

Engineering research and international development: summary of the academics' roundtable.

Introduction

Engineering is crucial for sustainable development, and underpins a significant part of UK aid¹, whether it is building new primary schools in Pakistan, providing sanitation in Ethiopia, or generating renewable energy in Nepal. Academic research can provide new knowledge to improve the way we do all of these things. In 2012 UKCDS² embarked on an area of work to explore whether UK engineering research is playing its full potential in enhancing the UK contribution to international development. Despite notable instances of thought leadership from the UK engineering research community, a number of pieces of evidence indicated that the UK research base could have more of an impact. These include the opinions of key academics and institutions like the Royal Academy of Engineering, who have been long interested in these issues.

Following a cross-Government discussion in October 2012, UKCDS and the Royal Academy of Engineering convened a roundtable for relevant academics in February 2013, to begin mapping the research base, and to ask how a group of funders, such as those represented by UKCDS, could help the academics' research to have more impact. Professor John Perkins, CSA at BIS, UKCDS Board member, and Fellow of the Royal Academy of Engineering, kindly chaired the roundtable.

This short note summarises the discussion, and outlines next steps for UKCDS' work in this area. The roundtable objectives, agenda, attendance list, and background paper are annexed to this note.

Areas of discussion

1. Mapping

The roundtable set out to map the size, nature, and changing strengths of the engineering for development research base (see Objectives in Annex 1). The roundtable did not map the research base in particular detail. The group discussed some of the difficulties in mapping, including defining boundaries to 'engineering' and what counts as 'development relevant' (raised in the background paper – Annex 3), and the lack of data (see below). The discussion focused on how the research base could be mapped:

¹ In 2009-10, DFID channelled more than £900 million to infrastructure activities, out of a total budget of £6.6 billion.

² The UK Collaborative on Development Sciences is a community of funders with a shared interest in maximising their impact of the research they fund in international development. Members include Government departments, Research Councils and the Wellcome Trust.

- By engineering discipline. This would be relatively straightforward, but might contribute to continuing siloed discussions that don't reflect the interdisciplinary nature of today's development challenges.
- By teaching as opposed to research. Some participants thought there is more development-relevant teaching taking place than research, and mapping this would give a fuller picture of what UK capacity exists.
- By outcome e.g. water and sanitation. This most accurately reflects the real world, and the nature of problem focused funding, such as the Gates Foundation's recent competition to 'reinvent the toilet'. However, it could be challenging to do, especially in minimising duplication. GIS-usage capacity, for example, could be relevant to a number of outcomes including transport, food security, and better health.

The discussion also confirmed the suggestion in the background paper that there is very little data on the engineering for development research base. A number of proxies were proposed:

- Numbers of non-EU students completing engineering post-graduate qualifications. Many of these students come from, and return to, LMICs, and study engineering relevant to their home context. This proxy could give a sense of the quantities of human capital being trained, and the UK institutions that host them.
- Numbers of Commonwealth Scholars studying engineering. The UK has been training individuals from the Commonwealth (predominantly LMICs) since 1960. Based on the assumption above (these people focus on engineering relevant to their home context) this measure could also highlight throughput, and key UK institutions, in engineering research for development.
- DFID data. While a number of the academics did not see DFID as a major funder of their work, they are likely to spend £110-120m on engineering research over the next seven years.³ They publish who they fund, so mining that database would give an indication of which UK institutions are winning global tenders, and where the balance of current research focus is.

Participants noted that some relevant research was conducted in the NGO community, and published as grey literature, so any mapping of capacity and output should include NGOs.

2. Funding

The roundtable set out to better understand where UK development-related engineering researchers are sourcing funding from (see Objectives in Annex 1).

- The Research Councils do not play as significant role in engineering for development as they do in other sectors. A number of academics noted that EPSRC have little interest in this agenda, with more than one saying "I've given up on the Research Councils". Others noted that the ESRC is perhaps a better fit for 'demonstrating impact'.
 - One academic noted that the multi-disciplinary EPSRC grant on solar (4 engineers, 6 social scientists and 2 economists) led by Southampton and Imperial is the first of its kind. At three years old it might indicate a recent shift in EPSRC focus.

³ DFID, Personal Comm.

- Engineering, for EPSRC, is a ‘capability theme’ which means they are interested in funding research that will generate “lasting benefit to the UK”, including high tech jobs in the UK in the mid-term future⁴. It can be challenging to reconcile this with the types of research most relevant for development (see below).
- EPSRC, DFID and DECC *are* funding a call for research on energy and international development at the moment. However, the ‘EPSRC’ funding comes from the cross-Councils Energy programme rather than the engineering ‘pot’.
- Large charities and foundations, such as Gates, Gatsby, Leverhulme, Sainsbury etc. were seen to be very important funders of engineering research for development.
- A number of academics commented that the most useful research was applied, rather than fundamental in nature, and therefore could be a better fit with the TSB rather than the Research Councils. The Research Councils’ charters do permit them to fund applied research, but this is not their primary focus at current, and EPSRC do not have a strong international development focus whether in applied or fundamental research. The TSB are showing an increasing focus in international development (from a previous position of no engagement), currently recruiting for a position to scope further involvement – but are not yet a major funder of this work.
- Some present argued that engineers failed to lobby development policy and funding agencies with the same intensity as other groups, and that this may have contributed to lower levels of research funding.

3. Community

The roundtable participants were asked to consider whether engineering for development researchers and funders were as joined up as other fields (see Objectives in Annex 1 and the background paper in Annex 3).

The group agreed that there is not one strong community of engineering for development researchers, but that there are communities of practice in different sectors, disciplines or contexts, including the nascent Low Carbon Energy for Development Network. This was seen to be a positive development, with potential for replication in other fields. The challenges of fragmentation are not limited to engineering for development.

Opinions were mixed as to whether a stronger sense of community for engineering funders or researchers *per se* would be useful, with an alternative option being seeing engineering stakeholders better embedded into outcome focused groups. It was noted that engineers were less visible in development policy discussions than other professions, which could be linked to the lack of a coherent community.

⁴ <http://www.epsrc.ac.uk/ourportfolio/themes/engineering/Pages/engineering.aspx>

4. Challenges for academics

The academics noted a number of challenges encountered when focusing on engineering research for development. Opinions registered included the sense that:

- The passion for this type of research is not matched by the opportunities in the UK system
- The career trajectory doesn't fit well with the REF or university hierarchies
- While there is lots of interest among undergraduates, it is difficult to get PhD funding for those that want to continue
- It can be difficult to get engineering for development research published in top journals, with a focus on development issues amounting to 'career sacrifice' for some academics.

5. 'Appropriate' technology and skills

Discussion focused on what constituted appropriate technology and skills in engineering for development. The UK plays a significant role in training engineers for the world: are we equipping them to return to their home countries and be useful? Discussion also focused on the usefulness of 'appropriate' as a label, both in what is genuinely suitable and needs-based, and also with its Schumacher, "Small is Beautiful" heritage and associated connotations of scale and technology level.

6. What could funders do? Shaping potential further work in this area

The latter part of the roundtable focused on consulting the academics present for what a group of funders could do to assist their research to have greater impact in development (see Objectives in Annex 1). Suggestions included

- One or more international development KTPs
- Funding of doctoral training centre(s) in engineering for development
- Changing the impact assessment measures to allow engineers to better demonstrate the long term impacts their work can have.⁵
- Lifting the restriction on UK funding only going to UK/EU students

The academics also noted that as a group they needed to be better at communicating the business case for engineering research relevant to international development, particularly around benefit to the UK.⁶ There is knowledge and expertise in developing countries that will become increasingly important in the UK, e.g. around resilience and microgrids, but little evidence yet of how this transfer has had impact.

⁵ 'International Development' is accepted as a criterion in Panel A and Panel B, but not under Panel C which includes Architecture, Built Environment and Planning, and Geography, Environmental Studies. It is not included as a criterion in Panel D.

⁶ In EPSRC applications, there is a need to articulate national impact/benefit.

Next steps

Following the discussion, UKCDS and the Royal Academy of Engineering will continue to engage around engineering research and international development.

The roundtable was useful for framing the mapping exercise, but didn't map the research base in particular detail given the time constraints and its fragmented nature. UKCDS and the Academy have agreed to continue with a streamlined, more focused mapping. They will ask UK academics and other stakeholders just two questions: "What are the UK strengths in engineering research and international development?", and "What are the sources of funding for research relevant to international development?" This will not deliver a comprehensive overview, but will be useful in defining possible UK comparative advantages that could be built on by further funding (below).

UKCDS will continue to highlight the opportunities that do exist to academics. For example, UKCDS has had preliminary discussions with HEFCE about their Catalyst Fund⁷, and whether it might be suitable for UK ambitions around engineering research and development. UKCDS are also working with a number of Government organisations including BIS and UKTI to explore whether better support could be made available for academic researchers to access multilateral 'aid' funding – some of which may have an engineering component.

In addition, UKCDS and the RA Eng are in discussion with DFID about hosting a "Town Hall" meeting on engineering research. These Town Hall meetings give DFID and other funders the opportunity to engage with research communities, explain what they fund, and what's in the pipeline. They also allow for a two way dialogue on issues of shared interest. UKCDS hosted the first meeting in the series in October 2012, with DFID, the Gates Foundation, the Wellcome Trust and the MRC speaking on health research funding. Given the strong role played by charities and foundations in engineering research for development, it will be important they are represented in any meeting.

UKCDS will also take the feedback from this roundtable back to its Board, and the cross-Government group it convened to discuss longer term opportunities, including doctoral training centres, an international development KTP and TSB's ambitions in international development.

UKCDS will liaise with the research base and wider stakeholders as progress is made.

Ian Thornton, UKCDS

⁷ <https://www.hefce.ac.uk/whatwedo/invest/funds/cf/>

Annex 1: Objectives and Agenda

Engineering and development roundtable

Date: 19 February 2013, 1400-1600

Location: Royal Academy of Engineering, Carlton House Terrace

Chaired by John Perkins, CSA at BIS, UKCDS Board Member and FEng

Objectives

To bring leading UK engineering researchers together to

1. Map the size and shape of the UK engineering research community relevant to international development.
 - a. Identify what data (if any) exists on the size and shape of the UK engineering for development community
 - b. Draw from expert input to qualitatively profile the research base and its changing strengths.
2. Ascertain whether UK engineering research could be playing more of a role in enhancing UK international development efforts? (Or conversely, whether the lack of visibility of engineering research in development community reflects other factors).

Then, if relevant and time allows

3. Identify from key academics what issues a group of funders could address to enhance the impact of UK engineering research in development.

Agenda

1. Welcome – John Perkins
2. Introductions
3. Background to the roundtable – Ian Thornton, UKCDS
4. ‘Mapping’ the research base:
 - a. What data exists on the UK engineering for development research base?
 - b. What does the research base look like? How big, and what quality is it? What sectors does the UK have expertise in? How has this changed over time?

- c. Where are these researchers getting their funding from? And which countries are they collaborating with (both in the BRICs and beyond)?
 - d. Is there an engineering for development 'community' (a critical mass who see themselves as doing the same, or similar things)? Is the engineering for development community more fragmented than, for example, the health community? What are the implications of this in international development?
5. Conclusions and further discussion: What could funders do to enhance the impact of UK engineering research in development?
- a. Joined up funders?
 - b. Engineering as a 'brand'
6. Next steps
7. AOB

Annex 2: Attendance List

Engineering and development roundtable

Attendance list

Name	Affiliation
Professor Tim Benton	Global Food Security
Professor Simon Blackmore	Harper Adams University
Dr Jason Blackstock	University College London
Professor Sandy Cairncross	LSHTM
Dr Heather Cruickshank	University of Cambridge
Dr Bruce Grieve	University of Manchester
Dr Patrick James	University of Southampton
Elizabeth Jones	DFID
Professor Paul Jowitt FEng	Heriot-Watt University
Adam Kirkup	Institution of Civil Engineers
Kora Korzec	Engineers Without Borders
Dr Anil Kumar	Engineering UK
Dr Brett Martinson	University of Portsmouth
Petter Matthews	Engineers Against Poverty
Johanna Novales	University College London
Dr Colin Oram	Warwick University
Michael Ramage	University of Cambridge
Professor Chris Rogers	University of Birmingham
Andrew Scott	Overseas Development Institute
Dr Hayaatun Sillem	Royal Academy of Engineering
Professor Mohammed Sohail Khan	Loughborough University & WEDC
Gary Taylor	IT Transport
Dr Terry Thomas	Warwick University
Ian Thornton	UKCDS
David Trujillo	Coventry University
Professor John Wood FEng	Association of Commonwealth Universities
Holly Wright	Royal Academy of Engineering

Annex 3: Background paper

Engineering and development roundtable – background paper

Introduction

Engineering is crucial for sustainable development, and underpins a significant part of UK aid⁸, whether it is building new primary schools in Pakistan, providing sanitation in Ethiopia, or generating renewable energy in Nepal. Academic research can provide new knowledge to improve the way we do all of these things. This can enhance the UK contribution to sustainable development, and the knowledge can also be used by others, from rural farmers to the World Bank or Shell, to improve how they tackle shared challenges.

The influential 2011 Institution of Civil Engineers, Oxfam and WaterAid report on community based water management⁹ highlights the thought leadership the UK engineering research base can contribute to international development. As does the Institution of Mechanical Engineers' report "Global Food: Waste Not, Want Not"¹⁰ which hit headlines last month with the striking finding that as much as 50% of global food produced never reaches a human stomach.

DFID are likely to spend £110-120m on engineering research over the next seven years to enhance the UK's poverty alleviation efforts.¹¹ However, a number of signals indicate that engineering research may not be filling its role of improving UK aid as much as it could:

- Engineering for development research funders are not as joined up as other fields, increasing the chance of duplication or gaps in research.¹²
- Some development-related research currently funded would be strengthened by the inclusion of an engineering component.¹³
- UK engineering research capacity relevant to international development is thought to have declined, with late-career research leaders and few mid-career researchers.¹⁴ For example, road research capacity has declined significantly, and agricultural engineering 'fell between' two Research Councils, with an accompanied lack in resources.

⁸ In 2009-10, DFID channelled more than £900 million to infrastructure activities, out of a total budget of £6.6 billion.

⁹ The Institution of Civil Engineers, Oxfam GB, WaterAid (2011) Managing water locally. An essential dimension of community water development.

¹⁰ Institution of Mechanical Engineers (2013) Global Food: Waste Not, Want Not

¹¹ DFID, Personal Comm.

¹² Evidence from C Whitty, House of Commons Science and Technology Select Committee inquiry into science and international development, 2012.

¹³ An expert Grant Panel discussing research proposals to the ESRC/NERC Increasing Resilience to Natural Hazards scheme in 2012

¹⁴ UKCDS-convened roundtable discussion in October 2012.

UKCDS is well placed to bring together the key players to explore these issues, as the only organisation working across all disciplines to join up leaders and funders to advance UK science for international development. In October 2012 it convened a cross-Government group to discuss the state of play. This discussion was wide ranging, covering the research base, skills for today's global engineering companies and the changing nature of global development and aid. One key action emanating from this meeting was for UKCDS to work with the Royal Academy of Engineering (RA Eng) to better understand the shape and nature of the UK development-relevant engineering research base.

Existing data

While there are lots of data on the UK engineering research base (inputs, human capital, outputs) there are very little data on how much research is international development focused. This is not surprising: it is both very difficult to decide what should be included and excluded as 'development focused', and since data is often not categorised in this way at the point of collection, there are few datasets that exist.

To try and find what data is available, UKCDS has spoken to a number of organisations (Engineers Without Borders, Engineers Against Poverty, the Engineering Council, the Women's Engineering Society, Association of Commonwealth Universities and Evidence, Thomson Reuters). These organisations have confirmed that there is no existing data mapping the UK engineering for development research base.

Qualitative mapping

In the absence of quantitative data, UKCDS and the RA Eng have convened this roundtable of leading academics to gain expert insight into the scale and nature of the engineering for development research base. We hope to start answering these questions:

- How big is the engineering for development research base? How many researchers would consider themselves to be working on engineering research for development?
- Which research areas are strongest and weakest? Is the UK world-leading in any areas?
- Where are these researchers getting their funding from? And who are they collaborating with internationally?
- Is there an engineering for development 'community' (a critical mass who see themselves as doing the same, or similar things)? How has this community changed over time? Have particular fields grown?

The UK clearly has some relevant capacity: in a current DFID-DECC-EPSC call on Energy and International Development, there were 90 Expressions of Interest from UK academics. It might not be immediately obvious where the best researchers are based: of 40 engineers who applied, five came from non-engineering departments, including a business school.¹⁵

¹⁵ UKCDS analysis by Alex Green. 'Engineers' defined by a PhD in engineering. Data from EPSRC. Jan 2013.

Similarly, how do we reconcile the fact that there are only a handful of departments of agriculture in the UK, but 40 universities, 31% of the UK university sector, applied to the BBSRC/DFID Sustainable Agriculture Research for International Development (SARID) programme.¹⁶

Issues for discussion

1. Joined-up funding

Funders who communicate effectively and are joined-up can have more impact by not duplicating each other, spotting gaps, pooling resources to fund expensive equipment or experiments, and creating a critical mass where that is necessary for progress.

The UK health for international development funders are well joined-up, with established formal and informal channels for sharing information and brokering partnerships. Is the engineering community less joined up, as per the introduction? Does that just reflect the nature of engineering (see below), and most importantly, does it matter for international development?

Engineering as a process rather than a subject-defined field

Many fields of academic research are defined by what the knowledge is 'about' rather than how the knowledge was generated (e.g. neuroscience is fundamentally to do with the brain whether the information comes from fMRI scanning, or behavioural studies of patients with lesions).

Engineering, without getting into the exact definitions, is concerned with the application of scientific methods to practical problems. These practical problems vary from those that would classically be considered engineering e.g. developing earthquake resistant buildings, to those not so obvious e.g. developing drought resistant crops. In this way, engineering could be conceived as a process, rather than domain specific knowledge.

Engineering as a 'brand'

DFID label much of their engineering research under "Infrastructure". The Global Food Security Programme chooses not to use the phrase "agricultural engineering", instead using "engineering solutions for agriculture". In addition, as engineering is embedded across different research themes (see the text box above), it may have less of a profile, or 'brand' than other fields of research.

For example, in the post 2015 discussions taking place at the moment, the health community are very vocal, with events at the Department of Health, in Parliament, position papers and a vibrant discussion. The engineering community are not so visible, at least not labelled as 'engineering'.¹⁷

Does, or will, this have negative implications for the UK contribution to international development? Are there examples from other sectors where a *lack of branding* has led to lower resource allocation (and therefore lower development outcomes)? NB. This is related, but not to be confused with sectors dropping out of fashion for non-branding reasons e.g. tertiary education under the MDGs.

¹⁶ Carter, A, and Waage, J. Understanding the UK agricultural research contribution to international development and food security: Historical perspectives and future opportunities (2011).

¹⁷ Googling "post 2015 health" and "post 2015 engineering" really highlights the difference.

2. How could engineering funders' help UK researchers better fulfil their potential in advancing sustainable development?

Given the points raised during the discussion, we would like to ask how engineering research funders, such as UKCDS members and the RA Eng, could improve the role that engineering research plays in development. Are there practical measures that could overcome or mitigate some of the challenges that have been raised?

Ian Thornton, UKCDS, and Holly Wright, Royal Academy of Engineering, February 2013