Australian Mathematical Society

Contact: Ms Jan Thomas, Executive Officer
Dept of Mathematics and Statistics
The University of Melbourne
Victoria 3010

Email: J.Thomas@ms.unimelb.edu.au Telephone: 03 8344-4254
Fax: 03 8344-4599 Mobile:041-900-6205

2. Nomination for broad thematic priority

The Mathematical Sciences

3. Nomination for priority goal(s) within the broad thematic priority

1. Aspirational
(a) Meeting the mathematical needs of Australian research in the sciences and the humanities with quality, depth and a vibrant basic research climate in the mathematical sciences.
(b) A mathematical sciences base to support research across other priority areas such as biotechnology, the environment and advanced computing

2. Outcomes-focused
(a) Technology diffusion e.g. efficient mathematical methods for data analysis in biotechnology, advanced computing etc
(b) Improved mathematical models for areas such as climate change, industry, social sciences etc
(c) A continued contribution to the arts and culture through, for example, special effects in films, new design techniques, authentication of art works etc

4. Key objectives

Australia's research priorities can only be built on a sound base in the enabling sciences, especially mathematics. Mathematics will underpin much of the research in whatever priorities are set and, in recognition of this, most nations have increased their support for the mathematical sciences in recent years. Australia has not and, as a result, many of the nation's most talented researchers—new and experienced—are currently working overseas. In particular, by declaring the mathematical sciences a priority area, the USA has provided very attractive opportunities to both new and experienced people from Australia.

There is insufficient mathematical expertise to meet research and industry needs and this will represent many missed opportunities unless it is addressed. A key objective must be to makes the mathematical sciences a priority area and promote a climate where it is as attractive to work in Australia as it is to go overseas. This is not just an issue of salaries—a crucial aspect is critical mass in core mathematical disciplines and the building of inter-disciplinary teams where appropriate. This needs to take account of the fact that the nexus between basic research and applications is strong, and the boundaries between pure and applied mathematics are no longer well defined. For example, the CD was developed using new research in pure mathematics.

5. Selection criteria

The Australian Mathematical Society supports and endorses the criteria submitted by Professor Peter Hall as Chair of the National Committee for Mathematics. These are appended.

Additional comments below emphasise mechanisms supported by the broad mathematical sciences community including the Heads of Mathematical Sciences Departments, other research institutes, industry, and mathematics educators.

Criterion 1. The scope for increased Commonwealth research effort in the priority area to deliver a measurable and significant positive impact, by:

(a) Recent funding from the Victorian Government for establishing the Australian Mathematical Sciences Institute (AMSI) if supported by the Federal and other State governments has the potential that would enable AMSI to emulate similar institutes in Canada. The Canadian institutes support basic research but have also demonstrated that they promote cross-disciplinary work and transfer to industry.

AMSI, currently supported by universities in all states except Tasmania and the Northern Territory, has the potential to both support basic research but also to ensure that this is transferred to links with post-graduate education, business, industry and other disciplines.

(b) AMSI specifically addresses Australia's mathematical strengths, opportunities and needs arising from:

i. our nation's geography which makes effective delivery of advanced mathematical sciences difficult without national collaboration.
ii. issues of global competition for a scarce resource which if not addressed will leave Australia without an essential research tool.
iii. Australia's competitiveness in a global context in that good research in many areas is dependent on critical mass in the mathematical sciences. Delivery of advanced mathematical services and research within Australia is needed to underpin the appropriate uptake of many new technologies, including those developed overseas..

Criterion 2. The scope for Australia to build the capacity needed to achieve that impact, taking into account that:

(b) Existing expertise and experience has been seriously depleted in the mathematical sciences due to a significant brain drain. With appropriate support Australians working overseas will be prepared to spend time in Australia. Complemented with other talented people from overseas, the local base can be strengthened and a climate induced that will encourage talented people to come to Australia permanently.
(c) Compared with many laboratory disciplines, research infrastructure for the mathematical sciences is relatively inexpensive. This however also contributes to the high mobility of mathematical scientists and so research infrastructure must meet international best practice to attract and retain good people.
(d) Research in the mathematical sciences is global and thrives on international

collaborations. The recent establishment of institutes in Singapore and New Zealand should enhance regional as well as global collaboration. A number of Australians and ex-Australians have prestigious positions on professional bodies and editorial boards. For example, the President elect of the International Committee for Industrial and Applied Mathematics is Professor Ian Sloan of UNSW.

(e) The overall magnitude of the investment required to make an impact is premised on the Canadian model for institutes where a mixture of the equivalent of State, Federal and Industry money is involved. Something of the order of $5 million a year of additional Federal money, supplemented by State and Industry support, would enable significant activity.

Criterion 3. The scope for Australia to capture the benefits of the research, through the potential of the research to:

(a) achieve commercially, socially or environmentally relevant outcomes over the cycle of the priorities regime; or
(b) enhance significantly Australia’s overall innovation capacity by broadening the knowledge base, and fostering acquisition of skills and understanding of emerging areas of ‘hot’ research.

Australia will fail in many of the areas listed in (a) and (b) above unless the issues in the mathematical sciences are addressed. Not only will opportunities be missed in Australian R & D but there will be a failure to take up and adapt to Australian needs new and emerging technologies from other nations. In this regard there are also a number of security issues in both defence and the financial services for example.

6. Implementation and Monitoring

AMSI has already developed a detailed Business Plan for the Victorian Government and will be operational by the time the priorities are announced. Extension to a major national program could be achieved in a very short time-frame with appropriate and detailed marketing, risk management and monitoring mechanisms. A copy of the AMSI business plan can be supplied on request.

The Australian Mathematical Society would like to stress that AMSI also addresses a number of issues that overlap with the Review of Higher Education, especially aspects of course rationalisation in post-graduate education. In turn these overlap with research.

APPENDIX

Selection criteria – PROFESSOR PETER HALL

Criterion 1. The scope for increased Commonwealth research effort in the priority area to deliver a measurable and significant positive impact, by:

(a) achieving an appropriate `critical mass' of excellent research through specific support and/or coordination and collaboration at the national level; and
(b) addressing Australia's strengths, opportunities or needs arising from: (i) our nation's geography, climate, bioresources, economy, way of life and/or culture; or (ii) issues of

global importance which impact significantly on Australia; or (iii) Australia's competitiveness in a global context.

Australia is losing some of its strongest mathematical scientists, at an alarming rate, to countries where working conditions are substantially better than here. (For example, there are 30% fewer mathematicians working in Australian universities than 7 years ago.) This highlights the need to develop an appropriate `critical mass' of excellent researchers in the mathematical sciences.

The mathematical sciences make wide ranging and enabling contributions to the Australian research enterprise, and to Australia's economy. This makes them ideal for support through a Commonwealth research effort; the effect of such support would be felt across many sectors, in the physical, natural and social sciences. For example, the mathematical sciences, including statistics, provide methodology for modelling and analysing change in the areas of climate, bioresources, the economy and our way of life. They enhance our competitiveness in a global context, for example by providing key tools for the development of industrial processes and for monitoring quality. See Criterion 3 below for more detail.

Criterion 2. The scope for Australia to build the capacity needed to achieve that impact, taking into account:

(a) existing expertise, experience and technological capacities or whether such capacities can be reasonably acquired or accessed;
(b) the availability, quality and scale of necessary research infrastructure;
(c) research conducted in other nations and the potential benefits of international collaborations; and
(d) the overall magnitude of the investment required to make an impact.

Several years ago, DEST produced data which showed that of all areas of the physical, natural and social sciences in Australia, the mathematical sciences had the greatest international impact Therefore, the necessary expertise and experience existed in Australia until very recently; the research infrastructure is still largely in place. Now, however, both expertise and infrastructure are decaying and dissipating, as many of our key mathematical scientists leave Australia to take positions abroad, and as those who remain are restricted in their research by increasingly heavy teaching and administrative workloads. These difficulties have a substantially negative impact on Australia's ability to train new mathematicians and statisticians. It is not too late to reverse the trend, but time is running out.

The mathematical sciences thrive on international collaboration. Of all the sciences they arguably derive the greatest single benefit through enhancement of international contacts. Moreover, as an intellectual science mathematics does not demand massive investment in infrastructure in order to produce significant impact.

Criterion 3. The scope for Australia to capture the benefits of the research, through the potential of the research to:

(a) achieve commercially, socially or environmentally relevant outcomes over the cycle of the priorities regime; or
(b) enhance significantly Australia's overall innovation capacity by broadening the knowledge

base, and fostering acquisition of skills and understanding of emerging areas of `hot' research.

The scope for commercial outcomes resulting from support of the mathematical sciences is substantial. For example, some of Australia's leading exports are in the field of mining and mineral processing; and in particular, 25% of the world's tin production is processed through just one type of machine, designed and manufactured in Australia. The work of an Australian applied mathematician (a winner of the Australian Mathematical Society Medal) has been pivotal to the development of that equipment, which has brought many millions of dollars to this country.

Successes of this type have been repeated across the nation, as mathematical scientists (including statisticians) work with industry, business and government to enhance Australia's industrial and commercial performance. For example, two Clunies Ross Awards (in 2000 and 2001) went to mathematical scientists, one for the development of software for improving security of e-commerce and net-based information exchange, and the other for gravimetric detection of ore bodies using airborne detectors. The mathematical tools developed to interpret such data for commercial use have generated a benefit that will last for many decades, from a particularly modest initial investment.

The uses of mathematics and statistics to model and analyse data on social and environmental change are likewise of great relevance and significance to our nation. The introduction and development of new scientific technologies, for example in bioinformatics and information & communications, rely on the mathematical science.