Dowling Review: call for evidence

This is an **Institution of Chemical Engineers** response to the Royal Academy of Engineering's call for evidence on the Dowling Review.

The development of this response was led by:

The IChemE UK Research Committee

And includes contributions from members of

Heads of Chemical Engineering UK (HCEUK)

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Summary

A supportive environment for industry/academic collaboration is essential. In preparation for this submission, IChemE consulted with its Research Committee and with representatives from both communities.

Key recommendations:

Incentivise universities to make IP available to sponsoring companies on acceptable terms. A formal review is needed to identify the most effective mechanisms and the alternative sharing practices available.

Address and improve the mobility of researchers between industry and universities for short secondments and longer-term career moves.

Enhance the availability of long-term sustained government funding to improve UK capability and encourage increased industrial investment. A ten year horizon is required.

Create a forum for the sharing of best practice and information exchange on the mechanisms and benefits of long-term academia-industry collaboration.

Provide coherent funding mechanisms across the different TRL levels, particularly to encourage inter-company collaboration with universities on pre-competitive research through larger, long-term projects.

Call for evidence response

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

IChemE is the voice for chemical, biochemical and process engineering professionals. HCEUK represents the view of academic leaders in chemical engineering departments.

The contributors to this response have drawn on their roles in industry and academia, and participation on advisory boards for research councils. There is demonstrable experience in the establishment of multidisciplinary research, innovation and development in small, large, national and international businesses. The group includes senior industry and academic figures responsible for strategic relationships.

This includes involvement in:

- High Value Manufacturing Catapult centres
- Doctoral training centres
- EPSRC National research facilities – eg Diamond Light Source, Catalysis Hub (Harwell)
- National research centres – eg Centre for Innovative Manufacturing in Continuous Manufacturing and Crystallisation (CMAC)
- Heads of Chemical Engineering UK (HCEUK)
- Providing consultancy
- Visiting professorship from industry into academia
- Energy Technologies Institute (ETI) projects
- Marie Curie projects

- European initiatives through Horizon 2020
- EU programmes e.g. Sustainable Process Industry through Resource and Energy Efficiency (SPIRE)[1] Public-Private Partnership (PPP)
- Previous regional initiatives such as Regional Development Agencies
- Directly funded long-term university research collaborations by international companies.

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?

Successful partnerships should:

- Share a common interest and mutually beneficial vision
- Be based on, and facilitate, mutual trust and understanding of each other's culture and drivers
- Be long-term, and linked to a company's long-term business strategy
- Be interactive with an exchange of personnel in both directions
- Be broad in scope, encompassing research, consultancy, education and business development
- Draw from, and build upon, demonstrations of successful collaborations at simpler levels; e.g. CASE PhD studentships, consultancy projects and undergraduate projects
- Have informed technical and business leaders among all collaborating partners
- Operate on a large-scale in terms of funding, critical mass of people and resources

The need for adequate funding is important. However, the sustained commitment of time and input from senior people is of equal importance.

Successful project completion is reliant on 'transferrable skills'. Flexibility and pragmatism are called for when dealing with the different cultures, timescales and priorities in business and academia. A tangible benefit of collaboration is the emergence of trained researchers with experienced and skills.

Effective communication is essential to success. All parties must be aware of, and open to, discussion around issues such as intellectual property (IP).

Successful projects will deliver additional, and sometimes unexpected, benefits to those involved. This includes visiting lecturers, industrial placements and internships, undergraduate projects, collaborative projects, consultancy opportunities and membership of faculty and departmental advisory boards.

Relationship building and mutual support is the essence of any collaboration; it should not be restricted to the research in question. The strongest collaborations are often those with multiple links (see examples in question 8).

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

IP: This is the biggest barrier to productive business-academic collaboration. IChemE's business community feels that setting up IP agreements is a time-consuming process that is often bureaucratic and resource intensive. Inflexibility around IP issues is a common obstacle, but one that can be overcome. The important thing about IP is not who owns it, but how and by whom it can best be translated into commercial value.

[1] http://www.spire2030.eu/about-a-spire

IChemE calls for a simplification of this process to improve methods of sharing the risk, cost and ultimately, opportunity. In line with the Lambert toolkit[2] and the National Code of Practice for Managing and Commercial Intellectual Property from Ireland[3] we suggest the use of standard agreements between industry and academia to ensure a clear discussion is held on full economic costing and who benefits from IP. This will help facilitate negotiations between potential collaborators, reduce the time and effort required to secure agreement and offer examples of best practice.

Cultural differences: Many industry representatives assert that universities' understanding of business and commercial culture is limited. IChemE believes this barrier can be overcome by devoting time to the collaboration and developing a relationship based on trust, facilitated where possible by exchange of people. Universities should also develop inter-institutional partnerships.

Different time-scale expectations: The tendency of companies' interests to move at a faster rate than academic research is also a barrier. Commercial priorities change, and by the time a research project is completed, the results may no longer be of interest to the company involved. An adjustment in expectations is required to bring short- to medium-term commercial benefits.

Funding: Financial incentives, in terms of tax breaks, innovation vouchers and matched funding, are required to secure the UK's position as a global leader in academia-industry collaborations

Where there is limited ability to make financial contributions, the importance of continued collaboration through in-kind funding is crucial. For example, access to in-house resources and expertise is still extremely valuable.

Consideration must be given to the time and cost of preparing and submitting a funding bid. This impacts large companies and SMEs alike. Moreover, successful bidders are impeded by the demands of bureaucratic, quarterly reporting. Most organisations cannot afford the overhead associated with an expert team conversant with the complex funding and network landscape required to secure winning bids.

External funding (e.g. government funding) and in-kind support provides a mechanism to share cost and risk. These can increase industry's appetite for strategic relationships and collaborative working.

Catapult Centres[4] offer a way for companies to share the risks of collaboration. These allow business to access concentrated expertise, cutting-edge equipment and specialist facilities to develop and test ideas. The Centre for Process Innovation (CPI) is an exemplar, but others must be given time to mature. In future, academic-industry centres of excellence should be formed with support from Innovate UK to address the short-, medium- and long-term research needs of industry. With proper strategic vision, these centres will become self-sustaining.

It is unclear how EPSRC and Innovate UK work together at the interface between industry and academia. This relationship must be clarified. There is a perception amongst the industrial R&D community, that funding from Innovate UK or the Catapults is not easy to access and that application processes are opaque. More openness will make this 'translational' funding more readily available.

Different universities use different models for full economic costing. This lack of a consistent methodology to calculate overheads causes confusion and is a challenge that must be addressed.

[2] https://www.gov.uk/lambert-toolkit
[3] http://www.forfas.ie/publication/search.jsp?ft=/publications/2005/Title,785,en.php
[4] https://www.catapult.org.uk/

Skills development: The expansion of Doctoral Training Centres and support for Engineering Doctorates (EngD) offers a much improved skills pipeline for technically able engineers. In addition, these postgraduate students have stronger business awareness and effective transferable skills. These programmes must be protected and enhanced where possible.

Incentives might include tax breaks to support and promote the completion of EngDs and industrial placements. Clearer identification of what constitutes 'R&D' will incentivise companies to be more proactive.

Research excellence framework (REF): This can be a driver for better industry-academic interactions if appropriate consideration is given to the value of collaboration, project duration and the potential for publishing.

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

Cultural: The understanding of business/commercial strategy is often poor. This includes a lack of appreciation that industrial collaboration brings fundamental research problems as well as applied ones. Academics need greater exposure to, and experience of, the business environment. Working with potential partners to define the problems that need solving and understanding which solutions might make a real business impact is an essential part of moving to strategic long-term research collaborations.

IP: The barriers experienced by universities in relation to IP have significant overlap with those of industry. However, there is a difference in terms of how the different organisations can best utilise and benefit from it. Aggressive IP policies by many universities can act as a strong deterrent to companies to enter into significant research collaboration. Industry is best placed for patent protection, whereas universities may be more able to benefit from large numbers of licensing opportunities if IP is for a technology that has many and varied applications. Overcoming the barriers requires a clear understanding from all parties of what the IP covers and its application.

People and experience: A lack of experienced people is a common barrier. This can be addressed through improved opportunities for long-term secondments from industry to academia and vice versa. Senior leadership in both industry and academia must understand the benefits that secondments can bring and demonstrate full support for long- and short-term placements.

A new public funding mechanism is needed to facilitate academic secondments. This funding should cover issues such as providing additional teaching support while the staff member is in industry. The Royal Academy of Engineering Industrial Secondment Scheme[5] is an exemplar. Academic-industry relationships are two-way and both sides should ensure they have an identifiable "front door" for collaboration enquiries.

Industry must demonstrate support for these secondments – both in terms of hosting an academic and sending an industry practitioner to a university. Tax breaks can encourage this mindset. Universities may require modest additional funding to cover the secondment. Ways to bring industrial experience back onto the value criteria for university staff, particularly in engineering, are required.

Early stage, pre-competitive collaborative research funding: A stated in section 4, whilst some mechanisms for involving multiple companies and multiple universities do exist (eg in High Value Manufacturing), these opportunities are limited. The scope for companies sharing the risks and costs

[5] http://www.raeng.org.uk/grants-and-prizes/schemes-for-people-in-industry/industrial-secondment-scheme

of pre-competitive research, with partners from different industrial sectors, is high. The introduction of Research Council funding streams which enable networks of companies and universities to collaborate on research of this type, with appropriately high funding levels over extended periods (eg >£10M over 5-10 years) would open up this potential and also increase the volume of the pipeline leading into TRL3-5 projects.

The industrial development landscape can change quite rapidly and although investment in longer-term projects in important, academic research needs to be agile in order to respond swiftly to these changes.

The EPSRC CASE scheme is successful but involves industry applications fro funding. Once awarded, the academic partner can proceed. A two-directional approach to funding collaborative research partnerships should be developed. For example, the US National Science Foundation Grant Opportunities for Academic Liaison with Industry (GOALI) where the applications are made jointly by academics and industry partners.[6]

Career progression: Some academics are reluctant to seek industrial funding because they (misguidedly) feel that this is always applied rather than basis, or this funding sometimes is not valued as highly in promotion assessment. Other concerns are restrictions on publication or that more applied research may not attract the same level of citations as fundamental work. Whilst this may often be a matter of perception, more clarity is needed in universities to recognise industrial research collaboration more in promotion metrics and other recognition processes, and to provide mentoring of young academics with few industrial contacts on how to develop these.

Business development: Lack of business development engagement expertise and mechanisms within universities is a barrier. There needs to be more effective activity to develop relationships and collaborative research opportunities. This requires high quality business development professionals who can develop effective networks combined with academics that understand industries' needs and drivers and can work alongside the business team to identify and deliver win-win collaborative programmes. The influence of RAE/REF on university staff recruitment, demanding high quality publication records and a track record in bringing in major funding, has led to a major decrease in the number of staff with industrial experience in UK universities over the past 20+ years. Government should ensure that the metrics and drivers of future REF exercises provide encouragement to universities to recruit researchers with 10-20 years industrial experience to redress this balance, especially for engineering.

Peer review: There are concerns that in some areas that the current peer review system lacks specific expertise in some areas which are industry driven, such as in process engineering eg manufacturing and formulation. This requires the research councils to ensure either that the review of joint university-industry research proposals involves enough informed industrial expertise or that alternative mechanisms such as expert panels or involving sponsors directly are used more.

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?

Incentives: These are insufficient, particularly to participate in pre-competitive research. We recognise the need for more joined-up approaches in funding and incentives across the different TRL levels.

[6] http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504699

More effective policies and practices to promote awareness and understanding of the value of collaboration are needed; particularly with consideration of the business strategy and long-term view. A forum for the sharing of lessons learned would be valuable.

Organisation-led collaborations (rather than those led by individuals) offer the potential for stronger alignment with corporate strategy and ultimately, longer-term investment and partnership (eg ten years of funding rather than three years).

Collaborations can be more effective when dedicated people are available to manage the brokerage (eg university or departmental business development staff). These roles must be integrated in the research community, rather than in university administration, to ensure better understanding of the academic base.

Professional engineering institutions provide powerful networks and support for technical communities. The Knowledge Transfer Network can provide additional support to complement this (eg a conduit to EU funding) by cultivating successful partnerships with universities. Additional professional networks are needed in sectors that don't currently have these (eg retail).

IP: A review of IP relationships and mechanism, as well as commercial exploitation, to provide a more encouraging, supportive environment for collaboration is needed.

Funding: Sustainable and defined levels of public funding for R&D is required and a commitment to real-terms funding increases must be restored. A long-term, funding strategy is needed to transcend the tyranny of five-year parliamentary terms. This requires all-party support and IChemE calls for a broad coalition of interests to fully support the UK's science base and to sustain the infrastructure required to deliver economic growth.

Tax incentives, matched funding and a bigger research budget will stimulate private sector involvement. Where government leads, industry will follow.

Publicity: Industry and academia must publicise successful collaborations. This will encourage others to do likewise. The UK community needs to be a lot more bullish about the potential of its research activity. Professional bodies such as IChemE can provide a mechanism for this, but industry and academia must be more forthright in sharing output.

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

The Industrial Strategy must provide a mechanism that highlights successful collaborations to date and offer support and guidance to companies entering into new ventures. The various industry leadership groups, must highlight and encourage key needs, where industry is already active and indicate where government can 'turbo-charge' this activity. University partnerships can support and respond to the key needs identified, thus benefiting UK plc.

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?

Current policies do not adequately demonstrate the value of academic collaboration to sceptical businesses and sectors. IChemE's industrial community believes that not enough emphasis is placed

on the promotion of successful collaborations to SMEs. Better publicity for best practice, productive collaboration and clearly evidenced outcomes would make a difference.

Innovation vouchers: SMEs can benefit from the provision of simple, low-cost and low-risk mechanisms that enable engagement with the research base for the first time on a small scale. Innovation vouchers have been successfully used in The Netherlands and the UK. Such schemes are more successful when jointly funded, where business contributes to the cost, to better promote personal involvement in the collaborations. The result is new collaboration undertaken at limited cost to the taxpayer. Small grants facilitate university engagement and provide a cost-effective start-point for future collaborations. Regionally based mechanisms for engaging SMEs were very effective.

Industrial awareness and experience: Closer contact and more effective communication between universities and business should be encouraged. This should include the use of tax breaks and other mechanisms to drive a substantial increase in the number of undergraduate industry placements available within the sectors that depend on STEM knowledge and skills.
Catapult Centres: The introduction of the Catapults is vital for improved SME interaction, particularly since they approach the TRLs within the "valley of death". Catapults recognize that universities are incentivised for research rather than commercialisation, and they follow highly successful experience in other countries (eg Fraunhofer, TNO, VTT and A* STAR).

Mechanisms for collaboration: SMEs are often unaware of the research resources available. Partnerships with larger companies with experience in university collaborations, use of internships and consultancy can provide support to SMEs. This support aids risk management and can stimulate productive relationships.

Effective links between SMEs and universities should not focus solely on research. Other mutual benefits with impact include skills transfer and pathways to collaboration with large companies.

Access to business development and consultancy: Liaison with university consultancy and business development teams can lead to improved planning and more effective research strategies. These services require sustainable, long-term funding models.

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?

EPSRC Centre for Innovative Manufacturing in Continuous Manufacturing and Crystallisation (CMAC) at the University of Strathclyde[7]
CMAC works to accelerate the adoption of continuous manufacturing process, systems and plants to enable the production of high-value chemical products at lower cost and more sustainably through industry-academia collaborations. CMAC's research themes are selected through demand-led scoping; identified by an academic team with industrial partners. This work is a good demonstration of the output that can be produced through successful collaboration when support by significant financial leverage.

Qatar Carbonates and Carbon Storage Research Centre at Imperial College London (QCCSRC)[8]
The QCCSRC was set up to investigate key challenges in the exploitation of carbonate reservoirs by combining the international expertise of Shell, the local knowledge and expertise of Qatar Petroleum, the resources, assistance and strategic advice of Qatar Science and Technology Park (QSTP), and

[7] http://www.cmac.ac.uk/index.php
[8] http://www3.imperial.ac.uk/qatarcarbonatesandcarbonstorage

the research strengths of Imperial College London, through its Energy Futures Lab. This programme is a good example of a long-term academia-industry collaboration that has dealt with the difficulties of intellectual property.

The UK Catalysis Hub at Harwell[9]
Catalysis is a key component of process engineering and it poses major fundamental and conceptual challenges. It is economically important, generating in excess of £50 billion per annum for the economy. The Catalysis Hub works with industry and academia to shift towards innovative new areas to help solve the major industrial challenges of the future.

The Centre for Process Innovation[10]
A good example of an effective Catapult[11], with an open innovation model to develop products and processes with minimal risk. CPI offers a facility to test and demonstrate novel processes and assess their feasibility prior to the substantial investment in capital equipment and training.

Background

The Institution of Chemical Engineers (IChemE) is the global professional membership organisation for individuals with relevant experience or an interest in chemical engineering. We are the only organisation to award Chartered Chemical Engineer (CEng) status and Professional Process Safety Engineer.

We are also licensed to award the titles Chartered Scientist (CSci) and Chartered Environmentalist (CEnv) to suitably qualified members. Founded in 1922 as the professional institution for chemical and process engineers, IChemE has grown to its current status of over 42,000 members across 120 countries.

Our Royal Charter and charitable status confers upon us an obligation to advance chemical engineering for the benefit of society as a whole and support the professional development of our membership, which spans a wide range of individuals from industry, regulators, academia and consultancies.

We can call upon our members' expertise in these fields without bias or favour, in order to reach objective advice based on sound science. IChemE welcomes the opportunity to comment on this call for evidence.

This submission has been developed by IChemE's UK Research Committee and HCEUK – supported by IChemE's professional policy team – which promotes and facilitates research interactions between industry and academia.

[9] http://www.rc-harwell.ac.uk/UKCatalysisHub
[10] https://www.catapult.org.uk/
[11] http://www.uk-cpi.com/