

Knowledge Exchange in Mathematics

Progress and Prospects

Richard Pinch

Institute of Mathematics and its Applications

18 January 2019

rgep@chalcedon.demon.co.uk

Disclaimer

This talk is a commentary on the view of the Institute of Mathematics and its Applications, not a statement of policy. This talk does not represent the view of any of the other bodies mentioned.

The KE pyramid

A view of “the knowledge exchange pyramid”:

The base

- A broad range of applications of existing mathematical knowledge to problems which are reasonably well-posed and well-understood. The questions and answers are bounded in scope and time. This is the domain of mathematically qualified practitioners (possibly badged as mathematicians, statisticians, engineers) in business, government and so on, of undergraduate student exercises, projects and placements, and of ad hoc short-term consultancies.

The KE pyramid

The middle layer

- Development and extension of known areas, or the expert selection of appropriate techniques to problems exhibiting some degree of novelty. Problems are not well-posed or well-understood, scoping exercises and selection of appropriate team expertise is required. This is the domain of professional mathematicians working in the application domains, M.Sc. or Ph.D. projects, long-term consultancy and research relationships between research groups and customers.

The KE pyramid

The summit

- Research and development of novel mathematical techniques or areas. The problems are grand challenges with unknown time and scope, requiring significant effort even to delineate and assess. This is the domain of intra- and inter-disciplinary research groups, extended collaborations and research institutes.

The Bond Review

The Era of Mathematics

An Independent Review of Knowledge Exchange in the Mathematical Sciences

A community-led initiative, supported by EPSRC and KTN,
chaired by Prof. Philip Bond and published on 27 April 2018.
It has nine key proposals and 23 specific recommendations.

[epsrc.ukri.org/newsevents/news/
mathsciencereview/](http://epsrc.ukri.org/newsevents/news/mathsciencereview/)

The Bond Review

The Era of Mathematics

An Independent Review of Knowledge Exchange in the Mathematical Sciences

A community-led initiative, supported by EPSRC and KTN,
chaired by Prof. Philip Bond and published on 27 April 2018.
It has nine key proposals and 23 specific recommendations.

[epsrc.ukri.org/newsevents/news/
mathsciencereview/](http://epsrc.ukri.org/newsevents/news/mathsciencereview/)

Governance

- I. An Academy for the Mathematical Sciences should be established in order to facilitate links between academia, government and industry. The Academy should act as the focal point and coordinating centre for the community and draw on the deep expertise of the existing learned societies.

Skills

- II. Government and universities should create, at a minimum, 100 additional PhD places per year dedicated to training mathematical scientists looking to generate impact with their work. These PhDs should have a greater emphasis on breadth in training, with business and computer coding skills included in addition to deep mathematical expertise.

Resources and infrastructure

- III. To counter the underfunding of the MS research pipeline and adequately underpin MS in the UK, UK Research and Innovation (UKRI) should look to at least triple the funding going to MS across multiple Research Councils, including but not limited to EPSRC and Innovate UK.

Resources and infrastructure

- IV. A national centre in impactful mathematics for the UK should be created to work with industry and government to drive mathematical research through to commercialisation.
- V. There should be at least one national centre, based on the Heilbronn Institute model, to better enable mathematicians focused on fundamental research to engage directly with government and/or industry.

Regional

- VI. Funds should be made available for regional KE centres and/or thematic KE networks following several successful models.
- VII. Universities should have dedicated teams in mathematics departments to act as facilitators and KE translators. These should be connected to central KE functions within universities and coordinated through the National Academy.

Government

- VIII. The Government Chief Scientific Advisor should, in collaboration with the Government Chief Statistician, review the access to, use of, and impact achieved by MS within government.
- IX. The mathematical sciences should be encompassed in the HMRC definition of science and technology and included in the tax-credit scheme.

IMA response

The IMA broadly supports the proposals of the Bond Review. It has triaged the recommendations into those it believes the IMA should take a leading role in; those it should be an active participant; and those it has little or no stake in. It has also assigned priorities, given the constraints on resources. It has formed a *Task Group* to implement the IMA response to some of the actions.

IMA response

- 1 An Academy for the Mathematical Sciences should be established in order to facilitate links between academia, government and industry.

This will *not* replace or compete with the IMA. Its role is seen as comparable to the Royal Academy of Engineering.

The IMA supports this, as a member of the Council for Mathematical Sciences, as does the CMS as a whole — it is likely that the Academy would be built on and subsume the CMS.

IMA response

- 2 The means to structure, streamline and raise awareness of the existing KE support mechanisms that are available should be generated.
- 3 Existing mechanisms for KE initiation should be made more robust and expanded in scope and capacity. Mechanisms should be put in place that makes it straightforward for both industry and academics to find appropriate expertise.

The IMA will take as much of a lead here as resources permit.

IMA response

- 8 All mathematics students should acquire a working knowledge of at least one programming language.

There are clear calls for this from employers, but universities are (rightly) cautious of infringement on their academic freedoms.

The IMA does have a role in defining the qualifications of a *professional* as opposed to *graduate* mathematician. It would be best to frame this as part of a programme of supporting universities in delivering employability skills and competencies, in collaboration with employers.

IMA response

- 12 KE activities should be fully integrated into MS academic careers and career progression. This should include consideration of KE in academic appointment and promotion criteria, as well as mechanisms to incentivize and support KE activities. Mechanisms should include KE accolades and buy-out of teaching time for academics who complete an industry placement to ensure that academic research productivity is maintained.

IMA response

- 19 Universities should have dedicated teams in mathematics departments to act as facilitators and KE translators. These should be connected to central KE functions within universities and coordinated through the National Academy

The IMA will cooperate to develop a professional structure for KE staff.

Task Group activities

The IMA has formed a *Task Group* to implement the IMA response to some of the actions. Some work in progress —

- KE conference
- KE community building
- KE professional structure
- KE case studies
- KE prize
- Coding project
- Government Science and Engineering profession

Knowledge Exchange conference

The IMA held a Knowledge Exchange conference at Aston University on 3–4 December 2018 to bring together the KE community and identify some goals for further work.

- National Institute for Impactful Mathematics (B.IV,b.14,b.15)
 - Draft proposal under discussion with EPSRC
- Career structure and support for KE profession (B.VII,b.12,b.19)
 - Variety of structures
 - Case studies
- Barriers to academic involvement in KE (B.VI,VIII,b.7,b.9,17)
 - Sharing best practice
 - Network of KE/Innovation leads

Knowledge Exchange Framework

“The Knowledge Exchange Framework (KEF) is intended to increase efficiency and effectiveness in use of public funding for knowledge exchange (KE), to further a culture of continuous improvement in universities by providing a package of support to keep English university knowledge exchange operating at a world class standard. It aims to address the full range of KE activities.”

Knowledge Exchange Framework

“Research England is working with various stakeholders to develop the KEF, including Universities, learned societies, PraxisAuril, the National Centre for Universities and Business (NCUB), the devolved funding councils and other UKRI councils.”

— Research England

Knowledge Exchange Framework

Research England has launched a consultation on

- Principles and good practice
- KEF metrics

“Consultation responses are invited from any higher education institution, association, organisation or individual with an interest in knowledge exchange. We invite responses through completion of the online consultation survey by midday on Thursday 14 March 2019.”

IMA

The Institute of Mathematics and its Applications (IMA) is the UK's learned and professional society for mathematics and its applications. The IMA exists to support the advancement of mathematical knowledge and its applications and to promote and enhance mathematical culture in the United Kingdom and elsewhere, for the public good.

www.ima.org.uk