**UK engineering degree accreditation: the Engineering Doctorate**

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**Summary**

The standards of professional competence and commitment are set out in the UK Standard for Professional Engineering Competence (UK-SPEC) [Engineering Council a]. Accredited degree programmes provide the exemplifying levels of understanding, knowledge and skills for professional competence. Fundamentally, accreditation is an assessment of whether a degree programme provides its graduates with the knowledge, understanding and skills required to take them towards eventual registration as an Incorporated Engineer (IEng) or Chartered Engineer (CEng).

When UK-SPEC was introduced in 2003, the exemplifying academic qualifications mentioned were first and second cycle engineering degrees. Engineering Doctorates (EngD) were not included.

This paper describes the UK’s Engineering Doctorate (EngD) in the context of registration as a Chartered Engineer, and the mapping that was undertaken involving the profession and EngD providers to establish whether the EngD could be accredited as an academic award. As a result, the Engineering Council’s Regulations for Registration have been amended to include an accredited EngD as an exemplifying academic award for CEng for those holding an accredited Bachelors degree with honours in engineering or technology.

The work has led to the development of guidance for Professional Engineering Institutions (PEIs) about accrediting the EngD which accrediting authorities in other countries might find of interest and of assistance should they wish to accredit similar degrees. The first UK accreditation visit to consider an EngD according to these guidelines was undertaken in March 2012, and it is likely that universities’ interest in this will grow.

The paper also considers the development of professional engineer competence as a dimension of the EngD and its role in the initial professional development (IPD) of a potential registrant.

**Engineering Council and accreditation**

The Engineering Council sets and maintains the United Kingdom Standard for Professional Engineering Competence (UK-SPEC). This includes the overall requirements for degree accreditation [Engineering Council b]. Engineering Council accreditation of engineering degree programmes is a mark of assurance that the programmes meet the standards set by the engineering profession. The criteria for accreditation are set out as learning outcomes, general and specific, and have been reviewed internationally as being of a sufficiently high standard for the Engineering Council to be licensed to award the EUR-ACE label. Discipline-specific Professional Engineering Institutions (PEIs) are licensed by the Engineering Council to undertake the accreditation process according to UK-SPEC standards.

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Over 2000 accredited engineering degrees, first and second cycle, are recorded on the Engineering Council’s academic courses accreditation database (ACAD) [Engineering Council c]. When UK-SPEC was introduced in 2003, the exemplifying academic qualifications mentioned were first and second cycle engineering degrees. Engineering Doctorates (EngD) were not included at that time.

**Doctoral training in the UK**

The Engineering and Physical Science Research Council (EPSRC) supports studentships through three main routes. One of these is via Centres for Doctoral Training, and within that umbrella term there is a specific variant, an Industrial Doctorate Centre (IDC), which has a formal requirement about the level of industrial involvement and the extent to which students work directly with the company.

All the Centres for Doctoral Training bring together diverse areas of expertise to train engineers and scientists with the skills, knowledge and confidence to tackle current evolving issues, and future challenges. They also provide a supportive and exciting environment for students, create new working cultures, build relationships between teams in universities and forge lasting links with industry. Further details about doctoral training in the UK are published by EPSRC [EPSRC a and b].

**The EngD**

The Engineering Doctorate Scheme was established in the UK by the EPSRC in 1992, following the Parnaby Report [Science and Engineering Research Council, 1990] and has become established as a flagship programme. The EngD is a third cycle award aimed at providing engineers with an intensive, broadly based research programme, incorporating a taught component, relevant to the needs of industry. An EngD typically comprises three main elements:

* A Research Engineer role in a company
* A research project or projects culminating in a thesis similar to that required for a PhD
* Training that covers transferable skills such as business, management

This doctorate-level training provides ambitious and able graduates, called Research Engineers (RE), with the ability to innovate and implement new ideas in practice, and enables them to reach senior positions in industry early in their careers. The Engineering Doctorate (EngD) should be at least equivalent to the intellectual challenge of a PhD, but is enhanced by the provision of taught material in both management and engineering technical areas. It is considered by the academics involved to be philosophically different to a PhD.

The UK’s Quality Assurance Agency for Higher Education (QAA) guide to doctoral degree characteristics includes a set of descriptors which are a requirement for all UK doctoral qualifications [QAA, 2011]. These qualification descriptors summarise the research-specific and personal attributes agreed by the higher education sector as a minimum level of achievement for any doctoral graduate.

The UK doctorate has been confirmed as being in alignment with European-wide guidance, in particular, with the Framework for Qualifications of the European Higher Education Area (EHEA), through a verification process led by the QAA in 2008.

Godfrey (2012) provides a more detailed history of the EngD in the UK and includes details of a more academic nature. A community of Engineering Doctorate providers, researchers, sponsors, EngD alumni and other stakeholders in the EngD 'brand' has been established, the Association of Engineering Doctorates, to support and promote the brand and develop wider and more strategic industrial research collaboration. Further information is available at their website: <http://www.aengd.org.uk/>

This paper focuses on the EngD and professional engineer registration.

**Registration with the Engineering Council**

Registration is open to individuals who can demonstrate the required standard of competence and commitment. Professional competence integrates knowledge, understanding, skills and values, and for an engineer this generally involves a combination of formal education and further training and experience, generally referred to as initial professional development (IPD). However, the education and professional development are not necessarily separate or sequential.

The Engineering Council’s UK-SPEC sets out various options for achieving the exemplifying academic qualifications or equivalent for Chartered Engineer status. Each ultimately rests on demonstration of the necessary knowledge and understanding at Masters (second cycle) level. Third cycle degrees such as the Engineering Doctorate (EngD) were not included when UK-SPEC was published. Whilst it was clear that EngD graduates could not automatically be considered as registrable as CEng, the Engineering Council felt that it would be desirable for there to be a clear pathway to registration for EngD graduates, given the esteem of the EngD flagship programme.

An Engineering Council survey of UK Professional Engineering Institutions in 2011 revealed strong support for viewing the EngD as an exemplifying academic qualification, despite the fact that these vary enormously. If a mechanism could be found, the PEIs said that they would consider accrediting the EngD as ‘further learning’ for a graduate with an accredited first cycle degree, thus meeting the academic requirement for CEng. Since the publication of UK-SPEC in 2003, PEIs had developed wide experience of accrediting Masters degrees, and the publication of learning outcomes for Masters degrees [Engineering Council b] paved the way for the development of a process for accrediting the EngD.

**Mapping exercise - academic**

An Engineering Council working group was established and discussion centred on how the EngD might be accredited as an academic qualification. The work was greatly assisted by three academics from IDCs who are EPSRC-appointed ‘EngD Advocates’.

As 25% of an EngD is typically spent on taught course work, it was agreed that the Engineering Council’s published learning outcomes for Masters degrees provided an appropriate basis for a mapping exercise between the EngD and Masters level learning outcomes.

EPSRC-funded Industrial Doctorate Centres[[1]](#footnote-1) were surveyed to determine the extent to which EngD programmes map against the UK-SPEC learning outcomes for Masters degrees. Respondents were asked to respond yes, perhaps or no about whether each Masters degree learning outcome would be demonstrable in the EngD(s) offered by their centres.

Ten IDCs responded, and the overwhelming majority of the responses about each of the individual general and specific learning outcomes were positive. There were only a few responses of ‘perhaps’ and no-one responded ‘no’. The IDCs responded enthusiastically, believing that accreditation would bring important added value for the EngD. Evidence collected indicates that it ought to be possible for an EngD to demonstrate both the UK-SPEC *general* learning outcomes (broadly, general or transferable skills) as well as the specific learning outcomes, at the required level.

The area which attracted responses of ‘perhaps’ related to demonstration of ‘an advanced level knowledge and understanding of a wide range of engineering materials and components’. The respondents’ comments made some reference to this being dependant on the nature of the individual’s project. Given that the EngD is a Level 8 qualification in the EQF , it was concluded that the shortfall is more likely to relate to the descriptor ‘*wide range*’ and not to a lack of advanced knowledge.

Although the variety of EngDs and the specialist nature of some of them might be perceived to be an issue for accreditation, this mirrors the situation for MScs in engineering and technology, where UK PEIs have developed solid experience of accreditation and many UK MScs have been accredited.

The data from EngD course leaders gave a high level of confidence that an EngD programme could demonstrate the UK-SPEC learning outcomes for Masters degrees, and in February 2012 the Engineering Council’s Registration Standards Committee accepted the recommendation that an accredited EngD be considered as an exemplifying qualification for CEng for those holding an accredited Bachelors degree with honours in engineering or technology.

PEIs were encouraged to consider requests to accredit these as academic awards and brief guidance has been developed to assist PEIs[[2]](#footnote-2). This suggests that accreditors may wish to pay particular attention to: the nature of the project, the balance between the management and more technical engineering content, the integration of learning with the research project objectives and application, supervision arrangements for the RE, and systems for ensuring that the RE is allowed sufficient time to undertake any university modules and prepare for exams.

In line with normal accreditation practice, accreditors meet with REs during an accreditation visit. It is also useful to meet with some employers of REs. The assessment is whether or not the programme is delivering knowledge and understanding which will underpin the CEng standard of competence. When reviewing an EngD for accreditation as an academic award, the programme is not expected to provide full competence for CEng.

The guidance cites several reference points for accrediting the EngD including the Engineering Council’s learning outcomes for Masters degrees, the QAA’s doctoral degree characteristics, and the UK-SPEC CEng standards of competence. It is important for accreditors to take account of the varying nature and purpose, and the opportunity to study in greater depth and/or the multi-disciplinary nature of some EngDs.

Understandably, members of accreditation panels may be less familiar with the EngD and its basic characteristics. In support of this, the Engineering Council has produced a briefing sheet about the EngD for PEIs to share with their accreditation panels (Annex 1). The EPSRC’s good practice guidance [EPSRC b] is particularly useful as it highlights the roles and responsibilities of the host Higher Education Institution, the sponsoring company, supervisors and the RE.

**The EngD as recognised IPD**

The 2011 survey of PEIs referred to above also revealed that most respondents considered that an EngD graduate should be in a roughly comparable position to someone who had completed an accredited Initial Professional Development (IPD) programme, for example in a company. This reflects the strong focus within the EngD on industry-focused work and training in preparation for a career as an engineer.

The working group therefore gave consideration to whether the EngD could be accredited as IPD. The following features of the EngD are relevant to such considerations:

* An IDC research and training programme is undertaken in partnership with industry and academia
* 75% of the Research Engineer’s time is spent in-company
* The EPSRC requirements for competence development in each EngD programme
* The requirement to produce a thesis and/or a range of other reports/papers
* EPRSC’s published procedures with explicit roles and responsibilities for IDCs

An EPSRC review in 2007 had found that the EngD programme was meeting real business needs, that many of the REs are having a major impact on business performance, that the scheme was making a valuable contribution to UK knowledge generation and transfer into industry, while satisfying its goals in terms of scholarship and publication.

The review also demonstrated that EngD REs are gaining the skills necessary for future leadership roles in industry and for CEng registration. Their conclusion was that the technical and commercial competences acquired on the programme, coupled with its demanding entry requirements, made it an excellent fast-track route to the CEng title. Because it is rooted in real workplace activity, the EngD provides a RE with the opportunity to develop CEng competence in a similar way to an employee on a structured company training scheme.

To corroborate these findings, a further survey of IDCs was undertaken by the Engineering Council to determine the extent to which their EngD programmes map against the UK-SPEC competence statements for CEng. Responses from eleven IDCs covered a range of disciplines and revealed a high level of conformity between EngD programmes and CEng standards of competence. Some of the EngDs reportedly met all or almost all of the CEng standards. There were several answers of ‘perhaps’ and only two ‘no’ answers. Although additional comments were optional, many of the respondents took considerable time to include programme details in support of their responses, reflecting a strong interest in aligning the EngD with professional registration as CEng.

The cautious responses mostly related to the demonstration of:

* Leadership of teams, which in part depends on the nature of an individual’s project
* The contractual element of commercial leadership
* Elements that may be more under the control of the company/industry such as whether or not a design solution is implemented.

The survey corroborated the view that an EngD holder is in a broadly comparable position to someone who has completed an accredited in-company IPD scheme. UK-SPEC is supported by guidance material covering topics such as ethics, risk and sustainability [Engineering Council, The Royal Academy of Engineering and Engineering Council d and e]. Whilst this is guidance rather than mandatory, it is interesting to note that several elements of the guidance are likely to be developed during the EngD.

The acquisition of non-subject-specific skills as preparation for research and leadership roles is covered in a recent report by acatech[[3]](#footnote-3) (2012), about strategies for strengthening the engineering doctorate at German universities. Survey participants called for a stronger focus on training in ‘soft skills’ especially basic business knowledge, HR management, project management, foreign language skills.

**Accrediting IPD**

Of the eleven IDC respondents, eight indicated that they would be interested in exploring the opportunity of their centre being accredited by a PEI as a training centre. This is commonly undertaken by UK PEIs for in-company schemes, but has not been custom and practice for university departments or IDCs. However, in a pioneering precedent several years ago, two PEIs (the Institution of Engineering and Technology and the Institution of Mechanical Engineers) had jointly undertaken such an exercise at the University of Manchester and awarded accredited training centre status to an IDC there. A recent re-accreditation visit was successful.

Aspects arising from this that are worthy of particular consideration by PEIs that might wish to undertake a similar exercise in a university are:

* Being clear about expectations in relation to evidence (type, format, extent) of an individual’s development of CEng competence
* Being clear about expectations for the mentoring of development of competence

The inter-disciplinary nature of many EngDs mentioned earlier points to a clear opportunity for joint PEI accreditation visits.

A further more recent development relates to what links there might be with any wider frameworks for the professional and career development of researchers.

**UK Researcher development framework**

**Vitae** is the UK organisation championing the personal, professional and career development of doctoral researchers and research staff in higher education institutions and research institutes. The Vitae Researcher Development Framework (RDF) is a comprehensive approach to enhancing the careers of researchers, developed by and for researchers, in consultation with academics and employers from other sectors [Vitae 2012]. The RDF comprises a set of descriptors for knowledge, behaviours and attributes within four key domains, including some that might be termed ‘soft skills’.

The Engineering Council has been working with Vitae to develop an ‘engineering lens’ on the RDF. This comprises a set of bridging statements that interprets the RDF for engineering researchers. The lens has been developed by reviewing the RDF and identifying those areas that relate to the Engineering Council’s standard for competence and commitment for CEng. The lens demonstrates the strong link between the requirements for CEng and the development of an engineering researcher’s knowledge, understanding, skills, competence and attributes. The aim of the lens is to assist engineering researchers with their professional and career development. By making the strong link with CEng, the intention is to encourage more of them to seek professional registration. The lens will be published later this year and will complement the work to establish a clearly visible pathway to CEng status for EngD graduates.

**Conclusion**

Since the introduction of UK-SPEC in 2003, the competence and commitment standards and the degree learning outcomes have become well established and respected both in the UK and internationally. Academics have praised the accreditation criteria for their clarity, brevity and the emphasis on learning outcomes. PEIs have become experienced in applying the standards and have amassed significant accreditation experience. Accrediting the EngD as an academic award seems to be the logical final part of the jigsaw.

EngD graduates are likely to be high calibre researchers and have the potential to be amongst the best CEng candidates, so attracting such individuals to professional body membership and thence registration as Chartered Engineers is hugely beneficial to the profession. The Engineering Council’s work to establish a clear pathway to registration for EngD graduates has laid the foundations for this, building on the high esteem of the UK EngD flagship programme.

Whilst these developments are new, the early signs are positive, and work is now underway to explore a mechanism whereby the EngD may be accredited as an integrated learning and development programme.

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**Annex 1 Engineering Council briefing sheet: The Engineering Doctorate**

The Engineering Doctorate (EngD) was established in the UK in 1992 following the Parnaby Report’s conclusion that an alternative was required which would be distinct from, and complementary to, the traditional existing PhD, which had been criticised for its lack of industrial relevance.

The EngD is an alternative to the traditional PhD for students who want a career in industry. It is more vocationally focussed and better suited to the needs of industry.

The EngD is open to articulate and highly motivated graduates with a good degree in engineering or another relevant discipline. The four-year programme combines PhD-level research projects with taught courses, and students spend about 75% of their time working directly with a company, focusing on the corporate need. EngD students, known as Research Engineers (RE), undertake technical and management training, assessed as part of the degree, to help their professional development. Their PhD-level research projects are jointly supervised by the university and a company, and aim to help the performance of the company.

The success of the EngD development programme over the past 20 years is a consequence of the EPSRC-funding of Industrial Doctorate Centres (IDCs) which are exemplars of HE-industry collaborations. There are currently 27 EPSRC-sponsored IDCs all of which are interdisciplinary centres. Many are partnerships between universities and have a diversity of industrial partners and research programmes. More than 270 companies are currently sponsoring about 1000 active REs, with some companies sponsoring multiple EngDs in several centres. However, it is important to note that EngDs are also offered outside of the EPSRC IDC system. Not all EngDs are EPSRC-funded, with some attracting significant private sector support and funding from other sources such as European Union grants.

There is a strong emphasis on leading-edge research in a business context and development of competence that equips the RE for a range of roles in industry. The programme contributes to a body of knowledge on a particular technical discipline, industrial sector or multidisciplinary theme. Of the four years, approximately 25% can be recognised as ‘learning’ to at least Masters level via taught courses and 75% of the time is spent working directly with the collaborating company. Many individual REs spend a significant amount of their time in-company.

The EngD is at least equivalent to the intellectual challenge of a PhD (level 8 in the qualifications framework for England/Wales and N Ireland; level 12 in Scotland), but is enhanced by the provision of taught material in both management and technical areas.

**Confidence in the Engineering Doctorate Centres**

The EPSRC sets out rigorous standards for the IDC’s host HEI and monitors the centres, usually by way of a mid-term review 3 years after the start date of the grant. EPSRC expects centres to be exemplars for the individual RE’s training experience, specifically for developing and enhancing an individual’s creativity, and supporting innovation. The EngD framework appears to support the creation of professional engineering competency.

IDCs must ensure that there is appropriate support for the RE which typically includes the academic supervisor and an industrial supervisor. Preparation for the chartered professional review is supported in a variety of ways, for example, there may be a professional mentor.

When considering the EngD for accreditation as an academic award, a useful piece of evidence is the EngD validation document that the centre would have had to prepare for the university, showing the learning objectives.

**What to expect of an RE seeking CEng status**

The following expectations for RE competences are set out by EPSRC and are applicable to any EngD:

* expert knowledge of engineering/science areas relevant to their research project;
* an appreciation of industrial engineering and development culture including:
	+ the role of research;
	+ product development;
	+ marketing awareness;
	+ environmental impact;
* project and programme management skills - financial planning and control;
* teamwork and leadership skills - communication skills – oral, written, technical, non-technical;
* the ability to apply skills/knowledge to new and unusual situations;
* the ability to seek optimal solutions to complex or multifaceted problems.

EPSRC suggests that an RE keeps a log book of all their work including attendance on taught courses and the progress of their project work. This could be a helpful inclusion within an individual’s evidence of professional development. Each RE is subject to periodic progress reviews, copies of which could form part of the evidence that the CEng standards have been met. The RE may be registered on a PEIs’ development monitoring system.

**Reference**

The EPSRC Industrial Doctorate Centre Scheme: Good Practice Guidance

<http://www.epsrc.ac.uk/SiteCollectionDocuments/other/IDCGoodPracticeGuidelines.pdf>.

1. EPSRC-funded IDCS are not the only provider of EngDs in the UK; EngDs may be funded in other ways, for example directly by industry. The IDCs were chosen as an easily identifiable and contactable group. [↑](#footnote-ref-1)
2. Copies available upon request from the author. [↑](#footnote-ref-2)
3. The National Academy of Science and Engineering, representing the interests of the German scientific and technology communities, at home and abroad. [↑](#footnote-ref-3)