

## Work-based MSc Professional Engineering: an evaluation so far

Deborah Seddon (dseddon@engc.org.uk), Engineering Council, UK

Deborah Lock (D.Lock@kingston.ac.uk), Kingston University, UK

***Abstract:** In 1997, the academic requirement for Chartered Engineer (CEng) status was raised to a Masters Degree or equivalent. This has increased the pressure to develop a range of different provision at this level as alternatives to full-time education. Since 2006, the Engineering Council has worked with a number of universities and professional engineering institutions (PEIs) to develop flexible MSc Professional Engineering programmes as pathways to professional qualification. The model of provision adopted integrates the work-based development of Masters level knowledge and understanding with the development of the skills and competence required for CEng status.*

*This paper presents the findings of the interim evaluation of the 'Gateways to the Profession' project, initially funded by the then Department of Education and Science (DfES), and includes feedback from each stakeholder group through questionnaires and interviews. Overall, the responses have been positive and appear to confirm a high level of interest in this type of flexible pathway, as well as highlighting a number of areas that merit further investigation. Whilst the academic content and relevance of the programme is critical to all stakeholders, the quality assurance and administrative infrastructure have proved to be equally important, since the development of documentation that would be acceptable to a range of professional and academic organisations and enable professional accreditation at some point in the future is pivotal for the overall success of the programme.*

### Introduction

The most commonly offered UK first cycle engineering degrees are three year full-time (four years in Scotland) programmes leading to a bachelors award with honours (BSc or BEng). Second cycle provision in the UK includes MSc and MEng degrees, the latter being termed 'integrated' to acknowledge that the MEng combines both first and second cycle learning outcomes.

In 1997, largely due to a desire to ensure continuing international recognition of the standard of UK engineering qualifications, the requirement for CEng was raised to masters level knowledge and understanding. Contrary to common perception, more engineering students in the UK currently graduate with a BEng degree than with an MEng degree. Thus to achieve CEng status, the majority of first cycle UK engineering graduates need to undertake some further learning to masters level. Engineering Council analysis of HESA data suggests that approximately 44000 UK-domiciled BEng graduates since 2003 might be interested in the MSc Professional Engineering. Many BEng graduates in the workplace who although eligible to work toward becoming chartered have not done so, with the cost of undertaking further full-time study and the loss of earnings suggested as disincentives to enrolling on university-based accredited MSc programmes.

In response to the recommendations in the 'Gateways to the Professions' report (Langlands, 2005), the UK Government established a development fund for projects that tackled issues and barriers faced by people seeking to enter the professions through higher education. The Engineering Council was one of several professional organisations within England invited to submit proposals for these projects. The Engineering Council's submission aimed to address the issue that working engineers

who were eligible did not, for whatever reason, progress to become professionally qualified. The project aims were to:

- Develop and pilot a model pathway to professional registration of engineers in which higher education and professional development are combined through a work-based approach
- Target groups who are under-represented in the engineering profession at present
- Help address the shortage of engineers and have a positive impact on retention

The Engineering Council was awarded funding in 2006 for the first two years of a five year initiative to develop and establish a model for flexible pathways into and through higher education, leading to professional status in engineering. These would meet the needs of the profession, the individual and their employer, as well as providing universities with a marketable new form of provision.

The initiative is strongly collaborative, though for practical reasons a limited number of partners were involved during the development phase. These were four universities with experience of work-based learning (Hertfordshire, Kingston, Northumbria and Staffordshire) and three of the licensed PEIs - the Institution of Engineering & Technology (IET), the Institution of Mechanical Engineers (IMechE) and the Royal Aeronautical Society (RAS). Aston University is now offering the MSc, others are likely to do so later in 2010, and a further seven PEIs are now involved. The involvement of the PEIs is important because the aspiration is for the MSc programmes to be accreditable in due course, and the individuals would apply for a chartered professional review with a panel of peers at one of those institutions.

## Overview of the model

The basic premise is that in carrying out their role to meet their company's business needs, an individual could be developing masters level knowledge and understanding as well as developing the required level of professional competence for CEng. With the help of an academic supervisor and a mentor who is familiar with the particular PEI requirements, it is possible to ascertain what the individual needs to undertake, achieve and record to meet the academic and professional competence requirements for CEng. This involves mapping, auditing and planning at the start of each individual's programme.

This reflective examination and assessment of the individual's education, qualifications, experience and competence results in some form of agreement, sometimes referred to as a Learning Contract (or Agreement), which effectively outlines the individual's work-based programme (Anderson *et al*, 1996). This is tailored to the individual's specific situation and fits with company objectives. It will specify what is to be learned, how it is to be learned, and how the learning will be verified. Within or alongside this is a mapping of the UK-SPEC standards of competence, to illustrate the likely activity and type of evidence that will contribute to the demonstration of achievement of the UK-SPEC requirements (Engineering Council 2008a). Whilst the learning contracts are individually tailored, the PEIs and HEIs have liaised on the development of templates that meet the PEI's requirements.

The achievement of knowledge and the demonstration of professional competence are separately recorded and assessed, and in some cases, existing PEI electronic systems for recording professional development are utilised. The assessment of achievement of masters level outcomes is the responsibility of the HEI. The programmes align with requirements set out in protocols (between the Engineering Council and the HEI and PEI partners) and a guide to the MSc covering *inter alia* that learning is from workplace activity unless taught modules are chosen; there is an initial audit and development of a learning contract to record the negotiated programme of study; and minimal or no requirement to attend the HEI. The learning outcomes basis for UK-SPEC and accreditation enables the universities involved to offer a range of provision relevant to particular needs, with some including short modules on technical or professional skills. The PEIs involved have undertaken to review and comment on an individual's documentation at an earlier stage than usual to ensure that the individual is on the right track. However it is stressed to everyone involved that the same processes and rigour apply as for any other pathway to CEng, achievement of the MSc does not guarantee CEng status, and individuals undergo a professional review as for any candidate for CEng.

Negotiated work-based programmes based on a learning agreement are not new, and the MSc Professional Engineering is building on accepted practice at many universities. UK-SPEC requirements are central to this model, and there is no change in the required standards for individuals following this pathway. Students have enrolled at different times at the four universities; the first graduates are expected in 2011.

Full details of the pathway, including assessment and mentoring guidelines, the participating HEIs and PEIs, the protocols and a process map are available on the engineering gateways website ([www.engineeringgateways.co.uk](http://www.engineeringgateways.co.uk) a).

## Benefits

As well as removing the disincentive of a loss of earnings, and hence being a more affordable option, as the work has developed it has emerged that the model could:

- provide a flexible way of meeting company and employee aspirations, without losing engineers from the workplace
- address an increasing demand for a clear pathway to professional qualification since the demise of structured graduate training schemes in UK companies, with an individuals' learning and professional development rooted in reality
- provide a mechanism for greater employer involvement in their employees' education and professional development
- establish and nurture university-employer links, which is increasingly being encouraged by the UK government (Department for Business, Innovation & Skills, 2009) with the potential for knowledge exchange (Confederation of British Industry, 2009; Connor, H. 2007)
- provide a mechanism for engagement between PEIs and potential members.

More recently, it has been further suggested that for some individuals, the time taken to achieve professional qualification may be less than by other pathway(s), and that this model may be a vehicle for a Knowledge Transfer Partnership type of arrangement ([www.ktponline.org.uk](http://www.ktponline.org.uk)).

## Issues arising during the development phase

### Accreditation

It has always been an aspiration that the programmes would be accreditable, and the participating universities are particularly keen on accredited status as this brings marketing advantages. Whilst Engineering Council regulations provide for a PEI to confer accreditation in the absence of an output cohort, PEIs are understandably reluctant to accredit the MSc Professional Engineering at this early stage. However, students and their employers look for some level of confidence about the programme's likely future accreditation status.

To address some concerns, the following mechanisms have been put in place:

- the PEIs are involved at an early stage in the design of an individual's tailored programme
- the protocol signed between the Engineering Council and each PEI includes a statement that once there is sufficient output, the PEI will consider conferring accreditation
- universities have been offered the use of the Engineering Council logo for their programme documentation, and encouraged to include the statement: '*This programme was developed according to the Engineering Council framework*'.

Whilst innovative provision poses a challenge to traditional forms of degree accreditation by PEIs, the outcome-based system of accreditation operated in the UK since 2004 (Engineering Council, 2008a) provides for the MSc Professional Engineering to be accredited. Process issues such as delivery mode are indicators rather than absolute criteria. The future challenges for accreditation are more fully explored elsewhere (Shearman, R. and Seddon, D. 2009).

### Roles and responsibilities

The academic supervisor is responsible for the academic integrity and content of the individual's programme, and a workplace mentor who is normally based in the company (and often supported by a PEI professional development advisor) oversees the development of the individual's competence towards professional qualification. This level of support has generally been viewed as an advantage. However it was recognised that there is the risk of confusion about responsibilities, and therefore a guide to mentoring and assessment has been published, setting out responsibilities for the academic assessment and the monitoring of development of competence ([www.engineeringgateways.co.uk](http://www.engineeringgateways.co.uk) b).

### Documentation

Whilst all the PEIs are working to the standards of competence in UK-SPEC, and all the universities will be referring to the Engineering Council's published learning outcomes (Engineering Council, 2008b), the PEIs have their own specific documentation requirements for professional review and for

accreditation. The protocols therefore include clauses about reviewing documentation at an early stage to ensure that individuals on this pathway would not be disadvantaged and that the PEI can access the information it needs, for example about master's level learning.

All the PEIs provided feedback on anonymised examples of draft learning contracts provided by the universities early on, and appropriate adjustments were made. Such feedback at an earlier stage than is usual has proved to be beneficial both for the individuals concerned as well as for the development of the generic pathway processes.

## Sharing of experience

Whilst there is inevitably some competition for students between universities, in this project there has been a general willingness to share information and experience for mutual benefit and to avoid re-inventing the wheel. This has led to the recent development of a Stakeholders' Group for all partner organisations as well as others with programmes in development.

## The Interim Evaluation

### Methodology

The primary objective of the interim evaluation was to measure progress against the aims outlined above and to ascertain whether or not the MSc programmes offered are meeting stakeholders' needs. The evaluation was conducted by a small research team which included an independent consultant. An Evaluation Task Group approved the membership of the team, agreed the methodology, provided feedback on, and approval of, the data collection toolkit as well as guided the formative data analysis.

A multi-method approach was used to study four core areas: context, impact, output and process:

- *Context evaluation*: assessment of the programme's appropriateness to its context
- *Impact evaluation*: assessment of the impact of the MSc Professional Engineering programmes on key stakeholders
- *Output evaluation*: review of the results of the project
- *Process evaluation*: assessment of the project management, delivery and materials for effectiveness, efficiency and quality

It was felt that this approach would provide the required detail as well as ensuring a rich source of data.

### Data collection

The data was collected using either questionnaires (on-line or hard copy on request) or structured interviews conducted by telephone or face-to-face. Prior to interviews, the broad areas to be covered were forwarded in advance, careful notes were taken, and recording used as a back-up in most cases. Each respondent was given the opportunity to confirm the accuracy of the interview transcript. Particular challenges were accessing the individual work-based student due to data protection regulations, accessing the employers and the most appropriate respondent in each company, and ensuring confidentiality. To reassure stakeholders, the independent consultant collected the data and provided the research team with the anonymised raw data for analysis.

## Feedback from the work-based students/employees

### Respondents

Twenty responses (46.5%) were received from the 43 enrolled on the MSc Professional Engineering:

- 14 from University A (56% of their enrolments)
- 4 from University B (33% of their enrolments)
- 2 from University C (66% of enrolments)
- None received from University D (0% of enrolments)

Virtually all respondents were in the first year of their programme and working in diverse roles in different sectors of the engineering industry. All have a professional qualification at Level 4 - first year of a first cycle (degree level) – or above. 17 students have a BEng in different engineering fields and three have a BSc. 8 of the 20 respondents are members of the three initial participating PEIs: IET (9), IMechE (7) and RAeS (2). Eight indicated associate membership and one holds Incorporated Engineer status.

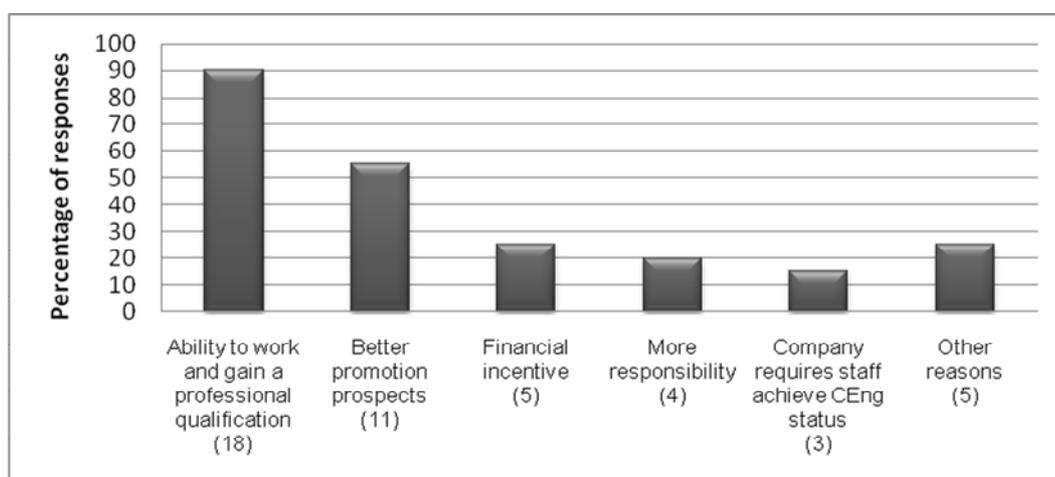
## Perceived importance of professional engineer status

Ten of the MSc students (50%) indicated that it was ‘very important’ to have Chartered Engineer status, nine that it was ‘important’ (45%) and one ‘fairly important’ (5%). No-one indicated it was less than fairly important. Fifteen (75%) said that their employer actively encouraged staff to be registered as a professional engineer; five (25%) indicated that there was no active encouragement.

## Reasons for enrolling on the programme

Whilst most respondents gave more than one reason for enrolling on the programme (Figure 1), the primary motivating factor appeared to be the ability to continue work whilst gaining a professional qualification (90%), with the promotion potential being second [55%]. A number of students also mentioned ‘other reasons’ for enrolling on the programme and these included:

- Achievement of personal goal, self development, and professional development
- Registration for a degree was a requirement of a Knowledge Transfer Partnership (KTP)
- Increased credibility in engineering sector



**Figure1: Reasons why individuals enrolled on the MSc programme (number of responses in brackets)**

## Reasons for not pursuing Chartered Engineer status earlier

When asked why they hadn’t pursued CEng status through an MSc programme earlier, the respondents identified – from a list given – a variety of reasons. No-one indicated they had not been interested or career minded before, but instead highlighted the importance of being able to work and study together as a key factor in their decisions (Table 1).

**Table 1: Reasons for not pursuing MSc and Chartered Engineer status earlier**

<i>Reason identified</i>	<i>%</i>	<i>No of respondents</i>
Could not take time away from work to meet further learning requirements	45%	9
The prospect of further debt needed to complete a taught programme	25%	5
Lack of opportunity at the place of employment	20%	4
Too early in personal career	20%	4
Not knowing how to go about it	15%	3
Not pursuing a career in engineering until now	15%	3
Family commitments and responsibilities	10%	2

Additional comments from the respondents supported the ‘fitness-for-purpose’ of the flexible nature of the programme, and confirmed that it met the need of work-based individuals for a clear pathway to

CEng. Therefore, based on the feedback from the students as to why they had enrolled and why they had not pursued CEng status earlier, it is reasonable to assume that the programme is addressing a specific market need.

### Delivery of the programme

Most of the MSc students had undertaken a university induction programme introducing them to their academic programme, and all respondents indicated that this was either 'helpful' (9) or 'very helpful'.

All the respondents confirmed that there was negotiation within their MSc programme. 90% (18 respondents) said that the whole programme was through a learning agreement where they negotiated what they would learn, where, when, how and the evidence for assessment. A range of methods of learning were reported, the majority citing work-based activities and projects, with some reporting use of their own study strategies e.g. use of web, library, and 1 cited the university's on-line learning system.

Most reported being aware of the key people who could provide support for their academic work and support for the development of professional competence. They did not access all of the facilities within the universities but focused on specific areas, with access to electronic resources most commonly cited. Although six felt part of the university student community, a significant proportion (32.5%) did not. This is something that merits further investigation since it could be an influencing factor in HEIs' recruitment and retention targets.

### Satisfaction with the MSc Professional Engineering programme

Most respondents indicated an encouraging level of satisfaction, with a number indicating that it was too early to comment under all categories.

10 respondents (50%) confirmed that the knowledge and skills gained on the programme had already helped them in their job and nine (45%) anticipated that their programme of study would help them in the future.

Nineteen respondents (95%) were aware of the CEng competence standards. Nine respondents (45%) thought that, having gained CEng status, they would stay within their current company and gain a higher position. Only 3 (15%) thought that they would leave the company for a higher position. Eight (40%) felt it was too early to say.

**Table 2: Satisfaction with MSc Professional Engineering programme**

<i>Focus of question</i>	<i>Level of satisfaction</i>
Quality of the university's academic supervision.	65% (13 students) were satisfied, or very satisfied with the programme, and only 15% (3 students) indicated dissatisfaction
Quality of company mentoring.	75% (15 students) were either satisfied, or very satisfied, with 50% indicating they were very satisfied. This was the highest level of approval in the categories. Only one person indicated any dissatisfaction
The university's academic assessment process	65% (13 students) were either satisfied or very satisfied, and no-one indicated any dissatisfaction
The extent to which the university programme contributed to the development of professional engineering competence	55% (11 students) were either satisfied or very satisfied, and only one indicated any dissatisfaction. 20% (4 students) indicated that it was too early to say
The general course organisation and management by the university	55% (11 students) were either satisfied or very satisfied, with 15% (3 students) expressing dissatisfaction, two of these indicating they were very dissatisfied
The overall quality of the university programme.	65% (13 students) were either satisfied or very satisfied, and no-one indicated any dissatisfaction. 15% (3 students) indicated it was too early to say

Any comments that expanded on the quantitative data above revolved around perceived resourcing issues at the university. Whilst there was an expression of frustration, another conceded that such issues are to be expected for a new course, things are improving and the benefits are beginning to show. Another reported very positively: 'The course gives a very clear direction to gaining an MSc as well as providing clear direction towards gaining CEng status. I wouldn't hesitate to recommend this course.'

## Feedback from the participating universities (HEIs)

An academic from each HEI was interviewed. The HEIs' reasons for wishing to be involved in the initiative included its alignment with the university's aims and recognition of the need for such provision.

### Delivery of the programme

All four HEIs have experience in delivering work-based learning programmes, though the level of negotiation within programmes varies. In three out of the four, the MSc programme was taken through a full validation process; the fourth had an appropriate validated framework so only approval of a minor modification was required.

Programme structures and processes vary but there is a high degree of commonality. All met the requirements set out in the protocol with the Engineering Council and the guide to the MSc as described earlier. The personal academic supervisor is usually skilled in the individual's area of engineering; in two HEIs there is additional support from module tutors for specific projects. One HEI appointed paid 'professional supervisors' who act as mentors, though this system is under review.

All the HEIs are considering how best to help the work-based students bridge the world of HE and work, and to feel part of learning community, though one commented that those currently on the MSc had never expressed a wish to meet others on the programme.

### Relationships

The HEIs adopt differing strategies for employer engagement, though all visit the company both before and after enrolment takes place. One commented that a face-to-face visit to a company is needed as a prospectus alone cannot emphasise the value-added of the MSc as a way of developing an engineer, for the benefit of the company.

All the HEIs interact regularly with the PEIs and feel that continuing collaboration is beneficial to programme development and to programme participants. In some cases the PEI has assisted in finding mentors. Their feedback on individuals' documentation was valued.

### Satisfaction with the programme

All the HEIs feel that the pathway is meeting the needs of their institution particularly in respect of employer engagement, widening participation, student progression, and lifelong learning, and it fits with current government priorities. Respondents were positive about the meshing of an academic programme with UK-SPEC, and feel that the collaboration with the Engineering Council and the PEIs is useful and beneficial to all.

Employer engagement is leading to a range of other benefits such as knowledge exchange, updating of academics' engineering skills and academic staff development in the area of work-based provision.

Whilst the HEIs feel it is too early to say if the intended aims are being met, there is general satisfaction with the way things are going, and all four HEIs are strongly committed to continuing to offer the MSc programme. All report increased levels of interest, and student numbers are expected to grow.

Areas identified for development include:

- identification of cohorts within a company to provide additional peer support and help to balance costs
- the development of innovative web-based delivery strategies
- investigating the alignment of the MSc with existing company graduate training programmes to assist companies with performance management
- development of a similar model at undergraduate level.

## Feedback from the Professional Engineering Institutions (PEIs)

All three PEIs re-iterated their commitment to the initiative; it matches their aims and objectives, particularly the provision of flexible routes for people to become professionally qualified. Appropriate PEI committees are kept informed, no additional charges are made for the support of these students, and ensuring that the process for registering these individuals aligns as far as possible with current practice is a clear aim.

Dealing with the learning contracts is the main new task, though this is not burdensome due to the small numbers. If numbers rise considerably, at least one PEI may consider some form of economic modelling.

Two of the three PEIs are pleased with the learning contracts, especially where there are explicit links with UK-SPEC. The third PEI is seeking more information, for example about Masters level teaching and learning standards. The PEIs noted that their earlier feedback has been acted on and progress made, though there remains work to do if the aim of one template acceptable to all the PEIs is to be realised.

Evidence suggests that the protocols are working and that feedback has been provided to students about the content of their proposed study, including in one case, advice that the individual is unlikely to be able to demonstrate achievement against the standards. If numbers grow, one PEI is likely to set up a specific committee to look after the applicants who follow this pathway.

Overall, the PEIs are broadly content with the way things are going, they welcomed the updated website and are satisfied with the Engineering Council's management of the initiative. However, they feel it is too early to say whether or not the aims of the project were being met.

## Feedback from employers

Five employers participated in the evaluation. The sample was identified via the students and the Evaluation Task Group, and represented a range of engineering sectors (including aerospace, automotive, construction and mechanical engineering), size (including SMEs) and location. The employer survey consisted of two core strands of enquiry:

- The importance of CEng status for employers and the perceived benefits to the company of having Chartered Engineers in post
- The level of engagement with the MSc Professional Engineering programme, such as negotiating and agreeing the content of the learning agreement with the employee and the university.

80% of the respondents claimed that CEng status was important for career progression and identifying leaders of the future. 'It gives a seal of approval, a minimum standard, beyond academia. It reassures the company that the person has attained a certain level with their skill set and capabilities'.

In addition to employee benefits, a number of commercial benefits to the company were identified such as helping with the tendering process, securing business and enhancing company credibility with potential clients. 'There is value, often a necessity, when presenting to clients. Middle East clients request copies of degree certificates, and want engineers to have PEI membership and professional status'.

The flexibility and negotiated nature of the programmes are considered important by all of the employers since this allows employees to work on real-time projects without being absent from the work-place. The MSc also provides an additional element of rigour to some company projects since the individuals are tasked with documenting the process and not just the system.

The majority of the employers (80%) are anticipating new income streams and new contracts as a result of the projects undertaken by the employees:

'The main project focuses on required modifications to aeroplanes which will resolve some identified problems. It will save several million pounds.'

'One of X's projects for the MSc is based on designing a new handrail system for a client - and, if successful, will bring in money for the company.'

Feedback was also received from a sector-specific organisation that has made a major commitment by sponsoring 12 individuals from amongst its employers at two of the universities. The organisation is looking to support this pathway within its portfolio of programmes. Some concerns have been expressed about the time taken for initial contract negotiation not matching business expectations.

Another issue is whether or not companies can provide the necessary work opportunities to develop masters level learning.

## Discussion, future activity and conclusions

It is clear from the feedback to date that the notion of a flexible negotiated learning programme that embeds professional competence is meeting a market need; specifically those employers and employees that require higher level skills development at a time of great economic uncertainty when day release and off site attendance may not be an option. The majority of the individuals enrolled on the MSc Professional Engineering have access to a wide range of diverse work-place projects, a large proportion of which are expected to benefit the business both financially and strategically by securing new contracts, diversifying income streams and enhancing business processes and systems.

Aspects of the model that have contributed to the success so far include: the involvement of the key stakeholder groups right from the beginning, leading to a sense of ownership and a shared understanding of the model; the establishment of protocols between the Engineering Council and each HEI and PEI participant that clearly set out the process and requirements; and the level of support for the individuals enrolled on the MSc.

Those involved appear to have a good understanding of the various roles and responsibilities. However whilst individuals on the MSc programmes feel supported, they do not feel part of the university student community. This warrants further investigation to ascertain whether this is something they would welcome.

The Engineering Council and the PEIs view this pathway as one further choice amongst the range of pathways into the engineering profession for which the profession has been praised (Panel on fair Access to the Professions, 2009). It will meet the needs of a particular market and is not intended as a replacement for other pathways. However, more needs to be done to raise awareness amongst employers as it is likely that there are others who would benefit from this approach.

Engagement of SMEs remains a challenge and if the pathway is mainly used by engineers in large companies, who can give staff time and high levels of support, then it will lessen its impact. Expanding the number of providers would help to raise the profile and should assist the universities in marketing their MSc Professional Engineering programmes. However, the lack of more aggressive promotion to date is understandable given that it is too early to achieve a key measure of success: achievement of CEng status by MSc Professional Engineering graduates.

There is work to be done to ensure that an individual can progress at an acceptable pace and in line with PEI processes. Of particular note is the fact that the PEIs are already thinking about process modifications for when the number of applications from this pathway for chartered professional review grows, which bodes well for the future; and also the willingness of the HEIs and the PEIs to engage collaboratively in such an innovative initiative.

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