

EPSRC Mathematical Sciences Programme

Action Plan: International Review of Mathematics

Foreword

This action plan is the initial response of the Mathematical Sciences Programme to the International Review of Mathematics. It contains actions that the organisation and the programme can deliver within its current resources, working alongside other partners, such as the societies of the Council for Mathematical Sciences, Universities and Industry, as appropriate. It indicates where EPSRC will take immediate action in response to the review, whilst retaining the flexibility to shape its actions where further consultation is required and/or where a longer term plan is needed to address the issues raised.

This Action Plan will be developed and evolved following further consultation with the research community and the Programme's strategic advisory team, for example through a series of regional meetings for EPSRC College members in the Autumn of 2004. The review will form an important input to the development of, and independent evidence in support of the Programme's strategy for the next business planning period (2006-08). This strategy will be articulated in the Programme's business plan for 2006-08. The resources allocated to the Programme in respect of this business plan will be decided by EPSRC Council in the autumn of 2005.

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| Investing in People | <p><i>Mathematical Research is a people intensive activity with competition at an international scale "...having access to a new generation of skilled employees properly trained in the latest developments of mathematical research in a broad sense has become an issue with far-reaching consequences for the prosperity of a nation."</i></p> | | |
| Doctoral Training | <p><i>The panel found that a typical UK PhD programme is of shorter duration and more narrowly focused than those in most other countries. As a result, new PhDs from the UK usually have less breadth and experience than their peers from other countries and have difficulty competing for research fellowships and academic posts. The pressure to complete a PhD in three years may discourage students from choosing ambitious topics with the potential for significant impact or research topics that are perceived to be difficult, such as mathematical analysis.</i></p> | | |
| | <p>EPSRC recognises the importance of a broad mathematical training for doctoral level studies, with a strong taught element if required, e.g. for interdisciplinary research projects. From October 2004 starts, we will be implementing the recommendation of the Roberts Review that the average length of PhD funding should be 3.5 years. The Doctoral Training Accounts provide the flexibility to fund students for up to 4 years and it is also possible to request up to 4 years support for project studentships funded on research grants. HEFCE also provides funding for postgraduate research students directly to universities based on an average 3.5 years study for a full time research degree.</p> | <p>Doctoral Training Accounts (DTA) and research grant support should be used by Universities to provide PhD students with high quality mathematical training and research experience. The mathematics community can take advantage of the additional funding period to develop PhD programmes with a broader base. Universities can pool DTA resources to provide taught courses for PhD students on a regional or national basis. The societies of the Council for Mathematical Sciences (CMS) will take a role in working with Universities to ensure the quality of Mathematics PhDs in the UK.</p> | <p>CMS societies, Universities, HoDoMS.</p> |
| | <p>Short, instructional courses in mathematical and statistical topics are provided by EPSRC in partnership with the London Mathematical Society and the Royal Statistical Society. Proposals for summer schools for training</p> | <p>The Mathematical Sciences Programme will explore options for encouraging universities to collaborate locally or nationally to provide enhanced training for groups of PhD students. EPSRC will review the allocation of Doctoral</p> | <p>EPSRC</p> |

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| | postgraduate students not covered by these contracts can be made at any time in responsive mode. | Training Grant funding through the Mathematical Sciences Programme to better reflect the quality and level of research activity within departments, strategic priorities and the quality and breadth of PhD training provision. | |
| Undergraduate and Masters Training | <i>The panel felt that in view of the increasing importance of mathematical research to the economy at large, the UK cannot afford to concentrate its advanced training for mathematics in a small number of highly competitive universities, and that encouraging regional cooperation for undergraduate and M.Sc. students would allow students in small departments access to a full spectrum of opportunities for learning mathematics.</i> | | |
| | Issues associated with undergraduate and MMath training are primarily the responsibility of the Universities and the Funding Councils. | The societies of the Council for Mathematical Sciences (CMS) can play a role in bringing these issues to the attention of the Funding Councils. | CMS |
| | EPSRC supports only 2% of all taught postgraduate studentships in mathematics. Our provision for taught Masters courses is delivered via the Collaborative Training Accounts (CTAs). CTAs empower universities to develop the vision and internal administrative arrangements to manage their collaborative training portfolios dynamically, and so become more responsive to developments in the economy and the needs of employers. CTAs also devolve greater financial authority and the responsibility for delivering training outcomes to universities. Whilst a major objective of CTAs with respect to Masters level training is to encourage knowledge transfer through innovative forms of provision and the involvement of users in course development and delivery, it is fully | Universities can respond to the responsibility placed on them to deliver high quality training outcomes by looking for ways to enhance their training programmes. This could include regional or national cooperation in Masters training courses. | Universities |
| | EPSRC is updating its postgraduate training strategy for consideration by Council in early 2005. | EPSRC | |

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| | recognized that there can be exceptions such as in some areas of the mathematical sciences. | | |
| Academic Research Career Opportunities and Development | <i>The panel felt that research career paths in the UK are currently difficult, and therefore unattractive to graduates. It also felt that the UK is not competitive in recruiting and retaining world-leading mathematicians, with the possible long term consequences of lack of leadership. The UK needs to pay more attention to retaining the best academics in mid-career and provide postdoctoral opportunities that facilitate the transition to university faculty positions. Professional environments which nurture creativity, without excessive bureaucratic demands will allow more researchers to develop strong academic careers. Advanced long-term fellowships are beneficial, but fellows must also participate in the life of their departments and gain some teaching experience.</i> | | |
| | As part of the Government's science strategy, <i>Investing in Innovation</i> , Higher Education Institutions are required to satisfy their Funding Council that they are trading in balance on their activities. This has led to the introduction of the Transparent Approach to Costing (TRAC) methodology which should enable HEIs to gain an improved understanding of their cost base and the total costs involved in taking on research projects. | Universities will develop a better understanding of the costs of individual activities (including administrative tasks) and so will be able to resource activities these at an appropriate level. | Universities |
| | EPSRC will support international star research chairs (based on a co-funding arrangement with industry), but does not fund internal faculty moves within the UK. The Faraday Partnership for Industrial Mathematics may also be able to help broker academic-industrial partnerships in the mathematical sciences. | Any company (or consortium of companies) wishing to jointly fund a research chair in a UK skill shortage area should approach EPSRC directly. | Industry, Faraday Partnership |
| | EPSRC supports non-faculty postdoctoral appointments through Research Assistant positions on research grants and through postdoctoral and advanced fellowships. Research Assistants can now be Co- | Young researchers often need support from their colleagues and EPSRC at the beginning of their research careers. Universities can help by providing mentoring and advice to non-faculty and beginning faculty researchers. | Research community |

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| | <p>Investigators on EPSRC research grants which request funding for their salary, in recognition of the contribution these researchers make to the formulation and success of research projects.</p> <p>Both postdoctoral and advanced fellowships allow the fellow to spend up to one day per week on teaching and demonstrating, to engage them in work of the department and to expose them to the undergraduate body from which future research students are drawn.</p> | <p>The EPSRC's Mathematical Sciences Programme will engage proactively with advanced and post-doctoral fellows in the mathematical sciences to provide advice about and promulgate examples of best practise.</p> <p>EPSRC will explore with the Mathematical Sciences SAT possible options for further assistance to postdoctoral researchers subject to the need to retain a balance of funding within the programme</p> | <p>EPSRC</p> |
| | <p>EPSRC's Mathematical Sciences programme has introduced short-term (up to 12 months) <i>Springboard Fellowships</i> open to all researchers in the mathematical sciences but particularly suited to mid-career researchers. The aim of these fellowships is to provide researchers with the space to explore high impact novel problems which have the potential to take the career of the fellow in a new direction.</p> | <p>EPSRC will explore with the Mathematical Sciences SAT possible options for further assistance to mid-career researchers subject to the need to retain a balance of funding within the programme.</p> | <p>Research community, EPSRC</p> |
| Strengthening and Broadening the Research Base | | | |
| Statistics | <p><i>"...the future holds very significant dangers for UK Statistics, which is failing to produce enough young research leaders to fill even currently available Chairs, let alone those which will become vacant in the near future. The seriousness of this problem is exacerbated by the rapidly escalating demand for Statistics and statisticians outside the university sector." The panel noted that the UK is not producing a sufficient number of PhD graduates in statistics to satisfy the demand from industry and simultaneously maintain the academic research base. It stated that more attractive PhD and PDRA stipends are needed so as to offset the competition. It felt that M.Sc. programmes in Statistics should enjoy greater security of support and that ways should be found of attracting mathematically strong students in other areas (e.g. biology, finance) to PhD training programmes enhanced in the</i></p> | | |

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| | <p><i>direction of a broad background in mathematics, probability, mathematical statistics and computing. The panel noted the perception among researchers in this area that research grant and fellowship applications are underrated because they must be evaluated in many dimensions, including mathematical contributions, relevance of the application and novelty of the statistical method.</i></p> <p>EPSRC provides resources for enhanced stipends for PhD students in statistics to universities through the Doctoral Training Accounts. These resources are held centrally by individual universities. Applicants for Postdoctoral Research Assistant positions on research grants or for Postdoctoral Fellowships can apply for enhanced stipends at the point of submitting a proposal.</p> <p>EPSRC provision for Masters training is allocated to universities via the Collaborative Training Accounts. Submissions to the pilot and the first open call suggests that the future of current EPSRC-supported MSc courses in statistics is secure in the short term. Further information regarding Masters and PhD training and academic research career opportunities, including research chairs, is covered under the heading Investing in People.</p> <p>EPSRC receives very few applications from statisticians for fellowships at any level (postdoctoral, advanced or senior). The feedback we have received is that there are few applicants for these fellowships because of the attractive positions elsewhere and because of the availability of permanent teaching</p> | <p>In 2005-06 EPSRC will earmark resources to support a number of additional PhD studentships in statistics.</p> <p>In 2004-05 EPSRC will, in partnership with others, take action to address issues of research leadership capacity in areas which are important either in terms of wealth creation or for the health of science in the UK.</p> <p>EPSRC will continue to monitor the CTA business plans submitted by universities for the level and quality of provision of Masters training in statistics. If necessary, EPSRC will draw the attention of universities to the priority we would wish to see given to statistics within our collaborative training portfolio and work with universities, the Royal Statistical Society and Industry to look for ways to ensure that essential training needs are met.</p> <p>EPSRC will continue to promote these opportunities to young statistics researchers. The Royal Statistical Society and universities can also help encourage young statistics researchers to develop their own research careers by taking advantage of these fellowships.</p> | <p>EPSRC, Universities, RSS, Industry</p> <p>Universities, RSS, EPSRC.</p> |

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| | positions available to young researchers. | To provide a better understanding of the facts surrounding the prioritization and funding of research proposals the Mathematical Sciences Programme will publish data relating to the number and value of proposals submitted and grants awarded via Mathematical Sciences peer review panels. | |
| | EPSRC has brought together representatives from a number of Research Councils to discuss statistics research and training and ways in which the Research Councils might work together. Of particular interest is the way we might facilitate researchers working in different application areas to network and to facilitate transfer of knowledge across the different application areas. | EPSRC will work with other Research Councils, the RSS, the COPS, the research community and other interested parties to explore possible options for further assistance for statistics, especially developing the next generation of statistics researchers, with the aim of developing a coherent suite of measures for inclusion in the 2005 EPSRC Programme business plans. | Research Councils, RSS, Industry, Committee of Professors of Statistics (COPS) |
| Algorithmics and the Interface with Computer Science | <i>The panel identified a weakness in the interface between mathematics and computer science in the UK, which was not felt to be developed at the appropriate level. The panel particularly highlighted research on discrete mathematics and computer algorithms, and the connectivity between computer science and the mathematical topics of combinatorics and numerical analysis.</i> | | |
| | The development of skills in the mathematics / computer science interface needs to be addressed in undergraduate courses, which are primarily the responsibility of universities and Funding Councils. EPSRC's Collaborative and Doctoral Training Accounts both allow the possibility of interdisciplinary training and / or the joint supervision of postgraduate students by researchers in the two disciplines. Further information regarding Masters and PhD training and academic research career opportunities, including research chairs, is | Universities can provide training at undergraduate, masters and doctoral levels that will develop the skills of students at this interface. The Learned Societies can play a role in bringing these issues to the attention of the Funding Councils and Universities. | Universities, Learned Societies, HoDoMS. |

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| | covered under the heading <i>Investing in People</i> . | | |
| | Research networks at the Mathematics / Computer Science Interface can be supported at any time through EPSRC's responsive mode. | In 2005-05 EPSRC will earmark resources to support Discipline-Hopping Fellowships at the Mathematics / Computer Science interface and will also set aside commitment to start addressing severely threatened research areas by providing some new research leadership capacity in partnership with others. | Research community, EPSRC, Universities, Industry. |
| | | The algorithmics community will organise a workshop in Autumn 2004, supported by EPSRC, to discuss the issues raised by the International Reviews of Computer Science and Mathematics and to consider possibilities for future actions. EPSRC will explore with the research community and the Mathematical Sciences and ICT Programme Strategic Advisory Teams possible ways to build capacity at this interface. | Research community, EPSRC |
| Analysis and PDEs | <i>The panel found that aside from several world-class senior researchers, the UK is lacking strength in depth in analysis and non-linear PDEs. The subject is not popular among students, partly because it is perceived as difficult and obtaining a PhD within three years will be challenging. This is an important area of mathematics in its own right and because it underpins other areas of applied mathematics.</i> | | |
| | There is a general recognition of the problems surrounding analysis and PDEs in the UK. These issues are long-standing and arise, not just from the difficulty in attracting PhD students to the subject, but also because of the teaching of the subject at undergraduate level in the UK. Undergraduate teaching is primarily the responsibility of universities and Funding Councils. | The societies of the Council for Mathematical Sciences can play a role in bringing these issues to the attention of Universities and Funding Councils. EPSRC will explore with the research community and the Mathematical Sciences Programme Strategic Advisory Team possible ways to build capacity in analysis and PDEs. | Universities, CMS societies, HoDoMS, Research community, EPSRC |

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| | Further information regarding Masters and PhD training and academic research career opportunities, including research chairs, is covered under the heading <i>Investing in People</i> . | | |
| Interface with Materials Science | <i>The panel felt that despite the contribution that mathematics can make to the modelling of materials, the interface between mathematics and materials science has not been an area of major investment in the UK.</i> | | |
| | In the UK, the teaching of continuum mechanics at undergraduate level is heavily based in favour of fluid dynamics and there is a small supply of students with a broad training in modern continuum mechanics. Undergraduate teaching is primarily the responsibility of universities and Funding Councils. Further information regarding Masters and PhD training and academic research career opportunities, including research chairs, is covered under the heading <i>Investing in People</i> . | Universities can provide training at undergraduate, masters and doctoral levels that will develop the skills of students at this interface. The societies of the Council for Mathematical Sciences can play a role in bringing these issues to the attention of Universities and Funding Councils. | Universities, CMS, HoDoMS |
| | In 2003, EPSRC initiated a three-year programme to fund research consortia in Materials Modelling. The aim is to advance the application of state-of-the-art predictive modelling techniques to new and emerging areas of Materials Science and Engineering. The projects should be interdisciplinary and multi-scale with appropriate links to experiment. Research networks at the Mathematics / Materials Science Interface can be supported at any time through EPSRC's responsive mode. | The research community can take advantage of existing funding opportunities at the Mathematics / Materials Science interface to develop this multidisciplinary field in the UK. | Research community |
| Regional | <i>"Mathematics is a discipline where small teams organizing themselves in networks can achieve an excellent level of</i> | | |

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| Cooperation | <p><i>exchange and create a highly stimulating environment for advanced students and young researchers</i> <i>Regional cooperation among universities benefits large centres as well as being absolutely vital for small centres..."</i></p> <p>EPSRC supports many opportunities for mathematics researchers to meet and exchange ideas and theories, for example through our support for symposia (including the Durham and Warwick Symposia), workshops and networks. These can be submitted at any time in responsive mode. Some of the learned societies also have a limited resource for small workshops.</p> | <p>The Mathematical Sciences Programme will clarify and publicise its support for research networks.</p> | <p>Research community, EPSRC</p> |
| Public Engagement | <p><i>"it has become increasingly important that [communicating mathematics to the broad public] be done, not only to be able to attract the best young talent into the field, but also to maintain the continuity of the funding necessary for the long-term health of the subject" The panel recommended that increased efforts be made to explore ways for communicating the vitality, utility and beauty of mathematics to a much wider audience"</i></p> | | |
| | <p>EPSRC provides resources for public engagement activities through a number of different mechanisms e.g. Public communication training funds (PCTF), Partnership for Public Awareness (PPA) awards, senior media fellowships, researchers in residence and NOISE! role models. EPSRC held a Mathematical Sciences Public Engagement Workshop in June 2004 with three aims:</p> <ol style="list-style-type: none"> 1. Inspiring enthusiastic researchers 2. Building a cohort of researchers with PE interests 3. Identifying suitable topics for engaging with the public | <p>EPSRC will continue to work with the learned societies to encourage the mathematics community to reach out to the public and to opinion formers. The Mathematical Sciences will feature as a priority area within the 2004-05 Partnerships for Public Awareness call.</p> | <p>Research community, Learned societies, EPSRC</p> |