Promoting Knowledge Transfer in the UK

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The Engineering and Physical Sciences Research Council (EPSRC) is the UK Government's leading funding agency for research and training in engineering and the physical sciences. EPSRC invests around £740 million a year in a broad range of subjects – from mathematics to materials science, and from information technology to structural engineering. Alasdair Rose is well known to the IMA for his support of mathematics and his encouragement of knowledge transfer. His views on this topic are therefore particularly welcome in this special issue of Mathematics Today. Alasdair Rose wrote this article in response to questions from former IMA President, Peter Grindrod CBE.

The Engineering and Physical Sciences Research Council (EPSRC) is the UK Government's leading funding agency for research and training in engineering and the physical sciences. Can you outline the role of the EPSRC and your own interest in knowledge transfer?

I was EPSRC's second Mathematics programme manager, from 1998-2003. In 2006, I was appointed to a new role as Head of Economic Impact, with the task of developing an EPSRC strategy for accelerating knowledge transfer between the researchers we fund and those organisations which could use the outputs, this increasing the economic and societal impacts from our investments in the universities. Implementing the strategy has resulted in a closer coordination of our knowledge transfer activities within EPSRC and interactions with other organisations also engaged in knowledge transfer.

The EPSRC is one of seven research councils in the UK. It is the main UK government agency for funding research and postgraduate training in engineering and the physical sciences. Almost all of our funding comes from government and is allocated by the Department for Innovation, Universities and Skills (DIUS). Although the Research Councils respond to government policy for science and innovation, they each have autonomy for making investment decisions on individual proposals submitted to them (under the so-called Haldane principle). EPSRC invests over £700 million a year in research and postgraduate training so that the UK will be prepared for the next generation of technological change. Following the government's 2007 Comprehensive Spending Review, EPSRC received in December 2007 its funding allocation for the next three years, and will invest in accordance with its published Delivery Plan[1] that has been accepted by DIUS.

The drivers that influence EPSRC's investment decisions are the desire to underpin economic development and enhance commercial competitiveness, improve everyone's health, personal well-being and lifestyle, and very importantly stimulate curiosity and culture. These factors are largely interdependent. The strategic factors that influence our role in knowledge transfer are set out in the EPSRC Knowledge Transfer and Economic Impact strategy[2]. The strategy builds on the EPSRC's 2006 Strategic Plan[3], and sets out how we intend to encourage more organisations to use the funding and expertise of EPSRC to help them form partnerships with the leading UK universities, many of which are internationally excellent, and how we will encourage more university researchers to view working with the public and private sectors as a way to enrich their research horizons. Our ten-year vision is for the UK to be the best place in the world in which to engage in research and innovation and to be as renowned for knowledge transfer and innovation as it is for research discovery. EPSRC will achieve this by continuing to maintain its support for research and excellence. I believe that supporting high quality research and ensuring better economic impact are mutual objectives that can be pursued together. This link is articulated in the Research Councils UK publication: *Excellence with Impact*[4], where the challenge for the research councils is to ensure that flexible processes and funding are in place to maximise the likelihood that research outputs are exploited, and to demonstrate the economic impacts over long time periods. I wish to assure readers that this does not imply that EPSRC is moving from away from basic research to applied research or vice versa. High quality research, whether basic and applied, has major impacts beyond creating new knowledge. John Ockenden's article on his experiences with Mathematics-for-Industry study groups demonstrates that real world phenomena produce interesting challenges and opportunities for mathematics, which has led to new mathematics. Such challenges should be welcomed and embraced by the mathematical sciences community. In this respect, it is encouraging that the study groups are stimulating the minds of younger mathematicians.

What changes have you seen in the profile of knowledge transfer in the UK during your involvement with it? Are you pleased or disappointed with its current status and level of activity?

There have been considerable changes in university culture towards partnership with industry. The phrase "ivory towers" has largely disappeared from society's vocabulary. Younger researchers are more likely to want to pursue entrepreneurial avenues than their predecessors. The number of university spin-out companies has steadily increased. About 40% of EPSRC grants support research projects that have collaborations with businesses and a similar proportion of research studentships supported by EPSRC are trained on projects generated or scoped by business. In mathematics, EPSRC has published an attractive brochure containing a range of easily understandable case studies[5] that demonstrate the importance that mathematics plays in society and business, and the opportunity to present the reasons why mathematics matters at an event in the House of Commons. However, there is more that can be done, and there are no shortages of reports that recommend how it can be done.

What is new about the current EPSRC's strategy for knowledge transfer?

There is quite a lot of new activity. We are learning, for example, that we need to publicise and celebrate successful outcomes from the research. We recognise that asking for a final report when our

1 http://www.epsrc.ac.uk/Publications/Corporate/DeliveryPlan2007.htm
2 http://www.epsrc.ac.uk/Publications/Other/KTEIStrategy.htm
3 http://www.epsrc.ac.uk/publications/corporate/strategicplan2006.htm
4 http://www.rcuk.ac.uk/cmsweb/downloads/rcuk/economicimpact/excellenceimpact.pdf
5 http://www.epsrc.ac.uk/ResearchHighlights/Maths/default.htm

grant ends is too soon to capture the impact of knowledge transfer, which may occur several years later. We are actively collecting success stories, from submissions to the EPSRC Knowledge Transfer Challenge Awards, from various publications and from our staff who visit research groups. Several of these have been highlighted in various case study publications (e.g. *Connecting with Business, 2007*[6], *Engaging Maths*[7]) and on our recently launched web site dedicated to business links.[8] EPSRC is entering into strategic partnerships with public and private sector organisations, individually and in consortia, to facilitate collaborative activities with research groups. Often these activities are multidisciplinary in nature, since real world phenomena do not usually respect discisipline boundaries. We are also building on the changing environment in universities by particularly concentrating on developing our relationships with those universities that collectively receive the majority of our investments, and are holding a series of workshops with them on a range of subjects including knowledge transfer and economic impact. We are also working closely with the other research councils in responding to the review initiated by the government: *Increasing the Economic Impact of Research Councils*.[9] Examples of working together include studies[10] of economic impacts arising directly from research council investments that include EPSRC highlights, and of harmonisation of funding opportunities, and publishing examples of successful spin-out companies that utilise research council funded research.[11]

Where does the UK stand in relation to interdisciplinary research and thematic research? Is the balance right between ensuring core (pure science) is supported and promoting exploitation?

A few years ago, I would have said that a lot of research in the UK, including in the mathematical sciences, was conducted in dicisipline silos. This is now changing, and I am much more optimistic about the future. The EPSRC three-year investment Delivery Plan[12] published in December places more emphasis on the key contributions that the engineering and physical sciences disciplines can make to key research themes, such as energy, the digital economy, the next generation healthcare, global security, and living with environmental change. The mathematics sciences is a pervasive discipline that has a great deal to offer in advancing the challenges presented by these themes, and the research community should not hold back but consider imaginatively how the discipline can contribute. In terms of the balance between core (pure science) and promoting exploitation, I do not see a hard distinction, rather a spectrum of activity. Even so-called pure mathematics has a role to play in exploitation, and the work of James Clerk Maxwell is a case in point, although the timescales between proving a theorem and its application may not at first be obvious.

Are the current mechanisms for stimulating knowledge transfer effective? For example, the Knowledge Transfer Partnerships (KTPs) have a low uptake in maths, and EPSRC has launched the new internships scheme.

Surprisingly, perhaps, an independent a study[13] of research council mechanisms concluded that there are not a large number, and that some schemes have a welcome degree of flexibility. A key challenge for the mathematics community is to draw to the attention of business the contribution that the discipline, often in collaboration with other disciplines such as statistics (financial services and pharmaceutical sectors), life sciences (pharmaceutical sector), signal processing (communications sector), has to offer. A few years ago, I recall that the Smith Institute (now a Knowledge Transfer Network) produced an excellent roadmap, *Mathematics: Giving Industry the Edge*,[14] which described the reliance and impact of mathematics in a range of business sectors. I hope that the Smith Institute KTN is valued by the mathematics research community. It employs technology translators – people who understand mathematics and at the same time can relate their knowledge of mathematics to the technology challenges faced by business. I view the Smith Institute KTN acting like a mathematics shop window for business. The KTN is in an excellent position to direct their problems to a Mathematics-in-Industry study group, a customised short or medium-term Knowledge Transfer Partnership project supported by the EPSRC or the Technology Strategy Board, an EPSRC Industrial CASE studentship allocated through the Smith Institute, a proof-of concept study funded either by EPSRC or in partnership with one of the local regional development agencies or their equivalent in the UK devolved administrations, or a short-term doctoral student internship project financed by EPSRC and launched in 2007 by the Smith Institute.[15] Later this year, EPSRC will be launching Knowledge Transfer Accounts that will extend the flexibility of the Collaborative Training Accounts by allowing universities to be more innovative in creating an improved knowledge transfer environment.

So in conclusion, I think the mechanisms for stimulating knowledge transfer are in place, but the challenge is to make businesses and the mathematics sciences research community more aware of the many knowledge transfer opportunities that are available. I am conscious, for example, that few researchers and their business collaborators are aware that EPSRC will support from the university's Collaborative Training Account the salary of the postdoctoral researcher for up to a year in the collaborating company at the end of the research phase as a means of effectively transferring the research knowledge to the collaborating partner.❑

6 http://www.epsrc.ac.uk/Publications/Other/BusinessBrochure.htm
7 http://www.epsrc.ac.uk/ResearchHighlights/Maths/default.htm
8 http://www.epsrc.ac.uk/Business/default.htm
9 http://www.berr.gov.uk/files/file32802.pdf
10 http://www.rcuk.ac.uk/innovation/impact/default.htm
11 http://www.rcuk.ac.uk/aboutrcuk/publications/corporate/impacts.htm
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