turbocharger-related skills would give students a clear advantage when applying for employment in this important industry.

The proposed VP work programme covered both undergraduate and postgraduate studies.

Pierre contributed to the engine systems module, which involved around 150 first-year students and around 50 third-year students each year. Students learned how the application of turbocharging and other air handling systems was becoming key to achieving emissions levels and fuel consumption targets. As a member of the Institution of Mechanical Engineers, Pierre had the background to teach about professionalism in engineering, so he contributed to the professional studies module that ran throughout the whole school, benefiting over 300 students a year across all engineering disciplines.

As well as teaching, Pierre helped develop second-year laboratory classes in engine thermodynamics and performance for around 150 students each year, to enhance their industrial relevance.

Pierre's knowledge has the biggest benefit in the degree's later syllabus. In helping to define, structure and supervise industry-based or industry-related projects for final year students, he provided a realistic view of the project types to expect in industry. Coupled with a recent upgrade of some of the university's labs to reflect the standards and processes expected in industry more accurately, this helped students move smoothly into their first graduate roles.

Formula Student is a major project that the university uses. It includes elements of project management, organisational skills, people management and working to deadlines. Pierre's involvement significantly improved the experience for the many undergraduate students involved from the second, third and fourth years, setting an example for other student project groups to follow.

Pierre's appointment also has wider benefits. One proposed objective was for him to help establish a series of mentoring events linking students with local engineering alumni, so that students could learn from engineers who had succeeded through the same educational process. Pierre's contacts in the local region helped establish this. He also contributed to the development of the department's strategy by helping the university understand the knowledge and skills industry requires

of graduates. Similarly, his appointment benefited the Turbocharger Research Institute, already an important part of the longer-term departmental strategy.

The experience

In his first year, Pierre developed and delivered eight two-hour lectures to classes of around 100 students as part of the professional development module. These covered employability skills, teamwork, ethics, leadership, problem-solving and intellectual property from an industrial perspective. He emphasised industry approaches, employer-expectations of newly graduated engineers, the importance of people skills, the need to work in teams, and to realise that one is working for a company and not for oneself. Having graduates start work with realistic expectations and an appropriate attitude helps them develop more quickly. These lectures were integrated into the curriculum and recorded as a revision aid.

Pierre also acted as project supervisor for six final-year students, providing reflection and ideas while leaving the student in charge of the project, which proved popular. He also helped review the design methodologies taught within the undergraduate courses, identifying areas for improvement. A series of talks on the topic of classification of characteristics was planned to complement design review and FMEA processes taught in the university.

In his second year, Pierre continued to develop new lectures to include in undergraduate programmes, particularly to enhance students' understanding in areas that are rarely covered during normal university studies. Around 500 students attended these talks on:

- ethics in industry
- leadership and teams
- problem-solving
- intellectual property
- classification of tolerances
- 'tips on being in industry'
- 'how turbochargers really work'.

Several were developed in conjunction with Cummins Turbo Technologies and the material was presented jointly by Pierre and specialists from the company. The relationship is now established to an extent that Cummins is prepared to support this initiative for future years.

Pierre advised the department's research group on heat-transfer technology development in turbochargers, which led to a framework for a master's project with the involvement of Cummins Turbocharger Technologies. He attended poster day and independently marked several projects. The marks he awarded were compared to those of university staff and a good correlation noted, indicating that the university's marking reflected how the industry might view the work. Pierre was appointed to the Engineering School Board during 2017.

In his third and final year as VP, Pierre was extensively involved in undergraduate programmes; he continued to provide lectures and supervised two final year projects. He was involved in assessing student presentations and poster sessions; his 'fresh eyes' approach has had an influence on the way that staff and students approach these assessments.

Pierre also continued as a member of the Engineering School Board during 2018, advising on the restructuring of the master's level courses.

The future

The material that Pierre developed will continue to be available for staff use and for the benefit of the students. At the same time, staff will benefit in the longer term by learning new technical and management skills, in particular working with someone with a wealth of experience helped to develop the more junior staff in ways that can only be achieved through long-term exposure. However, the best indication of the value of Pierre's work with the university is that the university appointed him as a VP for five years from the end of his current tenure. He is also still heavily involved in the professional studies modules at all levels.

> ***Having graduates start work with realistic expectations and an appropriate attitude helps them develop more quickly in the first few years.***

Dr Isobel Hadley

Visiting Professor in Safety Critical Engineering Components

University of Bristol

Summary

Dr Isobel Hadley was appointed as a Visiting Professor (VP) in 2016 to exploit existing close inter-department collaboration within engineering at Bristol. In particular, her appointment aimed to provide a rich teaching programme with significant and meaningful industrial input.

The need

The University of Bristol's Faculty of Engineering traditionally had a number of undergraduate courses related to failure of engineering materials and structures. Their content was often practically orientated, but these courses required much more significant interaction with industry.

The solution

Creating master's-level courses that have significant industrial interaction was a strategic initiative with three objectives:

- Facilitating links between academia and industry.
- Bringing together new undergraduate M-level modules.
- Helping to meet the skills gap.

The overall aim was to develop and deliver new courses that developed industrial experience among fourth year (final year) undergraduate students.

> *"Helping fill the gaps between the course content and the skills needed by the nuclear industry was identified as a key role for a VP."*

The courses would be principally available to mechanical, civil and aerospace engineering students, with an aim to include undergraduates from the Faculty of Science. Irrespective of their disciplines, these new courses would expose students to challenges faced by industry in operating and designing safety critical engineering components (such as power generation systems and gas transmission pipelines).

These new courses, in the integrity of safety critical engineering component, would be based around:

- application of fracture mechanics to high-integrity structures
- examples of, and investigations into, engineering failures
- importance of integrity in infrastructure
- understanding hazards and risk
- the role of codes and standards
- the culture of quality.

The VP would also promote 'industrial thinking' in the wider teaching programme. They would also contribute to the University of Bristol being able to provide leading-edge and innovative research and education to support the safe operation of safety critical systems in the UK and worldwide.

The role

Dr Hadley, the Technical Authority at Integrity Management Group (IMG) and Technology Fellow at TWI Ltd, was appointed VP in integrity of safety critical engineering components.
Her roles were to contribute to the development and part-delivery of the integrity of safety critical engineering components course themes and to provide advice in the curriculum development of the remaining themes.

Initially, Dr Hadley used material she had previously created developed and refined for internal training within TWI, working with academic staff in the aerospace, civil and mechanical engineering departments to tailor the material to meet the learning outcomes for engineering undergraduates.
In parallel, she advised on the development and content of other relevant courses. Later, she helped deliver the new material, providing 24 classroom teaching sessions of about 50 minutes each. Related activities included:

- being available for Q&A sessions
- helping students to independently carry out example numerical exercises
- contributing to student assessment
- supervising two individuals, or one group, per academic year to meet the requirements for the new structural integrity units in the M-level programme
- leading one group challenge task and helping facilitate similar tasks with industrial partners.

The new modules provided foundations in the science and engineering of the structural integrity of safety critical engineering components. Through project work, they also exposed students to the underpinning requirements for ensuring structural integrity not normally covered in any depth at universities. The courses developed the knowledge and skills industry needs as they were derived from the requirements for industrially 'suitably qualified and experienced personnel'.

Dr Hadley's industrial expertise also enabled her to introduce 'quality' as an essential ingredient in structural integrity, thus helping students understand key characteristics of industry, such as safety culture; this was a key employer requirement. She also helped students appreciate the immediacy of industrial challenges as a preparation for interaction with and employment in industrial sectors such as oil and gas, power generation, and construction and engineering.

Dr Hadley helped develop industrially focused group work and research projects for students. The group work provided context and perspective on the kinds of challenges that engineering graduates face in the 'real world'.

The experience

Dr Hadley provided substantial input and development to the new course. She specifically developed sections on:

- The concepts of fracture mechanics and structural integrity assessments, in theory and application – preparing several real industrial case studies around which lectures are structured.
- Explaining the standard and recent experimental methods through which the fracture parameters are determined and how they are used in the assessment of engineering structures – as the chair of the committee that develops and maintains BS7910, her intimate knowledge of this national standard, informed her teaching.
- Application of numerical simulation (finite element analysis) in fracture mechanics – this section was based on her experience of undertaking many structural integrity assessments of safety critical structures in industry.

Surveys were carried out at the beginning and at the end of term to understand the course's impact, compared to conventional lectures, and to measure the change in students' views about the skills they require to be a successful practising structural integrity engineer. The surveys identified that, before the introduction of the new course, many students had little idea of what would be required of them; afterwards, they were much more aware of issues such as the importance of standards in industry.

The future

The department plans to further develop the course in structural integrity, which is currently offered at M-level to master's students in mechanical engineering and nuclear science and engineering, for other fields such as civil and aerospace engineering.

> ***"... the material provided in the courses aimed to ensure that the content was targeted on industry needs, in terms of knowledge and skills."***

Malcolm Lees

Visiting Professor in Software Performance Engineering

King's College London

Summary

Malcolm Lees was appointed as a Visiting Professor (VP) in September 2017 to help educate students at King's College London in software performance engineering. This included modelling performance-relevant aspects of systems, using different techniques for performance analysis and techniques for avoiding common performance issues in system design, and understanding how to balance these additional demands with the increasing time pressures of modern software development. Students would, therefore, be prepared to understand the work on performance engineering assignments in industry from the start of their career and know the importance of software performance engineering.

The need

Software performance engineering provides tools and techniques for modelling and analysing the performance of a proposed software architecture before it is implemented. Together with techniques for monitoring and continuously improving the performance of a system as it is implemented, deployed and used, this can provide substantial improvements in system stability and scalability while reducing the cost of system development and maintenance. Despite the clear benefits, software performance engineering is not habitually practised by many software development teams. In particular, many teams following an agile approach to software development often view the required upfront effort as unproductive overhead.

The solution

Malcolm helped the university counter this trend by improving education about the problems of and solutions for software performance. Malcolm's extensive industrial experience includes real system performance issues and effective methods of addressing them. This combined with the university's expertise in education, and software engineering and architecture to provide the foundations of a new module in agile software performance engineering that was trialled and developed into a sustainable offering.

Malcolm's industrial experience includes over 15 years as an independent consultant on performance engineering for large-scale software-intensive projects. This enabled him to teach students in a practise-oriented manner, helping to prepare them to work on performance-engineering assignments in industry.

He set assignments based on real-world scenarios, through which students explored the pressures on developers' time and their ability to consider the performance of the systems under development. Skills that students learned included assessment and prioritisation of performance risks, modelling of performance-relevant aspects of systems, different techniques for performance analysis, techniques for avoiding common performance issues in system design, and ways of balancing these additional demands with the increasing time pressures of modern software development. This helped them understand quality attributes of software systems.

> ***"Despite the clear benefits, software performance engineering is not habitually practised by many software development teams."***

Malcolm's contribution to teaching fit into the wider strategic focus on student employability and further enabled the university to embed employability skills directly within the curriculum. There were several specific activities that he supported, in close collaboration with Dr Steffen Zschaler, a senior lecturer in the Department of Informatics:

1. **Year one:** designing and testing teaching material for software performance engineering and integrate into the overall curriculum. In particular:

- designing and teaching a one-week intensive summer course on software performance engineering
- creating a new optional module on software performance engineering at Levels 6 and 7 for the next academic year. Malcolm helped identify content and prerequisites, a suitable location in the programmes the department offered, and mechanisms to ensure the longer-term sustainability of the proposed module.

2. **Year two:** trialling the module developed in the first year. The module was taught for one term, requiring Malcolm to spend 10 half-days teaching and spend three days designing and marking assessment activities. Malcolm also gave an introductory lecture on the importance of performance engineering to students on the software-engineering group projects. In parallel, he continued to engage in curriculum-design activities, including a continuous evaluation of the new module and revision of the teaching materials.
3. **Year three:** delivering the new module to a more substantial group of students, responding to issues arising and ensuring the module's sustainability and continuity beyond his tenure. Crucially, from the start an academic fully co-taught the module, who could continue delivery at the end of the Visiting Professorship. Malcolm also participated in curriculum and strategy development.

The experience

Malcom completed his first year as a VP in summer 2018. As planned, he co-developed the new module in software performance engineering, which was internally approved and made available for students starting from the academic year 2018/19. The module is optional and taught in the third year of undergraduate degrees. Discussions were underway about making the module mandatory for a new software engineering pathway.

Module sessions were based around particular issues in software performance engineering and used case studies. Each case study had structured information for students, questions, expected answers and insights into what really happened. This effectively drove students' group working sessions. Pre-reading was identified for each session with, in some cases, tasks to be undertaken; consequently, the module can be run in 'flipped-classroom' style, making the most of Malcolm's time.

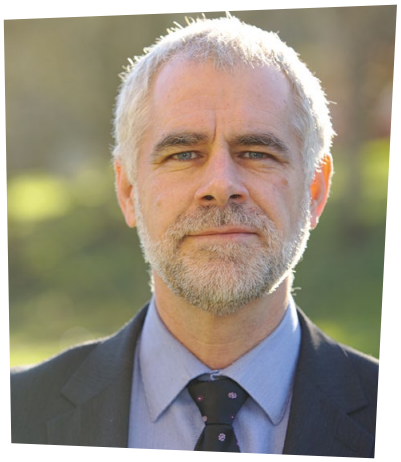
The original proposal included module trials via a summer school course and was offered in the 2018 prospectus. However, it was more difficult than expected to market the course as the format and target audience differed from the usual format. Although the summer school course was cancelled that year, it attracted interest from senior university staff. As a result, and following discussions, the summer school course is being offered from the summer of 2019.

The demands of developing the new module were greater than anticipated. Consequently, there was limited time for other activities. However, Malcom gave an evening workshop overview of software performance engineering and a similar session is being considered for 2018/19.

The future

Despite the need to focus heavily on developing the new module in the first year, the university saw the primary benefit in its relationship with Malcolm as the curriculum and design activities to improve the educational offering more generally. The department continuously reviews its programmes and modules to make them as relevant as possible to students' future careers. Over the second and third years, Malcolm will engage more in this work. Malcolm and the university may consider making the teaching materials he developed more widely available, possibly as a textbook on performance engineering, to ensure the work's impact not only beyond Malcolm's tenure, but also beyond the university's boundaries.

> ***"Malcolm's contribution to teaching fit into the wider strategic focus on student employability and further enabled the university to embed employability skills directly within the curriculum."***



Dr Jon Machtynger

Visiting Professor in Artificial Intelligence and Cloud Innovation

University of Surrey

Summary

Dr Jon Machtynger was appointed as a Visiting Professor (VP) in 2016 to help develop a strong industrial understanding of future emerging areas in technology. His remit was to help students develop broader skills to be successful in industry, as well as to provide visibility of IBM's activity in cloud and cognitive computing across the University of Surrey.

The need

The Department of Computer Science at the University of Surrey is continually looking to strengthen links with industry so that students can gain industrial experience and learn from industrial experts.

The department has identified machine learning, artificial intelligence and cloud computing as key areas in computer science. The demand for these skills in industry is growing strongly and therefore students need them to remain competitive and improve their employment prospects.

The solution

The appointment of a VP was intended to contribute to the development of these newly identified skills among Department of Computer Science graduates. The primary ways of achieving this would include:

- professional engagement sessions to help students develop a broader view of industry
- final year projects linked to this Visiting Professorship to help students demonstrate the relevance of their project to industry.

The main aim was to improve students' employability. At the same time students would increase their awareness of the industries that use artificial intelligence and cloud technologies and how they are used. This would inform the placement choices of students undertaking a professional training year.

Dr Jon Machtynger was a Cloud Adviser to IBM at the time of his appointment, having worked for IBM in different roles since 2002. He now specialises in advanced analytics and artificial intelligence solutions for global clients at Microsoft.

The role

Dr Machtynger's primary role was to provide industry leadership within the Department of Computer Science. He also helped develop relationships with other university departments that had an interest in cloud and cognitive computing, using IBM's active role with universities across the UK.

Finally, the appointment was expected to:

- strengthen the university's ability to identify competitive capabilities in cloud and cognitive computing
- influence the research in nature-inspired computing and engineering, which focused on the application of machine learning in healthcare and sustainability and on fundamental research related to computational intelligence.

The experience

In his first year, Dr Machtynger delivered the following taught sessions:

1. Career Progression: focused on the skills and attributes that complement the formal curriculum (including attitudes, eminence, supporting activities, personal branding, mentoring and identifying a set of next steps).
2. Final year project delivery hygiene: looked at contents of the final year project and how to make projects more industry relevant.
3. Cloud innovation sessions, with Hugh Varilly from UCL School of Management: considered computer science, business studies, biology, material sciences with a focus on the nature of 'cloud' (disruption,

industry implications, and how it impacts the user experience and solution process).

Less project supervision activity was undertaken than expected but this was balanced by greater effort at a broad, strategic level. A need was identified to focus on the industrial relevance of final year projects; therefore, Dr Machtynger developed and delivered a session to final year students to help ensure a pragmatic view on the deliverables – namely issues such as user-centricity, security, scalability and resilience. The final-year project guide was modified to reflect these changes, and a review of how similar changes in the future can be fully embedded.

Dr Machtynger also reviewed the practical business analytics module and identified a need to reshape the delivery of content to focus on industrial relevance rather than tools. He also engaged with the collective intelligence final-year module, which included being on hand to respond to student enquiries.

Dr Machtynger helped facilitate discussion about industry involvement in a new master's in data science. He has helped the department identify the types of internships that could be sought for the course and will be working with it to engage other industry partners to promote the internship within the programme. The course will begin in October 2019 following validation. The introduction of a master's in data science expands the department's portfolio master's programmes to align its research expertise in machine learning and artificial intelligence. The other master's programmes are in information security (a GCHQ-accredited course) and information systems.

The nature of cloud developments was reviewed, with reference to how curricula have followed cloud development, and the latency between industry adoption and subsequent inclusion in the curriculum. Dr Machtynger worked closely with Dr Gillam, the Director of Learning & Teaching and Senior Lecturer in the Department of Computer Science, on this review and the outcome of the work is expected to be co-published.

In his second year, Dr Machtynger supported the practical business analytics module. He helped a new staff member to transition into the module and balance delivering fundamental principles while strengthening its industrial importance. In light of these challenges, and by adopting a flexible approach, Dr Machtynger ensured that his efforts benefited the university and its students. He sought and took opportunities to discuss content and curriculum and to provide additional links into IBM for academic staff. His notable contribution was the introduction of IBM's design-thinking approach across the second and final year, both to support the second-year software engineering module, which was a group project-based module, and in the final year to support the scoping of designs in final year projects. It helped enormously to bring additional user-centricity into the heart of the codification and user-requirements process, a technique that is common in industry. This was undertaken with computer science undergraduates and also in the university's Digital World Research Centre for design undergraduates.

He continued to support individual project supervision and final year projects, which focused on artificial intelligent design and architectural approaches.

In addition to delivering taught sessions, Dr Machtynger also actively participated in presenting at two Surrey-led international workshops. The first was the 2017 Workshop on Hybrid Human-Machine Computing, and the second was the 2018 Surrey Law School Workshop on the Regulation of Artificial Intelligence.

The future

Dr Machtynger's delivery of design thinking methodology will feature strongly during the third year of his appointment.

In his final year, he will also work closely with the head of department to collaborate on the industrial aspects of the master's in data science. He will participate in the validation of the course and help identify opportunities to promote the programme with key industry stakeholders in data science.

He will also mentor the presidents of university societies that are related to computer science. This will provide the basis for supporting committees to identify ways to leverage industry support for talks, events and activities that they run.

In 2018, the department initiated a mentoring scheme, pairing up mentors from its alumni with current students. The Surrey computer science community is key for the department. It celebrates the successes of current students and values the significant contribution its graduates make in industry as technology and industrial leaders, and to society at large through the promotion of computer science. Dr Machtynger also respects the department's core value of community and has volunteered to become a mentor. He will also help the department mentoring programme, providing valuable input to make it sustainable and to identify strategies to evaluate its success.

Stephen Newbury

Visiting Professor in Future Materials Technology and Business

University of Oxford

UNIVERSITY OF OXFORD

> *"Teaching students how materials innovation creates value and intellectual property for firms helps them move from academia to industry where science is, ultimately, required to deliver a return on investment."*

Summary

Stephen Newbury was appointed as a Visiting Professor (VP) at the University of Oxford in September 2017. His aim was to help improve aspects of teaching and deepen the understanding of and connections to industry by introducing new content and perspectives to enhance, broaden and invigorate key elements of the undergraduate experience.

The need

The University of Oxford had identified areas in its materials science undergraduate curriculum that it wanted to strengthen, specifically adding new industry perspectives for how materials science is applied in a modern industrial setting, and increased awareness in the small, fast-moving, high technology company context. There was a need to introduce new content and perspectives, unavailable from existing staff and transform key elements of the undergraduate experience. The context for this was the growing economic importance of research and innovation undertaken by smaller and often very high-tech companies, of which the Oxfordshire region has many.

The undergraduate master's in engineering degree included four elements that introduced and developed skills in topics beyond core academic science and engineering content: entrepreneurship, team design project, research project, and industrial visits and talks.

Although these met some key learning outcomes required in the Engineering Council's UK-SPEC (UK Standard for Professional Engineering Competence), the university wished to strengthen outcomes to ensure that these elements were fully integrated.

The solution

Teaching students how materials innovation creates value and intellectual property for firms helps them move from academia to industry where science is required to deliver a return on investment. Armed with examples of how business models drive materials innovation and how this helps build value, undergraduates can demonstrate that they appreciate the commercial setting of their specialist materials knowledge. These examples, in the form of case studies and business model tools, provide a framework with which to understand how to build value for employers and customers. In particular, students can be confident about their roles in smaller companies and more likely to consider starting their own companies.

Stephen is an innovation specialist working across industry, academia and government, including Williams Advanced Engineering. His interest in business models along with his focus on building value by synthesising technology, engineering, customer needs, investment and entrepreneurship to drive growth in SMEs, was ideal for the VP role envisaged.

Stephen's input to curriculum development was intended to help improve the industrial relevance of the master's in engineering course. It would also demonstrate the university's commitment to maintaining a strong core content of immediate relevance to modern-day business. Through his extensive network, Stephen created new opportunities for undergraduates to attend events, join projects, get work experience, and make connections.

More widely, Stephen helped broaden the university's outlook and understanding, and provided direct engagement with other materials-related SMEs. The university's association with Williams Advanced Engineering was expected to facilitate new interactions with industry, particularly in performance engineering and advanced materials. Stephen also brought his extensive engagement with industry, including with SME innovation, through the Foresight Williams Technology Enterprise

Investment Scheme (EIS) Fund. His ability to bring together materials science innovation with business models and investment meant that the university could transform its ability to teach using current examples of fast-growth materials science SMEs, which bridge science and commerce, and help budding entrepreneurs understand and build tomorrow's firms.

A key part of Stephen's role was contributing to strategy development. He joined the Industry Advisory Panel and faculty and was the only external person on both. He was in a unique position to influence and link the department's teaching and industrial engagement strategy and content.

The four specific ways in which the university expected Stephen to contribute to the curriculum were:

- play a leading role in the curriculum development, delivery and provision of supporting documentation of an undergraduate module in entrepreneurship
- co-supervise second-year undergraduate team design projects, bringing example challenges and teaching students how such problems are addressed in industry
- lead a short induction programme for the fourth-year cohort's eight-month full-time research project, including workshops on how to consider and articulate engineering context, sustainability, and ethics and integrity
- facilitate industrial visits and deliver a workshop on technology and knowledge transfer in collaboration with Oxford University Innovation (the university's technology transfer company).

The experience

In his first year, Stephen focused initially on familiarisation to help his interventions over the three years incrementally improve and deliver positive impacts for students. Alongside and informed by this familiarisation process, Stephen identified a number of areas for improvement, and begun by implementing two new initiatives.

1. Developed a workshop to explore latest industry approaches on thinking about and measuring sustainability and any ethical implications for composites and metals deployment. Working with two external experts, Stephen would deliver the workshop in his second year, through lecture and group working.
2. Providing insights into markets and market disruption – how technology can be used to address customer needs wrapped in viable business models. Stephen developed a two-hour lecture and workshop, including case studies, explaining how markets work and exploring how to measure markets, how technology is sold and to whom in the supply chain. The session helped undergraduates understand the importance of identifying and validating the size of markets, and approaches to and risks of adoption.

The future

In his second and third years, Stephen will contribute to the undergraduate curriculum in the four ways originally identified and deliver a half-day workshop on sustainability ethics. The long-term impact of his efforts will be reinforced in ways that include:

- his new teaching materials being available to other staff who will be trained to provide continuation of knowledge
- the workshop on sustainability ethics forming a core part of future teaching, subject to acceptance by the department
- using lecture capture technology to record his lectures and workshops and make them available within the University of Oxford virtual learning environment
- creation of a reference library of business model case studies and other teaching material
- exploring longer-term strategic collaboration between Williams Advanced Materials and the university
- helping develop the Industry Advisory Panel so it provides more value for students and faculty over the longer term.

> ***"[Stephen] developed a workshop to explore latest industry approaches on how to think about and measure sustainability and any ethical implications for composites and metals deployment."***

Dr Andrew Sherlock

Visiting Professor in Product Design for Profitability

The University of Edinburgh

THE UNIVERSITY *of* EDINBURGH

> *"Most notably Dr Sherlock helped redesign a third-year course, Manufacturing Information Systems 3, on which he had been asked to teach."*

Summary

Dr Andrew Sherlock was appointed as a Visiting Professor (VP) in 2016 to help the University of Edinburgh ensure that its graduates can undertake engineering design in the context of a modern product development environment, thus enhancing their employability. His mix of industry and academic experience was expected to prove particularly potent.

The need

The University of Edinburgh was keen to enhance its product design students' employability by developing their ability to undertake engineering design in a modern product development environment. To achieve this, students needed knowledge of state-of-the-art design practices, including the development and management of product data and an understanding of how cost models contribute to successful products. They should also appreciate the many competing factors in a modern design office, including the role of IT in engineering design through computer-aided design (CAD) and analysis and product data management.

Students would also benefit from exposure to modern technologies and processes for working in collaborative business environments, from understanding how electronic hardware and software is incorporated in mechanical products to the role of concepts such as version control and part identification strategies in engineering solutions.

The solution

As CEO of Shapespace Ltd, Dr Sherlock had successfully undertaken profitability analysis projects with major UK companies and could bring relevant data, case studies and direct knowledge of these environments. This, plus his background as a graduate of, and a former lecturer at, the School of Engineering at the University of Edinburgh, enabled him to teach and mentor students in engineering design for cost effectiveness and help develop the design curriculum. Together with existing staff, Dr Sherlock had already contributed to the degree programmes and the university was keen to consolidate and expand this relationship. His presence helped new academic staff during the school's planned expansion, particularly as employability was a key benchmark for reviewing teaching programmes and the university's processes aimed to ensure an optimum balance of academic rigour and complementary practical skills.

The majority of Dr Sherlock's teaching contribution was expected to be to undergraduates. These teaching responsibilities would focus on the following:

1. Taking the lead in Mechanical Engineering Design 2A, a short intensive introductory course for second-year students, in which they learn how to solve problems with structured design processes. This included practical work in computer laboratories, CAD and drawing, as well as collaborative tools for managing design information and sourcing standard parts, and traditional lectures and exercises on, for example, materials selection and cost analysis. Dr Sherlock would teach the design of a simple device and coach students through a structured process to produce a solution to a realistic problem.
2. Contributing industry-based exercises to Computer Aided Engineering 3, a course in design that exposes third-year students to using computer-based methods for supporting design activities in a real-world, profit-conscious context. This demanding course was highly rated by students because it develops skills that are directly relevant to their future careers. Dr Sherlock's contribution was to highlight real problems in modern CAD environments, which are often overlooked in textbooks.

Dr Sherlock contributed to the supervision and assessment of Mechanical Engineering Individual Project, a final year design-related project that was the culmination of master's students' degree work.

The university did not expect formal teaching at postgraduate level, although it did ask Dr Sherlock to continue to give his guest lecture on the taught doctorate programme module in operations management.

Dr Sherlock would also contribute by:

- advising on the design curriculum during a planned review and restructuring process. Depending on the outcomes of this, Dr Sherlock's teaching commitments could change in the second and third year of his VP placement
- advising staff on general day-to-day activities including, for example, student industrial visits and linking staff with industrialists who might help in aspect of teaching and research
- teaching, developing curriculum and strategy, participating in the design, materials and management teaching committee and the industrial liaison board.

In the longer term, Dr Sherlock played a role in strategy development by advising on industry skills requirements. This strengthened the school's teaching, as him advising and participating formally in these processes helped the school achieve its aims of enhancing quality while also increasing staff and student numbers.

The experience

In his first year, Dr Sherlock was involved in teaching and had already made a very sizable impact in planning for future teaching strategies. Most notably he helped redesign a third-year course, Manufacturing Information Systems 3, on which the university asked him to teach. He contributed to three modules, largely as planned; he designed and delivered lectures and tutorials based around real-world design scenarios; added to existing course content using his links to companies; and informally contributed to undergraduate projects by advising students. Additionally, Dr Sherlock hosted one master's student placement and one vacation placement and participated on the industrial liaison board.

Dr Sherlock continued his successful involvement in teaching the following year. He also made a significant contribution to developing the school's teaching strategies. Because of his involvement in designing a new level 10 course in digital manufacturing, his teaching schedule for his third year would change such that he would not teach the second-year Mechanical Engineering Design 2A course.

Dr Sherlock has industrial experience in the use of augmented and mixed reality (AR/MR) technologies in manufacturing. It became clear during discussion with academics throughout the university that there were opportunities to use AR/MR to significantly enhance students' learning experiences, not only in engineering, but also in the School of Medicine and the School of Art. He received a grant from the Principal's Teaching Award Scheme to fund a developer for 12 months to work with academics to deliver three pilot teaching applications using these technologies. This will be completed in 2019.

> ***"Dr Sherlock had successfully undertaken profitability analysis projects with major UK companies and could bring relevant data, case studies and direct knowledge of these environments to the role of a VP."***

The future

The university envisages that the Visiting Professorship will generate a legacy in the form of teaching materials and methods, staff knowledge, curriculum and other strategic development processes that will last well into the future. However, it also expects that Dr Sherlock will continue to play a role by remaining on some of the committees. The result of the placement was seen as a long-term relationship with Dr Sherlock and several other companies that would help ensure that employability is considered and planned for at everystage of academic development.

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- Position engineering at the heart of society

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