Association of Engineering Doctorates

Submission to the Dowling Review on the development of more effective collaborations between businesses and university researchers in the UK

A Introduction to the AEngD

The Association of Engineering Doctorates (AEngD) was established in 2010. Its core members are EPSRC-designated industrial doctorate centres awarding EngD at UK universities. EngD research engineers, alumni and – importantly in the context of this review – industry sponsors are associate members. A community engaged in research in engineering and related disciplines, AEngD aims clearly state the need for collaboration with businesses in industry, including:

- promote acceptance and recognition of Engineering Doctorate (EngD) degrees within host institutions **and industry**
- develop wider and more strategic **industrial** research collaboration
- develop and promote taught programmes tailored to students' (or Research Engineers, REs) and **industry** needs

(Further background on the AEngD is given in Appendix 1.)

B The EngD

The EngD scheme was established by the EPSRC in 1992 following recommendations of the 1990 Engineering Doctorate Report, produced by a working group chaired by Professor Parnaby. By 2013, 28 EngD schemes were offered by UK universities – either singly or as multi-institution consortia.

The EngD is a research degree equivalent to a PhD.[1] However, the EngD student – or research engineer (RE) – pursues a research project while based within a company. The EngD is a qualification for practising researchers who aim to lead and innovate the development of products, processes and services in industry; REs develop academic strengths and leadership skills, both technical and managerial.

In representations to the Minister for Universities and Science, at the Department for Business, Innovation and Skills, on 8 April 2014,[2] the AEngD highlighted the unique nature of the EngD qualification:

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1 Note: further deliberations relating to an AEngD response to the QAA resulted in a slight amendment to this sentence (removing the word 'professional') after this document's submission to the Dowling Review on 6 March 2015.

2 AEngD (2014) "The EngD and its importance to UK plc" – full report available for download at http://www.aengd.org.uk/news/news-releases/minister-supportive-engineering-doctorates/ Accessed 06 March 2015.

> "The EngD constitutes a form of academia-industry collaboration, which not only generates new knowledge but also enhances knowledge exchange between industry/ business and academia. EngD programmes enhance human capital development by producing people with skills, including leadership, management, as well as technical skills - **focused on the needs of industry**." *[emphasis added]*

C Response to the Dowling Review

The AEngD welcomes the Dowling Review's exploration of collaboration between business and the UK research sector. Our collective experience of delivering high value collaborative research across a wide range of industrial sectors means that we are well placed to contribute to this important initiative. While the following comments are confined to the field of doctoral research, they are a cumulative product of many hundreds of intensive professional relationships between academics, businesses, and the Research Engineers who deliver research outcomes with both intellectual and industrial / economic impact.

The AEngD's core views regarding the Government's Industrial Strategy are, first, that there is a **numerically far greater need for EngDs in industry** than the need for PhDs to support academia, and, second, that **EngDs deliver value to industry more quickly** (see Q2 responses below) – vital if the UK is to achieve its competitive aims.

1. What experience do you have of establishing, participating in or supporting long-term research collaborations between business and academia?

1.1 Since the launch of the first EngD qualifications in 1992, AEngD core members (27 industrial doctorate centres, IDCs, based at UK universities)[3] have supported research projects for over 600 UK and international businesses in UK.[4]

1.2 Moreover, firms such as Airbus UK, BAE Systems, GSK, Jaguar Land Rover, Procter & Gamble, Renishaw, Rolls-Royce and Tata Steel, have invested repeatedly in EngD research (often spreading their investment across multiple IDCs and through successive cohorts of EngD REs). Thousands of EngD REs have been based in industry, co-supervised or mentored by their sponsors, delivering innovations, new products and services, and adding value to UK plc.

1.3 AEngD associate members include numerous representatives from industry sponsors. The AEngD has welcomed their involvement at its conferences and has an industry strategy group, chaired by a Rolls Royce executive, to help guide its efforts to establish and support long-term collaboration with industry.

2. What are the key success factors for building productive, long-term research partnerships between business and academia and how do these vary across sectors and disciplines?

2.1 In its BIS document (which also highlighted results of a study of EngD impacts undertaken by Manchester Business School, co-sponsored by EPSRC),[5] the AEngD

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[3] One IDC, at Oxford University, awards a DPhil degree.

[4] Figure quoted by Dr Paul Golby, chairman of EPSRC, in his presentation to AEngD conference, 1 November 2012. (The AEngD website lists over 450 industry sponsors, ranging from multinationals investing in the UK to UK-based SMEs, public sector organisations and charities – see http://www.aengd.org.uk/industrial-sponsors/ - accessed 06 March 2015)

[5] Kitagawa, Fumi (2014) "Understanding the EngD impact: A pilot study", University of Manchester study funded by EPSRC and the AEngD. Publication imminent.

identified differences between EngD and PhD programmes, several of which exemplify good practice in successful collaboration between business and academia:

2.1.1 **EngD research is driven by industry need -** Sponsors identify an industry problem or set of problems,[6] work with an IDC to define the research topic and objectives, and the research opportunity is then advertised. Following a competitive process, the calibre and industry suitability of EngD researchers tends to be higher than for PhD candidates. **Also, research engineers are motivated to choose EngDs because they want to be industry-focused in their research, and to work in industry in their future careers**.

2.1.2 **EngD research is co-supervised or mentored by industry** – Regular industry input helps ensure research remains focused on achieving the sponsor's objectives while maintaining the doctoral standard of creating contributions to knowledge.

2.1.3 **EngD research leverages high additional industry investment** – For example, one IDC estimated that EPSRC funding of £4.6M was matched by around £2.5M industry cash, plus significant industrial time and research infrastructure, which, if quantified, would "amount to over £10M."

2.1.4 **EngD researchers work mainly in industry** – An RE will typically spend the majority of his or her time (up to 75%)[7] located with and working with and for the sponsor.

2.1.5 **EngD adds immediate value to industry** – EngD research outputs are delivered throughout the doctorate direct to the business during the research process.

2.1.6 **EngD reduces 'time to market' for innovations** – Extending the previous point, EngD research allows continuous R&D of new products and services.

2.1.7 **EngDs aid industry collaboration** – Some IDCs and sponsors take a strong sector-based approach, identifying common issues and co-sponsoring EngD projects. The immediate value and reduced 'time to market' benefits are therefore potentially delivered across a sector and not just to one sponsor.

2.1.8 **EngD experience may count towards CEng** – The four years typically spent working within industry while undertaking an EngD may be counted as industrial experience relevant to achievement of Chartered Engineer (CEng) status (dependent, of course, on the policy of the relevant professional engineering institution).

2.1.9 **EngD graduates command higher salaries** – If value-added is calculated in terms of the salaries that individuals command upon graduation, evidence suggests EngD graduates earn higher salaries than their PhD counterparts.[8]

2.1.10 **EngD graduates more likely to be employed in industry** – Analysis of the employment destinations of graduating researchers shows that **EngDs are more likely to:**

1. **be employed**
2. **be employed in industry**
3. **be employed in specific industry disciplines**
4. **be appointed to more senior roles within their organisations,** and/or
5. **develop entrepreneurial opportunities building on EngD project outcomes**[9]

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6 EPSRC Good Practice Guidance says research should focus on "a real and relevant industrial problem, or series of problems, of similar difficulty and intellectual challenge to a conventional PhD programme."

7 EPSRC Guidance says "Research Engineers are expected to spend around 75% of their time working directly with the collaborating company on project work and 25% on taught courses".

8 Data collated by Kitagawa (2014) based on analysis of HESA Destinations of Leavers of Higher Education (DLHE) Surveys, 2008-09 to 2010-11

9 Kitagawa (2014) *op cit*

2.1.11 **EngD graduates become industry leaders sooner** – In short, the AEngD believes EngD programmes deliver the engineering leaders of tomorrow in a particularly efficient and targeted manner.

2.2 The AEngD has identified that:

2.2.1 **Some organisations are adept at realising the benefits of EngD research**. Businesses experienced in EngD research may have dedicated staff focused on managing multiple EngD programmes. They engage with multiple IDCs and appoint REs in successive cohorts (Rolls Royce holds an annual internal conference so that REs can share their research progress with Roll Royce colleagues).

2.2.2 By contrast, an SME, with little or no previous experience of academic collaboration, may only engage with a single IDC, and need considerable support from the IDC to initiate and support a single research project (see also our responses to Q3 and Q7 below).

2.2.3 In between these two extremes, similar issues may also be experienced by businesses from sectors where R&D investment has historically been poorly directed or coordinated.

3. What barriers do individual businesses face in developing long-term research collaborations with academic partners and how can these be overcome?

3.1 Industry perceptions that academic research does not add value for industry can hamper engagement.

3.2 The need to deliver academic value for the student and university (papers, thesis, degree) versus commercial value for the sponsor company (IP, new or improved processes, products and/or services) is a difficult balancing act, but one where EngD centres have proved adept.

3.3 Feedback from new industry sponsors suggests there is often initial confusion and uncertainty in identifying potential academic partners and appropriate research and funding models to deliver their desired business outcomes. Different universities may favour different approaches, and in a competitive research market, potential sponsors may not always be advised of all options so that they can take an informed choice of their best route forward.

3.4 In the engineering research context, therefore, the AEngD believes there needs to be on ‘honest broker’ information source that can help businesses identify the research collaboration most suited to their needs (see also 5.4).

4. What barriers do academics and universities face in developing long-term research collaborations with businesses and how can these be overcome?

4.1 Based on AEngD experiences, the following barriers need to be addressed:

4.1.1 There is a need for stronger recognition, first, of the interdependence between engineering science and engineering practice, and, second, that doctoral level research and training, combined with cross-disciplinary teaching in this area, is critical to the UK’s industry and infrastructure strategies.

4.1.2 Academic preferences for new funding tend to focus on traditional mechanisms rather than newer, more collaborative and end-user focused approaches such as the EngD.

4.1.3 The 2013 CDT funding decision-making process did not, in the AEngD's view, adequately attract universities to apply as EngD centres or adequately evaluate EngD programmes in comparison to PhDs.[10]

4.1.4 Perceptions by academics that this area of research is not as REF-able or eligible for academic career advancement, mitigates against engagement (see also 3.2 above)

4.2 The EngD is a proven means of breaking down such perceptions but must either be balanced by an adjustment to REF and career development criteria or by financial recognition.

4.3 There needs to be a shared understanding of the need to deliver industry benefits that are congruent with universities' needs to further and promulgate new knowledge (the EngD is a prime example of where this works well).

5. How effective are current incentives, policies and funding streams for promoting this type of collaboration? How could these be improved in order to scale up the range and impact of collaborations being undertaken nationally?

5.1 Reflecting the cross-cutting nature of much research, the AEngD believes ability to synthesise across disciplines and to abstract knowledge from what is done is a core strength of the EngD. It enhances learning by industry and so confers competitive advantage. The AEngD feels that the UK government might usefully look at a broader, more collaborative approach to funding research that considers the impacts of that research on wider growth issues. For example, the potential environmental and sustainability, employment, economic productivity and other impacts might usefully be considered by a wider range of government funding sources.

5.2 In particular, the AEngD would like to see funding for engineering research increased, perhaps by greater use of non-EPSRC funding (this might include contributions from other Research Councils, other government departments or agencies, eg: InnovateUK, and/or from the EU).

5.3 Industrial research collaboration, however, should not be solely publicly funded. The AEngD has suggested that selection of EngD centres should be determined by industry need for a particular dedicated research centre under-pinned by 50% match funding from industry.

5.4 With wider (public and private) funding, responsibility for providing strategic direction for engineering research might need to pass to a body able to provide a pan-disciplinary perspective and a longer-term view of the industry research landscape that is not dictated by political cycles. For example, a pan-disciplinary institution such as the RAEng might advise on appropriate funding and delivery mechanisms.

6. How can progress under the Industrial Strategy be harnessed to stimulate collaboration between businesses and researchers in the UK?

[10] Due to AEngD-perceived shortcomings in the 2013 funding round (detailed in the AEngD submission to BIS, April 2014, *op cit*), the number of EngD centres placing all students for 75% of their time into industry was cut from 28 to 16. EngD centres previously comprised around 40% of CDTs, but – excluding 'mixed' centres with a few EngDs – EngD-centric programmes now comprise c. 14%, despite the demonstrable benefits of the EngD to date.

6.1 Enhanced EngD programmes could contribute to achieving three core elements of the Government's Industrial Strategy:

- developing strategic partnerships with industry
- supporting emerging technologies
- working with business to help develop skills that businesses will need (the AEngD believes developing future industrial leadership is also critical)

6.2 Building on the overall Industry Strategy, several sector-based strategies have been developed. Delivery of key competitive advantages in these industries often requires a cross-cutting approach reflecting the inter-dependent infrastructures involved. The AEngD believes many existing EngD centres (and related ongoing industry sponsor relationships) make them well-placed to deliver the necessary systems integration skills and research at doctoral level.

6.3 In its April 2014 BIS representations,[11] the AEngD included two examples – the nuclear sector and construction – outlining how EngD research could contribute towards achievement of vertical industry strategy objectives.

6.4 The AEngD urges the creation of industry leadership groups, similar to that established for the oil and gas sector, to cover those industry sectors – like construction – where cross-cutting R&D direction and coordination are lacking, often due to industry fragmentation and a culture of under-investment in R&D.

7. Which models of collaboration have proved most successful for stimulating SME engagement with the research base in the UK? What additional action needs to be taken to strengthen UK performance in this area?

7.1 The focus on an SME-identified problem by a researcher who is based within the SME is attractive to small organisations with limited human and financial resources. This helps embed the research into the SME, delivering its benefits incrementally and enabling more rapid assimilation of its outputs into the SME's future business activities (*see also Q2 above*).

7.2 SMEs appreciate the opportunities offered by co-funding research projects under EngD schemes, either as part of a consortium of SMEs or as part of the supply chain, partnering with a large company.

7.3 The EngD experience also suggests that a four-year research programme meets many SMEs' requirements for a return on investment within a reasonable time-scale. Anecdotal feedback from IDCs suggests few SMEs will be considering time horizons beyond five years.

[11] AEngD (2014) "The EngD and its importance to UK plc" - *op. cit*

8. Which approaches/sectors/organisations – in the UK or internationally – would you identify as examples of good practice in business-university collaboration with the potential to be applied more widely?

8.1 The AEngD functions as a forum for exchange of experiences and good practice in the context of industry / academia collaboration.

8.2 It is a testament to its success that the EngD is increasingly recognised internationally as a strong model for industry-based research. Countries in the EU, plus Australia and the USA, are striving to deliver similar EngD-like schemes supported by government funding schemes.[12] Having spent over 20 years building the EngD brand, the UK is uniquely placed to help develop similar programmes in other geographies. EngD centres are a strong example of sustained academic-university research leading to exploitable products. We believe this model deserves expansion and sustained support as a means to reshape our ability to exploit research and deliver long-term value to UK plc.

[12] For example, an article, "Leadership in Learning: Collaborative Approaches to Building the Water Sector of the Future," in the Australian Water Association's journal (April 2014) concludes: "Looking ahead for the Australian water sector, there are opportunities to develop models of research education similar to the EngD programs run by IDCs." (p.7)

Appendix 1

The Association of Engineering Doctorates

The Association of Engineering Doctorates was established in 2010 and quickly embraced almost all of the 28 EPSRC-designated industrial doctorate centres awarding EngD at UK universities, with industry sponsors, existing EngD research engineers (REs) and alumni as associate members. A community engaged in research in engineering and related disciplines, it aims to:

- promote acceptance and recognition of Engineering Doctorate (EngD) degrees within host institutions and industry
- promote excellence and maintain the quality of EngD degrees
- develop wider and more strategic industrial research collaboration
- identify and promote the benefits and impacts from EngD research
- recruit sufficient and suitable top quality research projects
- attract and recruit high calibre REs
- develop and promote taught programmes tailored to REs and industry needs
- encourage strong academic engagement and feed back into the host institutions' research base

The Engineering Doctorate (EngD) scheme was established by the EPSRC in 1992 (following recommendations of the 1990 Engineering Doctorate Report, produced by a working group chaired by Professor Parnaby). By 2013, 28 EngD schemes were offered by UK universities - either singly or as multi-institution consortia.