Engineering Skills: Perkins Review Progress Report – in detail

Contents

1. Introduction and thanks from E4E

Professor John Perkins' examination of the state of engineering skills in the UK provided a seminal moment for industry. The now famous 'skills pipeline' graphic, and Professor Perkins' analysis of what needs to happen to pour more people in at every level and reduce 'leakage', has galvanised the engineering community to examine its great task for the years ahead.

While much is still to be done, there is a real appetite for change among the professional engineering institutions, companies, and organisations involved in implementing the Report's recommendations thus far. It has been a privilege to support Professor Perkins and the Department for Business, Innovation and Skills in this work.

Particular thanks must go to the Chairs and members of the Task and Finish Groups, which were created to implement the report's recommendations. Their continued energy and enthusiasm has been an inspiration.

Thanks also to all the organisations which have given their time to consider the proposed outputs from the Groups, and which have been so enthusiastic in their commitment to share the information as it is produced.

Finally, thanks to John Puddy of BAE Systems, and Matthew Beddow from National Grid, who have been seconded to support the Perkins project, and who have brought such great additional insights to the process.

If you would like to be kept updated on progress, please email Claire Donovan at the Royal Academy of Engineering.

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2. Background

2.1 E4E prior to Perkins

Education for Engineering (E4E) was formed several years ago, to provide a forum for the professional engineering institutions (PEIs) to discuss and agree messages around education and skills. In addition to the 36 PEIs, an Expert Advisory Group was also created, to bring in views from other key stakeholders in the engineering skills landscape.

Its role prior to involvement in implementing the recommendations of the Perkins Review was focused on reactive policy representation (such as responding to consultations and providing evidence to Select Committees), and proactive policy formation (such as briefs and messages behind which the engineering profession could unite).

It also provided a single channel of communication with the PEIs on issues of interest to all in engineering education – a useful mechanism by which other organisations could raise awareness of particular related initiatives. There has been less of this work done in 2014, as the resources of the E4E secretariat has been focused on support for the Perkins Task and Finish Groups.

2.2 E4E's role in the Perkins Review

E4E was asked by the Department for Business, Innovation and Skills (BIS) to take the lead in implementing six of the recommendations made by Professor Perkins.

Recommendation 9
The engineering community should provide continuing professional development for teachers, giving them experience of working in industry to put their academic teaching in practical context and enabling them to inspire and inform their students about engineering.

Recommendation 11
The engineering community should work with employers to encourage and support provision of work experience for post-16 students studying in colleges and schools.

Recommendation 15
Engineering employers should encourage their staff to share their skills and knowledge, for example by participating in the Education and Teaching Foundation's Teach Too scheme.

Recommendation 16
Government and the FE sector should encourage the application of learning technologies to extract maximum value from expert lecturers and the materials they produce, for example through Teach Too.

Recommendation 20
The engineering community should develop concerted engagement with university students, including work placements to raise the profile of engineering careers and ensure that students on every campus are aware of the full range of diverse opportunities with engineering employers, large and small.

Recommendation 21
Engineering employers should explore the potential for developing cooperative cross-sector schemes to support postgraduate students.

2.3 The Task and Finish Groups

To this end, four Task and Finish Groups were formed with an initial twelve-month duration, with a view to identifying and implementing solutions which would have an impact and could be sustained beyond the lifespan of the Groups.

These Groups were formed under the direction of senior and respected leaders from industry and academia. We drew together people who could contribute to the respective recommendations in four areas:

1. Experiencing industry. Covering teacher industrial continuing professional development and engineering work experience for students post-16. This Group is chaired by Steve Holliday, FREng, CEO of National Grid.
2. Cutting-edge skills in further education. Covering industry sharing its skills and knowledge with FE, and helping engineering FE to exploit new learning technologies. This Group is chaired by Carol Burke FREng, Managing Director, Unipart Manufacturing.

3. Employer engagement in higher education. Covering the involvement of engineering companies in higher education, particularly small firms, and particularly relating to placement opportunities. This is chaired by Professor Dame Julia King, FREng, Vice-Chancellor of Aston University.
4. Specialist skills for industry. Covering post-graduate level skills for the engineering sector. This is chaired by Professor Helen Atkinson CBE FREng, Immediate Past President of the Engineering Professors' Council and Head of the Department of Engineering at the University of Leicester.

To ensure effectiveness across all these workstreams, and secure coherence in delivery, an oversight committee comprising Judith Hackitt FREng, Allan Cook FREng, and chaired by Sir Dick Olver FREng was also put in place.

The Groups were formed from professional engineering institution members of E4E, engineering companies, university engineering departments, colleges, stakeholder representatives, and those already offering schemes in the activities recommended.

2.4 Choosing the right approach

Over the past year, these Groups have met to agree the right approach to each recommendation, to develop supporting materials where necessary, and to secure the right dissemination channels to share information and good practice to improve the situation. A summary of the outcomes of this work is available in *Engineering Skills: Perkins Review Progress Report*, and this document seeks to complement that.

The Task and Finish Groups have largely avoided creating any new initiatives, focusing instead on making those which already exist more successful, more attractive, and more widely known, to both education and companies. All are expecting to create and/or communicate a business case, compile good/best practice and guidance, and secure appropriate dissemination channels to make improvement sustainable.

Taken as a whole, the recommendations addressed by the Task and Finish Groups all focused on engineering employer engagement in education in some way. Whether the direction was from education into industry (as with teacher industrial continuing professional development (CPD)) or industry into education (Teach Too), improving engineering employer engagement was the unifying theme.

Independently of each other, the Task and Finish groups have come to similar conclusions regarding the best way to deliver the Perkins Review recommendations. It was clear from initial research and conversations with the sector that there already existed many schemes and activities which helped engineering companies become involved with education. Some were local, some national, some focused on particular sectors or types of engineering, others targeted particular types of education provision or school subjects.

As a result, articulating the business case clearly for both business and education was key. With so many existing initiatives, we were able to draw on 'what works' to create good practice guidance and help for those wishing to engage. Finally, we have approached a wide range of organisations which are in regular contact with the audiences with whom we wish to share this information (teachers, employers, education providers, individual engineers, etc) to act as our disseminators and communicators.

2.4.1 The business case

For each activity, we looked at where the real 'drag' on engagement existed. Was it a lack of engineering employers willing to participate? Was it a lack of understanding on the part of the education provider of the value of engaging with employers? Or was it that the students were not interested in taking part?

Wherever it has been possible to identify the tangible, measurable benefits to each stakeholder in the activity, we have done so. We have spoken to everyone involved in the process, and heard about perceived barriers, and the solutions which many have found.

Where a business case has been created, we have looked at the best format for it, and considered who needs to be convinced, and how. If more than one set of interests is involved in the decision to participate, a business case focused on each need has

been created. The exception to this is the business case for further education, for reasons which will become obvious.

We have also created a single business case, for any engineering employer engagement in education, which takes the most compelling information and presents it as one giant call to action. Everything about this activity has been focused on answering the question, *"Why should we do it?"*

2.4.2 Guidance and good practice

Following the development of various business cases, it was clear that the next questions would be *"How do we do it?"* The membership of the Task and Finish Groups provided access to great companies, schools, colleges, universities, and schemes, which were working on practical answers. Case studies were written and collected, and extensive research done to find those key success factors. These were captured and turned into guidance for those wishing to start, increase or improve their activity.

2.4.3 Dissemination and communication

Given the breadth and depth of good practice which we saw during our field research, the key missing ingredient was a mechanism to share this more widely. The engineering and skills landscape is populated with organisations which all have specific strengths and support structures, and which are ideally placed to share this information. There are organisations which support the individual, such as Professional Institutions, and unions, while others are focused on the employer interface, or dealing with schools.

As a result, we have chosen a few key 'host portals' for the information we are creating, which will host the information, and provide the single point of reference to which all the other stakeholders can point. Hopefully, these portals will be places with which some of the audience are already familiar and visiting frequently. We do not want to create anything 'new' in terms of websites or online destinations (the exception to this being the proposed portal for post-graduate information for which there is no existing single trusted source currently). Everyone else will be able to look at the information, and decide the best way to share it with their particular partners. There has been significant work already done to bring all these organisations up to date on what will be produced, and how they might wish to use it. The response, in all cases so far, has been positive, with many relieved that there are no new initiatives, but believing that the approach has real potential to change behaviour of individuals, companies, education providers, etc.

If your organisation would like to be kept up to date on progress on these initiatives, or has ideas for their future development, please see the Next steps and Mobilising the engineering community sections.

3. Boosting teacher industrial CPD

3.1 The value of CPD in industry for teachers

Professor Perkins identified an immensely powerful way to improve the engineering understanding of young people – by getting their teachers out of the classroom and into industry. Whether it is for a day, a week, or longer, teachers can gain hugely from spending time in an engineering company. It enables them to see and understand more of the real world application of their subject, and also helps illuminate some of the careers opportunities in the sector. These kind of placements can be a real benefit to the company too, giving them an insight into what is being taught, and how. While working with students is satisfying, if a company can help a teacher understand more about the sector, it will have an effect on every child with whom that teacher comes into contact.

3.2 Practical information to boost activity

There are already some schemes focused on supporting teacher industrial CPD in engineering. The Royal Academy of Engineering's STEPS at Work Scheme, run through the University of Wolverhampton, provides short placements in industry. The new Teacher Industrial Partners Scheme (TIPS) has been created to develop effective partnerships between local employers and schools, while supporting teachers to increase their experience of how STEM subjects are used in industry. Teachers are seconded on a two-week placement with an engineering Industry Partner, supported through professional development sessions run by the National Science Learning Centre. TIPS is a joint initiative between the Institution of Mechanical Engineers and the National Science Learning Centre, with further support from the Institution of Engineering and Technology (IET).

The Group has taken information from these schemes, and created an 'escalator' of activity for teachers. It is hoped that this will 'lift' both teachers and engineering businesses from an initial, short activity, to something longer and with more impact. These schemes have also provided guidance on good practice, and examples of activity which could be done during teacher industrial CPD.

In addressing the barriers to more teacher industrial CPD, it is clear that the business case must be compelling in terms of the business, the school, and the individual teacher.

- For employers: focused on the commercial benefits of offering such activity (understand the curriculum being taught in local schools; improve teaching for young people, making it exciting and relevant to modern engineering; improve the careers guidance available to young people on routes into engineering; gain access to the right quality potential recruits through teacher; raise profile in local community). This business case will also point business to effective brokers who can ensure that the approach to schools is made in the right way.
- For schools: focused on the impact on the quality of teaching at the school, its impact on teacher recruitment and retention, etc. This business case will also point schools to effective brokers who can ensure that they access the best provision for their staff.
- For teachers: focused on the impact on the quality of their teaching, their confidence, and their enthusiasm for teaching (as evidenced by NSLC information). This business case will also point teachers to effective brokers who can ensure that they receive information on all the quality opportunities which are available.

3.3 Ownership of the information

The National Science Learning Centre is the obvious choice to develop and disseminate the information under this recommendation. They are the primary location for STEM teacher CPD, and have a national and regional structure of support.

3.4 Sustaining change in practice

There remain other barriers to teachers taking part in any CPD activity, such as difficulty in convincing school leadership and governing bodies of the value of time away from teaching. Teachers can face pressure to

be constantly 'present' in the classroom, and struggle to justify time which is not directly focused on the school's success measures (whatever they may be). Teachers who do get out into industry are often not recognised or rewarded for the enrichment which this brings to their teaching. Schools and colleges which support their staff in this activity are similarly not recognised in general. School performance measures and inspection regimes can be interpreted as deterrents, rather than enablers of teacher industrial CPD.

4. Increasing work experience for post-16 students

4.1 Making work experience work

There have been many solutions proposed to boost the opportunity for work experience for those studying post-16. The value of work experience as a concept is widely accepted by industry, but we have found many barriers exist in practice, such as employer concern over the need for Disclosure and Barring Service checks, companies' belief that they have no work suitable for a work experience student, and schools/colleges wishing to focus students on examinations and qualifications.

Some companies, schools, and colleges have long experience of offering and managing work experience, with tried and tested mechanisms for making it work. They have looked far beyond the desultory week of mindless repetition which is the fear of every student, and created materials and opportunities which challenge and develop the individual. They have also considered the company perspective, embedding the work experience activity in logical ways. They have thought about what a student needs to know, what the student and the company can learn from the experience, and what are the best ways to get a good outcome without upsetting the work process.

In June 2014, National Grid successfully delivered a one week engineering work experience programme to 30 students in the West Midlands aged 16 – 18 who were in 6th form or colleges to test demand and approach. These students were in education and training, but had no relationship with an employer. We will be building on this to finalise the materials and resources ready for use and implementation in the early part of 2015.

4.2 Off-the-shelf project briefs

We want to create a dozen or so project briefs which would enable a company to pick one 'off the shelf' and run a work experience. The projects would be

- mainly office-based, to assuage companies' health and safety concerns
- adaptable to large and small companies, in any engineering sector

The briefs will set out on a page of A4 the idea for the project, the purpose/outcome, the age/suitability for the individual, the route/suitability for the individual, the skills and knowledge it will develop, the skills it requires (so projects can be selected tailored to the individual's existing skills), the recommended project duration, the business exposure the project will require, and then a simple but flexible recommended programme for the company and individual to follow.

We are currently collecting ideas for projects from our employer contacts, but suggested topics have included:

- Find three new international markets for our top selling product
- Propose three ways for the company to reduce waste (water, cardboard, metal, electricity, etc)
- Create a one-day activity for the company to deliver in your school (college/ university) which demonstrates the range of careers we offer

As you can see, these kind of projects are not about teaching students engineering skills, but rather about helping them understand engineering companies. Where companies are comfortable incorporating more of the 'hands-on' aspects, this is still possible, but projects like this may be a suitable proxy in high-risk environments. They could be undertaken by individuals or groups, thus possibly opening the door to more students getting the chance for work experience in engineering.

4.3 Supporting documents

We have also created documentation, based on good practice, to help a company before, during, and after a work experience placements. This documentation includes considerations such as diversity and inclusion in making places available, guidance for supervisors, and how to help a work experience student prepare for their placement. While it is extensive and comprehensive, companies can of course omit those elements which are not relevant or useful to them. However, following this documentation will give students the very

best chance of a great experience, which has a lasting positive impact on their learning and career choices.

We have also investigated and extracted the specifics of Disclosure and Barring Service checks, so companies can be certain they are acting in accordance with the law.

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4.4 Ownership of the information

The potential holder of the work experience information and briefs is likely to be Tomorrow's Engineers, as part of their new employer 'packet'.

4.5 Sustaining change in practice

There have been many suggestions discussed in the group, regarding the required changes in the landscape which long-term improvement in engineering work experience requires. These include:

- Helping schools, colleges, and engineering employers to create long-term relationships incorporating many different types of engagement, including work experience
- Raising demand for work experience among students, so that providers and employers are motivated to offer great opportunities to enthusiastic young people
- Working with awarding bodies and standard-setting organisations to raise the profile of quality work experience in professional and vocational qualifications
- Making it easier for companies and schools to make connections at a local level, through organisations such as Local Enterprise Partnerships.

5. Helping employers share the skills and experience of their staff with FE

5.1 Further education in the real world

The further education sector is in a unique position in the education landscape. It covers the widest possible range of learning, from the most basic skills in literacy and numeracy, to the highest levels of technical competence. Its learners are both young people and adults, with diverse needs and backgrounds. It plays a social and community support role, while also working directly with employers to meet their needs. It must attract and retain teachers who are in demand for their vocational skills from industry, while balancing funding through multiple funding streams.

Further education therefore already understands the value of engaging with employers, but sometimes needs support and encouragement to move beyond existing arrangements to explore new and innovative ways to strengthen the relationship, such as Teach Too and learning technology.

5.2 Boosting Teach Too

The Perkins Recommendations particularly recommended that employers utilise the Teach Too scheme to enable their staff to contribute directly to the learning delivered in local FE. Teach Too provides the structure and support for an engineer to teach in FE on a part-time basis, while retaining their engineering role outside the college. It was developed as an outcome of the Commission on Adult Vocational Teaching and Learning, to boost the relevance and currency of the teaching delivered in FE. It is still in relatively early stages, and the Education and Training Foundation is currently working with its partners at the Institute of Education to expand the scheme. Teach Too has already published some excellent exemplars of good practice and lessons learned, which the Group has used to extract elements relevant to engineering.

5.3 Wider employer engagement

The Group understood that Perkins called for more than just engagement with Teach Too, but wanted to see engineering companies sharing the skills and knowledge of their staff with further education through other mechanisms, such as mentoring, curriculum development, technology sharing, etc. Colleges and employers have therefore contributed their experience of working together across a range of initiatives, to inform good practice and guidance for those wishing to improve their own activity. This will be compiled into a series of case studies and guidance documents for both companies and colleges to use.

For the engineering sector, with its reliance on further education's engineering 'capital', engineering employer engagement provides an opportunity to do more than simply improve the 'output' of young people from a local college. It can help engineers and their companies understand in depth the situation in further education, benefit more from its strengths, and address its weaknesses. It can also help companies involved in work-based learning, such as apprenticeship, improve their own performance in terms of training, by linking the off- and on-the-job elements, and improving the skills of those delivering training in the workplace. Successful engagement creates the true 'two-way street' which both industry and education need to achieve their goals.

5.4 The business case

The Group has drawn together colleges and companies to develop the business case for employer engagement from both perspectives. An early recommendation was to develop a 'joint' business case, which enables local partnerships to express the value of engagement to both engineering companies and FE institutions at the same time. By articulating a joint goal (eg 'Help more young people progress into successful engineering careers'), then drawing out the business case for employers and FE, and then helping them both see the kind of activities which achieve this goal (drawn from the case studies), it makes it easier for both parties to act together. It also brings home how local engineering firms, and local FE provision, share many aspirations for engineering education provision. These shared aspirations build bridges and nurture

relationships between people and organisations.

5.5 Learning technology application

Another of the Perkins recommendations for FE related to increasing the application of learning technologies to extract maximum value from experts and materials. This is because further education, more than any other aspect of education, relies on the very latest technical and sector-based information. Further education needs both the flexibility which new technology offers in teaching methods, and access to the latest industrial technology in order to support local industry. FE may be tempting adult learners who are a long way from an 'education mindset' to try some learning at home, using a vocational subject in which they are interested, or supporting someone who is studying a high level technical vocational qualification in the workplace. Further education stands to gain a huge amount from developing its application of learning technology.

The Group is considering two activities under this:

1. The Royal Academy of Engineering is currently progressing an FE project which will develop virtual learning environments for the delivery of contextualised mathematics and other engineering content. Using this technology enables a 'flipped classroom' approach, where students receive course content through online facilitated learning approaches outside the face-to-face lecturers. This enables lecturers to take a more seminar-based question and answer approach or undertake practical learning approaches. A number of options are being considered: MOOCs (Massive Open Online Courses whereby a lecture is recorded and viewed by students online through a media stream player such as YouTube), multi-platform applications (the development a more dynamic virtual learning environment using animations, simulators and a variety of testing approaches); and work experience (developing online support materials for meaningful work experience for 16-19 year olds in engineering. This involves the development of online project platforms which guide students through a simulated project, while interacting with engineers and other functions within a company).
2. Some companies and colleges are already finding innovative ways to share learning, for example, we have met with companies which hold lunchtime seminars for staff, and these are videoed and live-streamed to local colleges and schools. How this activity might be shared more widely, and undertaken in other companies, is being explored.

5.6 Ownership of the information

A number of 'hubs' for the information have been suggested, including the Education and Training Foundation's information repository. As this is currently under refurbishment, a specific host for the immediate future has not yet been identified.

5.7 Sustaining change in practice

While the FE sector is particularly focused on supporting employers, and is therefore, in many ways, the most advanced of the education sectors in terms of engineering employer engagement, fundamental barriers and 'drags' on activity still exist. For some, the need to provide a breadth of appropriate provision to their local community must take precedence, while for others, lack of skilled engineering teaching staff prevents expansion of technical provision. While employer engagement may be seen as a solution to these issues, it is also time consuming, and requires expert brokerage in some cases to secure the best outcomes for both parties. The diversity of the FE sector, with its provision stretching from community learning to technical training, and from basic skills to the highest levels of practical study, mean that there are barriers affecting some provision and not others.

7. Supporting employers to engage with HE

7.1 Key drivers

The Employer Engagement in Higher Education Task and Finish Group was convened to lead the implementation of Action 20 from Professor John Perkins' Review of Engineering Skills.

In progressing this action, the Task and Finish Group has identified a number of key drivers to delivering increased, positive engagement between employers, students and universities:

Firstly, there must be a desire to engage, on the part of the engineering community, the part of the university and the part of the student. A *compelling case* is needed, which both captures and communicates the benefits of engagement, providing evidence to increase and sustain engagement in the face of the daily challenges of engineering and academic life.

Secondly, support is required to raise awareness of the range of activities which might be undertaken by employers, students and universities. Good practice in engagement should be identified and clearly communicated, enabling employers, students and universities to learn from activities undertaken previously and drive continuous improvement in their own activities.

Thirdly, support is needed to better communicate current opportunities for engagement, including the availability of placements; a signpost communications model, recognised by employers, students and universities, is needed as a focal point for engagement.

Finally, the number of placements being undertaken must be increased; in part through an increase in student demand and in part through a corresponding increase in the availability of placements from employers. The availability of placements in small to medium size companies is particularly important as it is anticipated a step change in the number of placement opportunities could be achieved given the sheer number of SMEs within the UK.

7.2 Creating the outputs

The Task and Finish Group therefore agreed on the following points of action:

1) To establish a '*compelling case*', a business case documenting tangible benefits to employers, students and universities, as a catalyst to greater engagement.
2) To document a series of guide notes which capture the range of opportunities for engagement and from which good/best practice can be extracted.
3) To establish an information hub, a location where the above information can reside, freely available to any interested university or engineer to access and in turn act upon.
4) To communicate the compelling case, guide notes and the existence of the information hub through all available and appropriate channels, to both large and small employers, universities, professional institutions and intermediary organisations involved in brokering engagement opportunities.
5) To drive an increase in the availability and uptake of placements, identifying and challenging barriers to placements and encouraging a greater proportion of SMEs to provide placements.

7.3 Findings from one-to-one engagement with PEIs and HEIs

In parallel to undertaking statistical analysis of the DLHE dataset and EPC survey results (see Annex A), the DLHE data were also used to prioritise one to one engagements with specific universities and specific course leadership teams.

It should be recognised, given the diverse range of activities identified in Annex A that universities, employers and the engineering community already collaborate extensively across the sector. The passion that exists to see young people develop within higher education and then progress to a successful career within engineering is testimony to the dedication of the individuals involved. However, in many cases engagement activities arise as a result of action by

individual academics or employers. Where a culture of broad engagement exists across a faculty or university, in all cases examined, a strong leadership team with a passion for engagement and improving the student experience was in evidence. These relationships are often strongest where time has been allocated within the academic's / employer's workload rather than being an additional activity over and above the day job.

In no way is the range of activities static. New initiatives, new engagement opportunities and new approaches are being developed on an almost daily basis, all aimed toward a common goal of increasing relevance of the education students receive and thus increasing employment prospects accordingly. This further compounds the problem of making absolute statements about the DLHE data, with up to five years elapsed time between students participating in engagement activities and the results of the DLHE data for the corresponding students being available. It is likely that there will never be absolute certainty on the impact of individual engagement activities on student employability due to the lag between tangible statistics and the actions themselves.

Regarding the range of engagement activities ongoing, a number of general trends are worthy of note.

Firstly, in many universities there seems to be concerted action to deliver engagement activities earlier within the academic course, providing engagement opportunities during the first year of students' degree programmes rather than waiting until penultimate year placements or final year projects defined by / with employers. These earlier engagement activities include industrial / peer mentoring for first year students, internships, site visits, guest lectures early in the programme and even working on employer-defined projects in first and second years. The objective of these earlier engagement activities is on providing awareness of the profession early and to encourage students to remain focused on the engineering profession rather than being swayed by the appeal of other sectors.

Secondly, concerted effort is being made in a number of universities to 'flip the curriculum'; that is to deliver larger projects within the first and second years, which provide an experience of the whole engineering challenge (requirements capture, design, problem solving, customer engagement, etc.) rather than focusing on just the building blocks of engineering skills. The hypothesis within these revised course structures is, again, to provide awareness of how exciting and challenging engineering can be and motivate students to stay within the profession. A notable secondary effect to this approach however is it has also been observed to support students becoming more resilient when faced with difficult subjects or challenges. This resilience also helps the development of students such that when they do encounter difficult course content they have an appreciation of the bigger picture and thus the motivation to work through the challenges.

Finally, a number of universities and employers have also started to consider which groups of students they engage with and how they go about that engagement.

Figure 1 presents an illustration of a number of different student groups overlaid on a normal distribution of student performance. Group A representing high achievers, Group B the core of the student performance and Group C the underachievers.[1] Traditionally, employers have competed for the 'best' students, down selecting through student grades, assessment centres, interviews etc. This has resulted in competition for a small, finite number of candidates but also risks setting false expectations on how far / fast those candidates might rise to the dizzy heights of management. This can lead to students becoming disillusioned and / or seek to move on very quickly, with some employers reporting high turnover in graduates.

On the academic side, universities, understandably, like to showcase the progress of these high-flying candidates using them as examples of achievement.

[1] Figure 1 deliberately omits any indication of absolute numbers of students within each category since the boundaries are not as absolutely defined and the distribution of students will vary by university. However, as a global assumption, with approximately 22,000 students starting engineering degrees each year and assuming Group A represents >+1 standard deviation, Group C represents <-1 standard deviation and Group B ±1 standard deviations, then it is conceivable Group A represents ~3,500 students, Group C ~3,500 students but Group B ~15,000 students.

However, this can lead to alienation of many of the current student base; Group B students being unable to relate to their Group A peers and through a lack of association fail to recognise opportunities which are actually open to them.

The group has witnessed examples where employers are starting to consider consciously recruiting from Group B as they perceive this can lead to greater retention and a more stable workforce. Universities are also considering showcasing the successes of past students / alumni who fall within Group B since these ambassadors may relate better to the current student base.

Comparing this early engagement model with other sectors, it was noted that several industries including banking, often cited for enticing engineering students to seek a role in the City, employ a model of early engagement with great success. The earlier engagement of employers and the engineering profession is therefore essential and a key recommendation from the Task Group.

Recommendation 1: Employers and the engineering profession to be encouraged to undertake engagement with universities and students earlier within degree programmes.

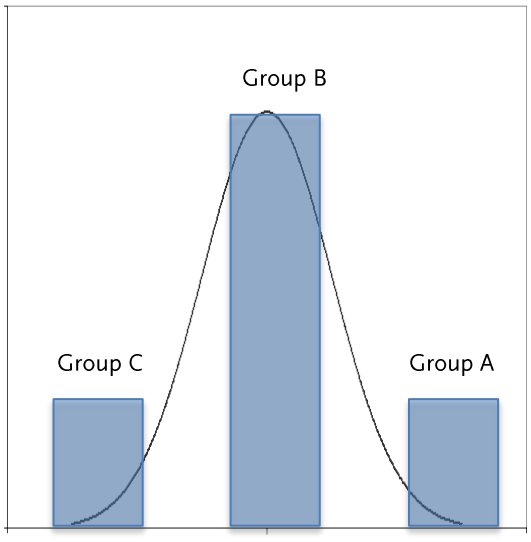


Figure 1, Groupings of students based on performance

7.4 Role of PEIs, accreditation, and Industrial Advisory Boards

Many of the engagement activities would not be viable without the support of the professional engineering institutions, and while many of institutions have suffered a reputation of being inflexible and prescriptive, most have undergone a transformation to more adaptable, supportive organisations. Testimony to this transformation are the range of novel course structures gaining accreditation; integrated four-year Masters courses where one year is spent in industry; flipped course content delivering larger projects with greater industry engagement; and more integrated schemes across multiple institutions. The challenge is to break down the perceived barriers around inflexibility in accreditation to enable students to receive greater context and thus motivation to enter the profession.

The Task Group has highlighted the four-year Integrated Masters course, which includes the third year spend on placement in industry, as being of particular value. The value of placements is well documented and is discussed later in this document, however one of the barriers to students taking placements is concern over taking an additional year of study, both incurring additional tuition fees and deferring the start of generating an income a further year. The Integrated Masters' course structure offers a solution to this problem; universities should be encouraged to implement the Integrated Masters course structure and all PEIs should be encouraged to adopt the accreditation model, learning from those who have already implemented is as appropriate.

Recommendation 2: The Integrated Masters course structure should be adopted more broadly, both in implementation by universities and accredited by all professional engineering institutions.

A worthy side note to the discussion on the duration of degree programmes is a new two-year Bachelors of Engineering degree at Wolverhampton University. Developed with employers, the degree programme discards the normal academic year and instead delivers 45 weeks of teaching, predominantly all day Friday and 12 Saturdays throughout the year. This structure enables students to

remain in employment while undertaking the degree programme but delivers the same number of teaching hours as a 'traditional' course structure. However, students incur one-year less of tuition fees and remain in employment which is seen as a significant advantage. Many of the current students have progressed to this degree programme from a part time apprenticeship (or similar) and thus are more familiar with the structure of the teaching. While not presently accredited by any PEI, the long term plan of the university is to gain accreditation; were this the case, it is not unforeseeable that through the development of a further year's study this model could be extended to a three-year Masters programme.

The role of Industrial Advisory Boards is an interesting and emotive topic when engaging with universities. Industrial input and engagement is part of the requirement for course accreditation by the professional engineering institutions, with many universities choosing to demonstrate this engagement through the existence of /influence from an Industrial Advisory Board. However, that there are examples of universities who demonstrate strong industrial engagement in course structure and content without having an advisory board. In many cases where Industrial Advisory Boards are in place, universities and employers have commented that strong leadership is required to maintain focus, avoid descending into a 'talking shop' and ensure direction from the board is effectively communicated to and implemented by the broader teaching staff, many of whom may not necessarily appreciate the need for change, especially if they perceive they are performing well as a result of, for example, good exam grades.

The professional engineering institutions also play a critical role in accreditation and sharing best practice across the sector. In undertaking accreditation visits, institutions use teams of three assessors with two coming from the institution or academia and one from industry. It may not be well communicated, but the role of these assessors is not simply to look inward at the course itself, but is also for those assessors to act as ambassadors, sharing best practice from their wider experience and identifying new practice that may help elsewhere.

However, industrial participation within accreditation visits is often hard to secure; institutions are forced to rely upon the recently retired engineer who may have time, but perhaps not so much awareness of the current needs of industry. Therefore, while industrial participation within individual university advisory boards is to be encouraged, so is participation in the accreditation of other courses, both to advise and to bring back knowledge to shape one's own institution. Where offers of support from employers are available, their take up is to be encouraged by universities, with students increasingly examining employer engagement and employment prospects as part of their university selection criteria.

7.5 Findings from one-to-one engagement with industry

Many of the actions identified within the Perkins Review of Engineering Skills highlight the need for industry to provide increased engagement with education. This engagement may be showcasing the range of opportunities available, providing inspiration and motivation to students or ensuring students develop the skills required in industry. However, the dichotomy facing industry is that engagement necessitates committing valuable time of experienced engineers to non-profit making activity, yet without this engagement, industry risks future restrictions on freedom of operations due to lack of resource.

In discussing this issue with a range of companies, it appears there is an evolution of thinking as to why companies become involved in education:

- Initially, engagement with education often occurs within small, local clusters driven by individuals who feel they want to support the development of students or by specific projects that might involve education. Many of these engagement activities are undertaken below the radar of the company leadership team, not because they should not be undertaken but because they are simply too small to warrant the time of senior management.
- The next step in this evolution is the involvement of, and support by, [senior] management who believe the activities support some kind of corporate social

responsibility agenda. Perhaps a policy is established giving a certain amount of time to every engineer to undertake activities with education, however there is often no direction or coordination on what specific activities engineers undertake.

- The transition to the next step occurs with the recognition that not only can outreach activities be good for the students involved but they can also be used to support the development of company employees and meet short-term objectives of the company. Whether the objectives are skills development and staff retention of current employees, recruitment of targeted skills or raising awareness of the company within the local community. These short-term objectives enable companies to structure their programme of education activities delivering value to both students and company.
- The final transition occurs when companies develop long-term, integrated strategies which bring together all elements of staff development, company reputation, recruitment pathways and skill development. Buily upon tangible objectives, these programmes are often supported by senior leadership but the objectives are well understood at all levels.

The significance of this evolutionary pathway is that in the case of the first two stages, while these were most visible when engaging with companies, they lack the specific focus and objectives to enable them to stand up under scrutiny; almost every activity will at some point be challenged by an accountant focused on profit and shareholder value. To say that something 'feels the right thing to be doing' or to lack clarity on whether the specific activity is the correct one given the broad range of options available tends (without management intervention) to lead to an indefensible position, diminishing budgets and reduced engagement with education. The transition to stages three and four on the evolutionary pathway enables tangible benefits to be aligned to tangible action; the business case is clearly set forth for all to see, to act upon and to defend under the spotlight of external scrutiny. It should be noted that when viewing a company strategy which falls under phases three and four above, these strategies can often appear selfish or inwardly looking. However, in most cases companies in these categories were shown to be doing more activity than others, thus having a greater positive impact in education.

In collating evidence to support the business case, the Group has therefore focused on capturing tangible benefits that can be used to underpin defensible arguments for companies to engage with education. The Group is also working on the format of the business case, delivering a concise summary on the benefits to both employers and universities, but also enabling the information to be easily extracted and used to inform specific engagement activities, thus driving greater engagement.

As identified earlier, a broad range of engagement activities are already being undertaken between employers, students and universities, with a large number of employers involved across the country. However, in considering the challenge to increase the number of engagement opportunities, while many companies might offer a couple more placements or do an additional engagement activity per year, this will not deliver the step change in engagement activities needed to deliver the significant increase in graduate numbers required by the profession by 2020. Any company offering an increase in their engagement activities should be applauded and encouraged, however the Task Group identified the need to drive an increase in the number of companies offering opportunities. Further, noting the broad range of small and medium size enterprises (SMEs) which both exist in the UK and represent a significant driving force in the growth of the economy, increasing engagement on the part of SMEs will be critical. SMEs will require support in engaging with universities, and larger employers, PEIs and the profession as a whole have a role to support, through their supply chain and professional networks, the engagement of SMEs with universities.

Recommendation 3: SMEs should be encouraged and supported, through the supply chain and professional engineering networks to engage with universities to

increase the range of engagement opportunities and placements available to students.

7.6 Placements

Placements were identified in the Perkins' Review of Engineering Skills as priority activities for employer engagement in higher education. There is clear evidence within many universities of the value of undertaking a placement, which not only places learning in context but provides motivation to students to study harder. A general consensus on the value of placements is that they have the potential to motivate students who then go on to achieve a degree classification, approximately half a grade higher than they would have achieved without the placement. Furthermore, the impact of a placement is often more noticeable in students who are forecast lower grades than those at the top of the performance scale. The main challenge is therefore to provide more placements and to encourage a greater proportion of students to take up those placements.

From an employer perspective, many companies view placements as a key element of the recruitment process, enabling an extended interview between both the company and the individual student. Several companies view placements as their sole route for graduate recruitment, eliminating the need for costly recruitment campaigns by targeting focused placements and progression to permanent employment. In these cases, companies are often engaging significantly earlier in the student's degree programme, offering internships at year one of a degree programme to lead toward a placement in year two or three. These companies have the ability to reach a wider student audience and attract the most well suited candidates to their company.

Consideration of an earlier approach and the role of placements within the recruitment process is essential, as once the initial employment cost and time to support the placement student is considered, placements are not low cost activities. This cost factor may initially appear a daunting prospect but, aligned to a set of focused company objectives, it is easy to offset these costs against the benefit they bring, but without the clear business case it is often harder justify.

If the profession is to offer more placements, it is likely these will come from companies who have not offered placements before rather than asking those who already offer a number (aligned to their future recruitment needs) to offer more. This includes SMEs who, as outlined in Recommendation 3 should be encouraged to offer more placements.

In offering more placements, either separately or as part of the long-term recruitment pipeline, employers should be mindful however of the challenge completing a lengthy and in-depth application process presents to students. While it is understandable that many employers may wish to apply the same process to placement recruitment as they do to permanent recruitment, the capabilities of students who are earlier in their degrees are understandably lower than those in their final years. These in-depth application processes may be sufficient to put many students off, especially those in Group B who may benefit from placements the most. Becoming more engaged with universities offers employers a means to develop their understanding of student capabilities at each level, potentially engaging with students at lower levels of effort than an assessment centre (for example) and with the potential for a longer, more beneficial relationship.

From a university perspective, the uptake of placements depends upon a number of factors, not least of which is the culture that exists within the university as to the role of placements. Those universities where a culture of placements exists, with placements promoted or even expected by academics and careers staff alike, see the greatest uptake. However those universities where this culture does not exist often see very low uptake rates. It is true that certain students will likely always take a placement; however those who are undecided are easily influenced by those around them, choosing to continue with the same cohort through their time at university. If that cohort take a placement so will they; if most stay at university then others will follow the pack. It is incredibly difficult to change an organisation's culture, in this instance moving a university from one where placements are an exception to one where they are the norm.

However, both universities and PEIs can play a role in promoting the uptake of placements. In many cases where placements are optional, no academic credit/acknowledgement is given either to the student or the university, however the Task Group strongly believes that in providing credit for a placement, which both counts toward academic qualification and professional registration the student demand for placements can be significantly increased.

Recommendation 4: All universities should supervise and give credit for placement activity so that students can see a placement contributes toward their degree.

University placement offices and careers teams can have a key role in influencing demand, with some universities reporting up to 70% of all placements arising as a result of personal contact between the placements team and local companies. While careers / placements teams located centrally within the university can showcase opportunities to a broader range of students (not necessarily just engineers), those located within the engineering faculty have the opportunity to develop greater relationships with students, gain awareness of their skills and find more appropriate placements and opportunities on their behalf.

In many cases where this exists, the degree of trust placed on the faculty placements / careers teams is high, both on the part of the students in finding opportunities suited to their interest and ability but also on the part of the sponsoring employer. Employers offering placements often rely upon these careers teams to match their requirements to suitable candidates, therefore promoting relationships between companies and faculty-based placements teams appears to offer the greatest short-term opportunity to encourage those students within (or approaching entry to) higher education to continue to a career in the engineering profession. Interestingly, a number of universities report a shortage of students wishing to take placements as opposed to a shortage of placements themselves.

This does raise the question as to whether certain companies only ever go to the same universities for placement students, in which case perhaps broadening the range of contacts could increase the total number of students on placement at any one time. It may also be the case that those universities making best use of their alumni to find placements are leading to a point of saturation; would it be possible through communication with other local universities to share this excess of placements?

Finally, considering the length and timing of placements, they often fall within two categories; summer internships and full year placements. It is likely these two categories originated as a result of a 'neat fit' with the academic calendar; however, they are not the only option. A number of universities are now implementing six-month placements or even shorter activities (allied to group projects) within term time. While challenging in terms of restructuring the course content, these placements offer more flexibility to employers and may increase the total uptake of placements, with an associated knock on effect on the number of new engineers entering the profession.

There are a number of examples where short term placements used to be the norm although have now fallen out of favour; it seems appropriate to encourage the sharing of information between universities with experience in this area and those considering new approaches and as such, sharing of best practice and lessons learned should be encouraged. In some cases best practice is already being shared, for example with the IChemE having recently published a guide to implementing successful placements.

The Higher Education Academy Engineering Subject Centre has also published guidance on placements for engineering departments and employers.

7.7 Next steps

The activities of the Task and Finish Group moving forward focus on collation of tangible examples of engagement within universities and the onward communication of this information to encourage greater participation. These activities will be undertaken in coordination with the other Task and Finish Groups within a central communications plan.

Core to the communications plan is the establishment of a number of hubs of information; repositories which can host the

collated examples and business case and in turn making them available to a wider audience. The National Centre for Universities and Business (NCUB) has been identified as the preferred hub for employer engagement in higher education and work will be undertaken with NCUB to establish the precise process moving forward.

It is anticipated that the hub will offer links to sites such as 'Rate my placement' and to companies and schemes such as the 'Year in Industry' offering such experiences, thus enabling a stimulation in both supply and demand for placements, as well as highlighting good practice in terms of different types and length of placement available. Useful resources such as standard placement contracts should also be accessible via the HUB.

In addition to the activities with NCUB, dissemination of information will be undertaken via the professional engineering institutions, Royal Academy of Engineering Education Programme, engagement with Local Enterprise Partnerships and other representative bodies such as, EEF, SEMTA, Federation of Small Business, and Chambers of Commerce etc.

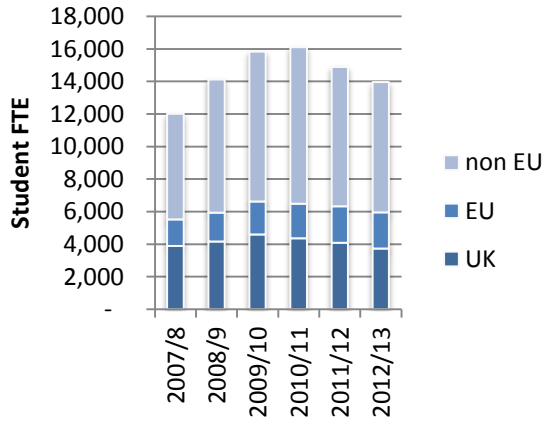
The engagement with Local Enterprise Partnerships is of particular note, as there may be opportunities to develop advice on using LEP funding, including funding from Europe, to support placement and internship activity with small and medium businesses.

8. Improving the postgraduate specialist skills offer

8.1 The importance of maintaining the supply of high level skills

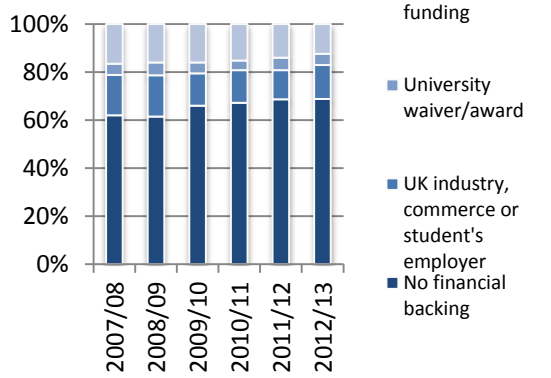
Postgraduates, and the advanced knowledge and expertise they offer, are sought after by businesses to help them address the major challenges that drive innovation and growth[2]: being able to recruit high quality engineering and technology postgraduates is an important factor in attracting global businesses to locate high-value operations in the UK[3].

Postgraduate (taught) engineering students[4]



Masters-level qualifications have an important role in upskilling and re-training the UK workforce, yet, already insufficient to meet the skills gap[4], the numbers of students of UK origin studying at Masters level have been falling, with nearly two thirds now receiving no financial support for their studies and the proportion funded by industry or their employer decreasing from 17% to 12% in the 5 years to 2011/12.

Sources of funding for UK-domiciled postgraduate taught engineering students [4]



8.2 What's been happening?

The task group felt it important to understand the motivations for students going on to higher level engineering research and education and the barriers and challenges that both they and their current and future employers face.

While a much more detailed study has been initiated by **a HEFCE-funded national consortium led by Kingston University**[5] - which will further inform this work as it evolves beyond this initial stage – it is already clear that students tend to fall into three categories:

- those who wish to set themselves apart for career progression purposes ("self-motivated career developers");
- those who have been sponsored specifically by an employer to acquire specific specialist knowledge ("employer sponsored specialism seekers");
- those who are "converting" from a related undergraduate discipline, such as mathematics or a physical science ("converters").

What's more, there is very limited and fragmented information for employers on the options that exist.

Noting some recovery in the proportion of industry-funded engineering Masters students in 2012/13 (to 14.5%), the group sought out examples of where universities

[2] *One step beyond: making the most of postgraduate education:* Professor Sir Adrian Smith *et al*, March 2010

[3] Source: Higher Education Statistics Agency data from the Higher Education Database for Institutions (HEIDI), analysed by Engineering Professors' Council

[4] *EngineeringUK 2103: The State of Engineering*

[5] Postgraduate Experience Project, Centre for Higher Education Research and Practice (CHERP)

and employers were working successfully together. Some of these examples (and these are by no means the only ones) may be found in the Annex. Common to them all, are:

- a shared objective for both university and industry, based on identified need;
- clear and tangible industry involvement in the development of the programme content and funding;
- a flexible and accessible approach to delivery by the university;
- a long-term, strategic approach to the collaboration, recognising the wider economic context.

Some particularly interesting early stage initiatives have been "seed funded" by the Higher Education Funding Council for England's Postgraduate Support Scheme. Launched in 2013, this focuses particularly on stimulating demand from groups of students who are under-represented at postgraduate level and in subjects aligned with the government's growth strategies. £25M was provided for pilot projects to test activity and finance models that support these aims.

Two of the projects - one led by the University of Derby which provides flexible and accessible approaches to gaining professional status and the other by Cranfield University which is piloting an innovative loan fund- have been highlighted as examples (see Annexes B-G). Other examples, such as the Marine Technology Education Consortium – (MTEC) have been around for much longer and really do demonstrate the possibility of developing sector-focused and sustainable models of collaboration for the continuing professional development of skilled engineers as well as providing some very useful learning for both universities and employers in making multi-partner collaborations work.

8.3 What next?

8.3.1 Developing a trusted source of information and advice

What's clear is that current information about postgraduate programme content and funding opportunities is fragmented and that a single, trusted source of accessible and comprehensive information for both employers and potential students is needed. This should extend beyond Masters programmes and encompass research degrees (PhD, EngD etc). Even where businesses are convinced of the advantages of employing postgraduates, identifying appropriate programmes to meet their needs can be challenging as there is no single, trusted source of information, making researching the options daunting. Working with businesses, the Engineering Council, UCAS and Engineering Professors' Council members, the means to provide a portal through which comprehensive information about Master's and postgraduate research programmes and related funding can be delivered will be investigated. Focused on the needs of industry, it will seek to provide advice and guidance for universities and industry on developing the business cases, overcoming practical barriers to collaboration and developing best practice.

8.3.2 Identifying and developing programmes which improve access for smaller businesses (SMEs)

SMEs are the engines of innovative growth, yet accessing postgraduate programmes in ways that meet their particular needs and challenges can be difficult. In addition to the information portal, further work will be carried out with universities and businesses which have developed such programmes (eg the University of Derby's MSc in Innovative Engineering Solutions) to share experience on how this can be done.

8.3.3 Improving supply

As identified earlier, postgraduate engineering students tend to fall into three categories and solutions targeted at these groups will be further developed.

For the "self-motivated career developers", further work will be carried out with HEFCE and the universities taking part in its Postgraduate Funding pilot to promulgate schemes which provide improved access to loans and other sources of funding (eg the Cranfield University loan scheme). The learning from the pilot will also be used to identify initiatives which are successful in attracting under-represented groups. At the time of writing, the HEFCE pilot projects were being reviewed with a view to making

recommendations for next steps. The full findings will report in Autumn 2014.

For the "employer-sponsored specialism-seekers", further work will be carried out with the Industry Strategy Councils to ensure that specialist skills initiatives and sustainable models of funding are reflected in their strategies.

The 11 Industry Strategy Councils have a particularly important role to play in championing and promulgating of these initiatives. Representing the key industry sectors identified by the government in its Industrial Strategy as being the engines for growth in the UK economy, all rely on engineering skills to deliver world-class competitiveness. A programme of engagement with the Councils will be further developed to ensure that specialist skills initiatives are reflected in their strategies. Examples which have potential to be adopted by other sectors include:

- the Automotive Council's model pathways for continuing professional development (an underpinning initiative being the Warwick Manufacturing/Jaguar Land Rover Advanced Skills Accreditation scheme);
- the Oil and Gas Industry Council's skills initiatives: *Opito*, an information portal developed for the industry focusing on delivering information about education and skills and the NERC Centre for Doctoral Training (CDT) for Oil and Gas;
- the Aerospace MSc bursary scheme, jointly funded by government and the aerospace industry which provides tuition fees for up to 500 UK students with the right aptitude and motivation to acquire the skills to lead the UK's future aerospace sector.

For "converters", existing initiatives which enable students to "convert" their undergraduate STEM degree to an engineering specialism will be showcased. The potential to extend the opportunity to those without a science degree but with the necessary aptitude will also be explored.

For more information on specific schemes, see Annexes B-G.

9. Perkins outputs and where to find them

Between **December 2014 and March 2015**, the following outputs will be finalised and placed in the designated locations online. They will be freely available to anyone, and we will be encouraging feedback on their usefulness, their format, and any other improvements which could be made, as they develop over time. Not included here are other longer term projects and deliverables, such as the postgraduate programme and funding portal and further work on postgraduate funding, the development of which will continue.

If you would like to be kept informed of progress as these outputs are published, please email Claire Donovan at the Royal Academy of Engineering.

	Output	Who is it for?	Where to find it
Teacher industrial CPD	Business cases for teachers, companies and headteachers/governing bodies	Teachers, companies, heads, governing bodies	National Science Learning Centre
	The 'escalator' of information and guidance on teacher industrial CPD	Schools and companies	National Science Learning Centre
Post-16 work experience	Project briefs suitable for engineering companies to use during a work experience	Students, companies	Tomorrow's Engineers
	Documentation to support pre-during-post work experience activity	Companies	Tomorrow's Engineers
	Guidance on Disclosure and Barring Checks for employers offering work experience	Companies	DfE publication extract
Further Education	The joint business case for FE and industry	Further education, companies	TBD
	Case studies and guidance on good practice	Further Education, companies	TBD
Higher education	Template employment contracts for use during placements of three months or more	Companies, universities	NCUB
	Information on funding streams to support engineering employer engagement	Universities, companies	NCUB
Postgraduate	Outcome of HEFCE postgraduate funding pilot schemes	Universities, companies	HEFCE

10. Next steps for the Perkins Review

The Task and Finish Groups will disband by the end of 2014 in their current form. In order to sustain and capitalise on the work done so far, three things need to happen.

10.1 Developing the outputs

Taking forward the outputs of the Perkins Review Task and Finish Groups is paramount. It involves:

- Developing the outputs (eg the business cases, the guidance, and case studies) further over time, adding elements and enhancing the content.
- Finding new ways to share and communicate the outputs, through other organisations, through events, media, etc
- Supporting the creation of a 'sharing' culture around the outputs, which would involve managing online forums, events to share good practice, etc

10.2 Addressing the barriers

The Task and Finish Groups have identified some barriers to both engineering employer engagement, and engineering skills expansion, which cannot be immediately addressed by the outputs. These barriers are more intrinsic to the skills landscape, and require change at a more fundamental level.

To influence these will require work at a strategic level, with representation to government and other bodies. In effect, it would require looking at some key questions, and laying out some recommendations. For example:

1. How can schools be encouraged to take part in more engineering employer-related activity? How can existing performance measures and inspection processes support schools which do it well, and provide their students and teachers with opportunities to experience industry
2. How can further education be incentivised to work more closely with engineering employers, in ways which benefit both parties?
3. How can teachers and tutors in schools and colleges be supported to look beyond the immediate demands of curriculum delivery, to improve their subject specific industry knowledge?
4. How can school and college governance be utilised to boost engineering employer engagement in their institutions?
5. How can engineering education across the board help engineering companies improve their own training activity, eg apprenticeships?
6. How can postgraduate study in engineering be made more attractive and attainable to the right individuals?
7. How can professional engineering institutions use their power and influence, particularly in their interactions with members and companies, and with higher education, to boost the activities which are known to be effective?
8. How can higher education be incentivised to embed effective working with engineering employers in undergraduate learning?
9. Are there financial incentives for engineering employers to engage with education?
10. What can be done to recognise institutions, companies, and individuals who are really making a difference to the engineering experience of students?
11. How can the qualifications system support industry engagement, particularly in the recognition of work experience, and the skills of teachers?

10.3 Monitoring progress

There are 22 recommendations in the Perkins Review, and there is a danger that their energy may dissipate after the Task and Finish Groups wind down, and Professor Perkins retires from his role in BIS at the end of 2014.

A regular report on progress and developments each year for the next five years would address this. During this time, it is likely that some recommendations will be fully achieved, and some will need some slight modification, all of which could be noted and supported.

An annual report would serve to keep the Perkins recommendations in the public eye, and also raise the real issues around engineering skills supply on an annual, proactive basis.

11. Mobilising the engineering community

11.1 The community

It is clear from the previous chapter that no single organisation can achieve even a portion on the next steps which are needed. The Task and Finish Groups are coming to an end, so activity will need to be taken forward by E4E and its partners:

- EngineeringUK and Tomorrow's Engineers
- The professional engineering institutions
- Engineering employers, large and small
- Colleges and engineering training providers
- Students of engineering and related subjects
- Universities offering engineering courses
- Engineering academics at all levels
- Schools and teachers
- Headteachers and governing bodies of education establishments

11.2 Support organisations

This means mobilising all these individuals and organisations to act and make a sustainable change to behaviour. As part of this work, we have been briefing a wide range of bodies who help these people and companies, such as:

- Unions
- Employer representative bodies
- Schemes and activity organisations
- Representative bodies for education providers
- Government programmes to improve employer engagement

11.3 Local Enterprise Partnerships (LEPs)

Some of the work already undertaken has investigated the utilisation of the LEPs as an overall 'enabler' for all engineering employer engagement in education, from schools to post-graduate level study.

Some LEPs have already been included in communications and activities, and are very enthusiastic about using the outputs from Perkins in their own work with engineering companies and education. We will be considering how to package the outputs appropriately for LEP use as they are developed, so that any LEP wishing to support all or specific aspects of the Perkins Review will be able to do so.

11.4 Getting involved

If you would like to know more about how you can support this work going forward, by sharing outputs, or by helping develop the outputs further, please email Claire Donovan at the Royal Academy of Engineering.

Annexes

Annex A – Data findings from Destination of Leavers of Higher Education

To collate evidence to inform the business case, identify example activities that might form the basis of a series of guide notes and in an attempt to prioritise engagement activities in terms of their impact on new engineers entering the profession, a review of existing activity was prioritised.

Destination of Leavers in Higher Education (DLHE) data were obtained from the Higher Education Statistics Agency (HESA) and a mapping was created to highlight which universities appeared to have high rates of conversion from undergraduate courses into sectors related to the course subject[6]. Rankings by university and course cannot be taken as an absolute indication of performance given the way the DLHE data are captured and uncertainty in the breadth and depth in the dataset. However, ranked data were used to prioritise targeted telephone and face-to-face interview with university teams to investigate the breadth and depth of activities being undertaken with industry.

Figure 1 shows the range of activities currently being undertaken in collaboration between universities and the engineering profession in the UK. Whilst Knowledge Transfer Partnerships and industrial research projects were identified as activities which had some influence within the undergraduate space, in many cases their influence was focused primarily on postgraduates and as such are not necessarily a key driver on undergraduates entering the engineering profession.

With the support of the Engineering Professors Council (EPC), a survey of universities was also conducted. Aimed at complementing the Destination of Leavers of Higher Education data analysis, this survey focused on gathering information on the range of engagement activities that are currently being undertaken, how those activities are perceived within universities and where university staff believe effort might best be expended to increase the number of engineers entering the profession. A total of 53 EPC members responded to the survey representing 30 universities

Based on the outputs of the survey, the different engagement activities were ranked according to their benefits on encouraging students to enter the engineering profession, based upon the perceptions of survey respondents. This ranking is shown in Table 1. The number of respondents offering particular engagement activities was also mapped and is shown in Table 2.

	Percentage of respondents offering activity			
	Yr 1	Yr 2	Yr 3	Yr 4
Paid year placements	4%	51%	69%	14%
Paid internships	24%	49%	65%	39%
Group projects co-defined / delivered with industry	4%	8%	55%	45%
Individual projects co-defined / delivered with industry	2%	0%	45%	59%
Subject-related guest lectures by industry	61%	61%	78%	80%
Careers skills lectures by industry	53%	49%	65%	61%
Modules / content co-defined / delivered with industry	20%	29%	43%	49%
Sponsorship of students	57%	65%	71%	69%
Industry mentors for students	24%	22%	37%	35%
Site visits	53%	49%	63%	47%
Unpaid internships	12%	16%	18%	16%

Table 2, Percentage of EPC Survey Respondents offering Engagement Activities

[6] It should be noted that a significant number of caveats exist around any analysis of DLHE data; returns for the data collection are optional and as such vary to an unknown extent. Furthermore, whilst the mapping described above seeks to identifying students entering professions associated to their degree subject, there is no certainty that students employed in sectors which on face value may appear entirely disconnected with their degree subject, they may in fact still be employed in engineering roles.

In terms of statistical data analysis, the final step was to examine the dataset for correlation between those activities offered by any given university and their position in the rankings of DLHE data. However, based upon the data available no correlation was identified in the dataset. Discussing this result during a meeting of the Task and Finish Group it was noted that this was not necessarily a surprise given differences in university students, engagements and result. Instead, it might be possible to examine correlations between students and engagement activities within individual universities, although it was accepted that in the limits of the time available this would not be possible.

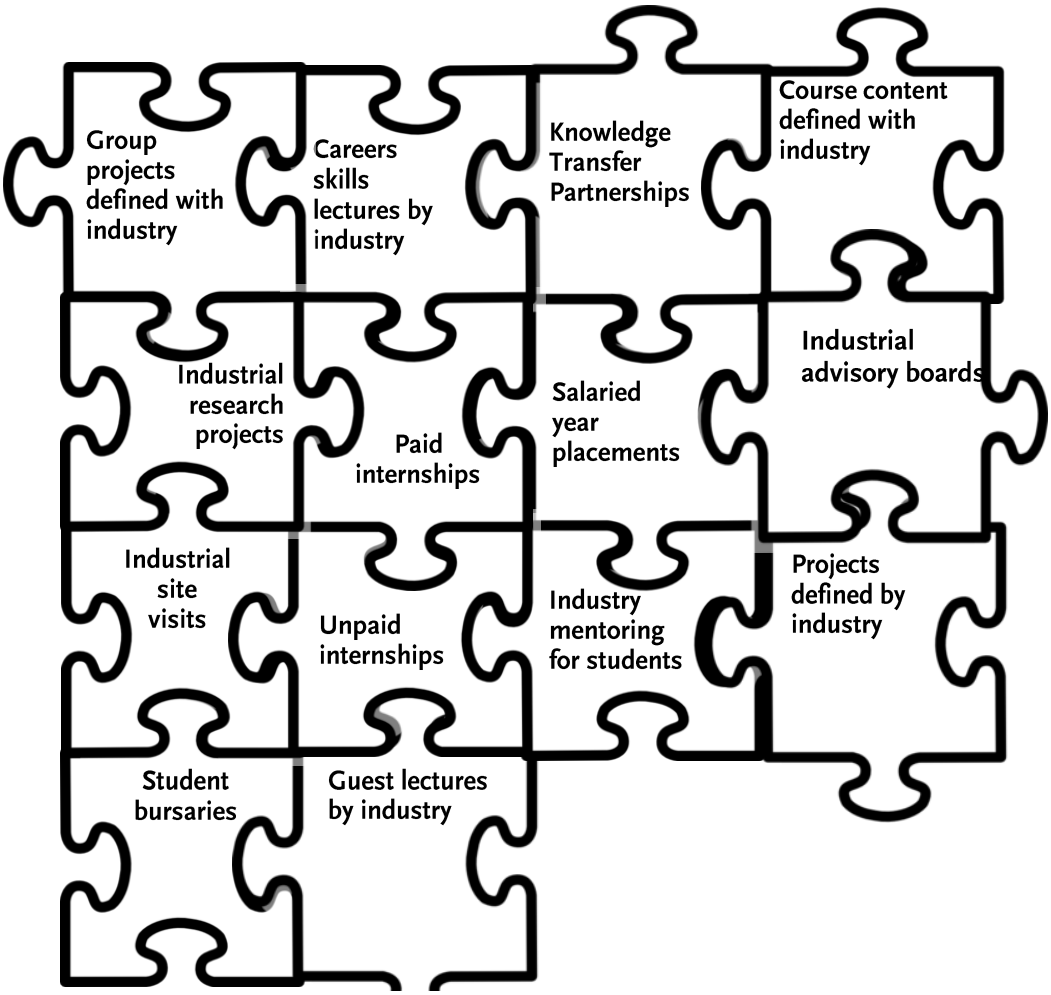


Figure 2 Typical engineering employer engagement activities in HEIs

Annex B – Aerospace MSc bursary scheme

The UK aerospace industry is second only to the US globally. In order to maintain this world-beating position, government and leading employers are funding the Aerospace MSc bursary scheme. Its aims are as follows:

- To generate new aerospace MSc qualified professionals with high level skills who will work in UK aerospace.
- To upskill members of the existing UK aerospace workforce and reinforce the supply of skilled people with knowledge and expertise in key areas of technology for the future.

Funding for tuition fees is available for up to 500 home students undertaking taught MSc programmes at UK universities which are accredited by the Royal Aeronautical Society or supported by the leading Partner companies, starting in academic years 2013/14, 2014/15 and 2015/16. Bursaries pay tuition fees up to £9.5k for study of aerospace engineering at a UK university.

Benefits

- Bringing into the UK aerospace sector people (for example, maths and physics graduates) who might not otherwise have entered it
- Raising to MSc the baseline skill level of new entrants to the sector
- Attainment of higher level skills for existing employees to meet specific identified business needs
- Creating greater breadth of skills available to the profession
- Increasing the availability of potential recruits with UK/EU/EEA citizenship (likely to meet the security clearance requirement of defence contractors)
- Encouraging universities to seek accreditation of their programmes.
- Encouraging better communication between industry and academia
- Facilitating individuals' career development through introduction to partner firms and engagement with the professional body

A unique collaboration has been forged between the UK government, leading UK aerospace companies, academia and the engineering profession. Currently on target to meet its objectives, the scheme has been well received within the sector. Its success to date opens potential for applying the model to other sectors.

Partners

Department for Business, Innovation and Skills, Department for Employment and Learning, Northern Ireland, Aerospace Growth Partnership, BAE Systems, Bombardier Aerospace Belfast, Airbus Group, Finmeccanica UK, GKN, MBDA Missile Systems, Messier-Bugatti-Dowty (a Safran Group company), Rolls-Royce, Spirit Aerosystems (Europe). The scheme is administered by the Royal Aeronautical Society and the Royal Academy of Engineering.

Annex C – Cranfield University: Affordable Postgraduate Study in STEM

Specialist stand-alone masters programmes are best placed to deliver the skilled individuals required by the engineering, high-tech and science sectors ('Masters with a Purpose' – UUK 2013). However, while 'other-EU'/international recruitment to Cranfield's programmes remains buoyant, UK demand has shrunk since 2009/10 by 20% for full-time and 15% part-time learners. This is principally due to lack of access to affordable finance. There is currently no funding from the Student Loans Company (SLC) for study on stand-alone masters courses, and Career Development Loans are little used because of their high cost of borrowing. This has the potential to socioeconomically exclude individuals from the professions on the basis of their 'ability to pay'.

Cranfield University is piloting postgraduate loans as part of HEFCE's Postgraduate Support Scheme. The Cranfield Postgraduate Loan Scheme (CPLS) offers affordable loans which allow individual learners access to the University's distinctive postgraduate courses in STEM subjects. These programmes underpin the need for high-level skills identified in the Government's Industrial Strategy, in sectors ranging from Aerospace and Manufacturing to Automotive and Agrifood. They also address the top five barriers identified by business (Pearson Education and Skills Survey – 2013) for 'rounded, grounded, and ready for work' graduates. Direct feedback from business shows that graduates from these courses are valued by employers and highly employable+.

CPLS directly addresses this lack of affordable finance. It has created a new and sustainable funding approach to postgraduate study. In this pilot Cranfield is working with Prodigy Finance to establish a loan scheme backed initially by HEFCE and the University, but with the potential for further investment or donations from industry and other third parties. The scheme allows UK learners to borrow for tuition fees and maintenance (tuition fees only for 'other-EU' students) at an interest rate equivalent to that of the Student Loans Company. Repayable over seven years and commencing six months after graduation, for UK students this produces a seamless transition to an additional year of funding for their chosen MSc. Loan repayments provide a rate of return to the scheme which will establish a revolving fund to ensure the long-term sustainability of loans.

In the pilot phase CPLS can make up to 100 loans per year, and since its launch in March 2014 78 learners have applied for and been offered loans [at September 2014]. Based on the career trajectories of Cranfield graduates, modelling shows that the scheme is considered to be highly resilient and scalable. It could be expanded to substantially larger numbers of borrowers depending on the amount of funding within the scheme. Access to CPLS is inclusive[7] and based on future earning potential, rather than current ability to pay.

[7] However, like the SLC, the scheme is currently not Sharia-compliant since it is loan-based.

Annex D – University of Derby: support for SMEs/gaining professional accreditation

The University has received funding from the Higher Education Funding Council for England's Postgraduate Support Scheme, piloting a number of innovative approaches to encouraging take-up of postgraduate study in subjects aligned with the Government's growth strategies. It is running two schemes – one which supports the needs of small and medium sized engineering businesses – and the other which offers a flexible approach to gaining professional status, funded by employers.

Master's (MSc) degree in Innovative Engineering Solutions (full-time)

A consortium of around 40 employers are working with the University, which has recruited 50 students with First or 2:1 Class degrees from engineering or related disciplines; such as design, physics, chemistry or maths. The selection process was rigorous and included aptitude and psychometric testing. Students from backgrounds where going into higher education is not a given or groups under-represented in engineering, including women were encouraged particularly. Recruitment has been successful in this regard with around 25% of the first cohort being women. The cohort also contains a significant number of people who have given up well paid jobs to gain the qualification.

Students (whose course fees and travel costs are paid) are studying a University-taught programme focusing on acquiring expertise in solving technical business problems in areas such as manufacturing, mechanical engineering, engineering design, materials and supply chain optimisation. They also undertake 24 weeks of paid work including an in-company placement, followed by a related research project at the University's Institute for Innovation in Sustainable Engineering.

The course is set-up so that employers can test potential employees' abilities - useful for small or medium-sized companies without a graduate programme - and students gain real skills, with job opportunities at the course's end. The work they've undertaken could also contribute to Chartered Engineer status.

Master's degree (MSc) in Professional Engineering (part-time, online)

Developed with the Engineering Council the work-based MSc in Professional Engineering enables full-time engineers to gain Chartered Engineer status. The project means students can study online through University of Derby Online Learning (UDOL), without attending tutorials in Derby.

As well as catering for those with a traditional engineering degree the MSc is also available to employees without traditional higher education qualifications.

Students' employers will pay their tuition fees. The course began in September 2014 and will normally take two to three years to complete.

Both courses will also see experienced managers within the student's company given structured training to become certified workplace mentors, to become an active participant in students' learning.

Annex E – MTEC: a consortium led part time MSc degree scheme

This MSc programme is delivered by a consortium of Newcastle, Southampton, Strathclyde Universities and University College, London (UCL) and is aimed at students who are in full time employment in the marine sector. The concept was driven by the marine industry requiring more graduates with the necessary skills and training in advanced technologies, management, business and IT. With this training, they will be able to provide the necessary leadership and vision to maintain and enhance the industry's knowledge base and improve competitiveness.

The programme is delivered as a part time modular programme with a maximum duration of five years (minimum two years) and students can leave with a Postgraduate Certificate, Diploma or full Master's degree. It is designed for students working full time in industry and therefore needs to be as flexible as possible. Students are able to choose which modules to complete each year and each module is delivered in three elements: pre-attendance work, an intensive week of attendance and post-attendance work.

The scheme is a true collaboration of both industry and the contributing universities. It is administered by Newcastle University, with the programme director based at the University of Southampton. Project supervision can take place at Southampton, Newcastle, UCL or Strathclyde.

The MTEC scheme was established as a result of an EPSRC initiative which, initially, provided scholarships for students and allowed the development of the specialist modules. Once the EPSRC funding had finished there had been a concern that the scholarships which paid for part of student fees would mean that the cohort would disappear. However, there has continued to be a steady demand from both the industry and students, with the flexibility and conversion potential (a Mechanical Engineering graduate can 'marinise' their knowledge) proving popular, attracting students from both the UK and overseas. Typically most students' fees are paid for by their company on a module-by-module basis. Further, the programme is under continuous review and development to ensure it meets industry need – for example, the Marine Renewable stream was funded by The Crown Estate and a Heavy Electrical engineering stream is currently under development.

The collaborative agreement between the universities is renewed every five years, with governance achieved through a Board of Management on which several industry representatives from the maritime sector sit, together with the programme director and programme coordinators from each of the universities of MTEC. The chair of the Board is an industry representative. The Board oversees the finance and viability of the scheme and the associated Board of Studies (which includes two external examiners) oversees academic standards.

Annex F – NERC Centre for Doctoral Training (CDT) for Oil and Gas

This initiative has had initial investment from the Natural Environment Research Council (NERC) for research and specialist skills development in the Oil and Gas sector. Aligned with the outcomes of the Wood Report and seeking to address the skill shortage it identified, it provides a practical means to supply the high calibre talent needed to unlock oil and gas reserves in a sustainable and environmentally aware manner.

Current investment in this CDT is at £8M over 6 years, with £2.7M from NERC and a further £5.2M from the various (academic and affiliated) partners. The first cohort of 31 students started in autumn 2014. Led by Heriot-Watt University (HWU), it consists of a team of 7 core partners[8] and a further 12 associate partners[9], this is a unique inclusive collaboration between the majority of academic providers for the oil and gas sector in the UK.

The areas of current focus for the centre are aligned with four main themes:

- Effective production of unconventional hydrocarbons
- Extending the life of mature basins
- Exploitation in challenging environments
- Environmental impact and regulation.

There is flexibility to adjust the themes in future years to ensure that the centre continues to be responsive to industry needs – indeed, this is already happening with discussions underway on the development of themes focusing on Enhanced Oil Recovery and Field Analogs.

In addition to a 4-year PhD programme, students at this CDT will also receive 20 weeks of formal, residential training delivered via a Training Academy. This consists of bespoke week-long modules delivered by academic, governmental and industry experts from the Earth Science, Environmental, Regulatory and Applied Business sectors and will be spread across the first three years of the PhD programme. The training topics will be of direct relevance to the sector.

The Training Academy has so far received underpinning support from both BP and Shell and is keen to develop such support from other industrial partners who will enjoy the advantage of access to a "one stop shop" of the latest research in the Oil and Gas industry and the opportunity for company staff to attend the Training Academy's field classes. Industry partners' staff may also serve on the CDT Industrial Advisory Committee which provides the opportunity to influence the strategic direction of the centre and ensure it continues to deliver the relevant research and specialist skills the industry needs.

[8] The 7 core partners are HWU, Imperial College, Aberdeen, Durham, Manchester, Oxford and the British Geological Survey (BGS). 6 of the academic partners in this core group have agreed to support 2 PhDs (equivalent to £547k of new University money) to match 1 from the NERC pool to ensure that 3 new 4-year PhD students will start in each of their institutions over the next 3 years, meaning that 18 new PhD students will study oil and gas at these institutions each year.

9 The 11 associate institutions are the universities of Birmingham, Cardiff, Dundee, Exeter (Camborne), Glasgow, Keele, Newcastle, Nottingham, Royal Holloway, Southampton and Strathclyde, two NERC affiliates/Centres – the National Oceanography Centre (NOC) and the British Geological Survey (BGS) - and these ensure that another 13 PhD 4-year studentships will start in each of the first three years of the 6-year scheme.

Annex G – Warwick Manufacturing Group: Advanced Skills Accreditation Scheme

Based on the success of Jaguar Land Rover's (JLR) Technical Accreditation Scheme which allows JLR employees to mix and match a variety of Master's level modules from a number of leading universities according business, individual and professional development needs, the Warwick Manufacturing Group (WMG) have, with JLR, developed the Advanced Skills Accreditation Scheme (ASAS). Aimed at boosting the skills of engineers working within the automotive supply chain and other hi-tech industries, it offers engineers the chance to develop the future engineering skills which will be needed to create world-leading new products and technologies in the future.

Led by Semta the sector skills council for Science, Engineering and Manufacturing Technologies, it is supported through the Government's Growth and Innovation Fund, together with £1M from the UK Commission for Employment and Skills. The funding means the scheme can be accessed by companies of all sizes within the UK.

WMG co-ordinates the relationships with educational establishments and an Employer Board, chaired by JLR and on which representatives of leading technology companies sit, oversees the quality and delivery of the overall programme.

The scheme involves 50 modules covering advanced skills and technologies such as hybrid technology and sustainable powertrain, which will be delivered through collaboration with a network of leading universities chosen for their research expertise in a given topic. The unique model of the scheme means individual Master's level modules can be accessed as and when required, unlike standard Master's level training which generally requires registration onto a complete, multi-module programme. Each module is individually accredited, giving standalone value.

The scheme is fully endorsed by the Royal Academy of Engineering, the Institution of Mechanical Engineers and the Institution of Engineering and Technology and is expected to attract engineers from over 2,000 companies.