Report of Subcommittee VI

Steering Committee for the development of

The Mathematical Sciences in Australia

A Vision for 2025

The Decadal Plan for the Mathematical Sciences 2016-25

Research centres,

present and future,

in mathematics and statistics

4th March 2014

Decadal plan subcommittee (vi): Research Centres. Report to the Steering Committee

Members

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Key Recommendation

(1) That the formation of a National Research Centre for the Mathematical Sciences be undertaken as a high priority. This will optimise our ability in Australia to develop strategic and coordinated research partnerships, both nationally and internationally; it will enhance and provide practical support towards research translation; it will leverage significant funds to the mathematical sciences from other sources. A National Research Centre will allow Australia to play a leadership role among our neighbours with similar and emerging aspirations in research in the mathematical sciences, and as such would represent a strategic investment for our future as a more knowledge based society.

Our Brief

At the start of the process, four themes relating to Research Centres were isolated for the consideration of the subcommittee:

1. Past and present centres – motivations, justifications, aims, activities, successes – within Australia and internationally.
2. What is presently missing from the Australian landscape in mathematical and statistical research that could be addressed by research centre(s), and what additional benefits can be identified to best make our case?
3. What model of research centre(s) is best for our purposes, how should the activities be structured, and what administrative and governing structures should be adopted?
4. How to go about implementing our recommendations.

Formal submissions to the sub-committee and process

During the consultation phase, the Decadal Plan project officer Peter Stacey coordinated meetings with stakeholders in the tertiary sector in all the states, and the ACT. The comments received were necessarily brief. On one side there were concerns: to what extent would a Centre take away from present ARC funds for the mathematical sciences; is the Centre primarily for one sector of the mathematical sciences, and if not how is the breadth of research interests, research entities and geographical location to be made inclusive? The essence of the other comments is captured in the formal submission to the Decadal Plan by the Australian Mathematical Society. The latter says that there is overwhelming support for efforts to establish a Research Centre, comparable to those well established in other countries. It is noted that there are at least two models for a research centre in the mathematical sciences used overseas, these being a distributed model without a fixed physical location, or a dedicated research station which can physically host programs, and in some cases provide accommodation. The submission noted that there are different views within the mathematical science community as to which is best suited to our needs.

In addition to the formal submission to the Decadal Plan by the Australian Mathematical Society, a formal detailed submission was made by the Australian Mathematical Sciences Institute (AMSI). Attention is drawn to the involvement of AMSI in a bid for a Research Centre in 2010, at the invitation of the ARC. For theme (2), one is referred to the 2010 bid document. There it is pointed out that internationally, Research Centres in the mathematical sciences are well established, and regarded as an essential part of the corresponding research infrastructure. For issue (3), a case is made in favour of a distributed model. It is pointed out that a dedicated research station in Australia would impact favourably on our engagement with the mathematical sciences in the Asia-Pacific region, but on the other hand would require partnerships with other disciplines to optimize the return on the costs involved.

At the invitation of subcommittee member Professor Thierry Coulhon, all subcommittee members were invited to the Mathematical Sciences Institute at the ANU, Canberra, on Monday 19th August for a face-to-face meeting to discuss the issues. All but two of the subcommittee members were able to attend. The meeting was characterised

by there being a remarkable level of agreement and common purpose relating to the issues of our brief. Subsequently a report was drafted. A subcommittee member not present at the meeting raised a number of additional points for consideration. These were debated, and our report correspondingly updated. On Monday December 9th there was a decadal plan workshop, in which all members of all the subcommittees were invited. This forum provided further opportunity for refinement of our report.

Report and recommendations of the subcommittee

Theme 1: Past and present centres – motivations, justifications, aims, activities, successes – within Australia and internationally

Australia has never had a national Research Centre in the mathematical sciences. Since 1980 there have been three successful Centre of Excellence bids for themed research centres in the mathematical sciences. One was obtained in 1981 at the Australian National University – the Centre for Mathematical Analysis – and the other in 2002 at the University of Melbourne – Mathematics and Statistics of Complex Systems (MASCOS). Full funding was obtained for between 7 and 10 years. In late December 2013 a new Centre of Excellence bid for themed research in the mathematical sciences was successful. It is entitled 'Mathematical and Statistical Frontiers in Big Data, Big Models and New Insights', with funding of 20 million dollars for 7 years.

Internationally there are numerous national, as opposed to themed, research centres in the mathematical sciences. Canada, for example, has the Pacific Institute for the Mathematical Sciences (PIMS), the Fields Institute, Le Centre de Recherches Mathématiques (CRM) and hosts the Banff Research Station. It furthernore funded MITACS, the Network of Centres of Excellence for the Mathematics and Information Technology of Complex Systems, which focussed on bringing together mathematical scientists from businesses, universities and government research organisations alike to stimulate innovation. Common to all existing national research centres is their international outlook. Part of the mandate of PIMS is 'to create partnerships with similar organizations around the world, with a particular focus on Latin America and the Pacific Rim as well as the scientific networks of the European Community'. A principle of The Chern Institute of Mathematics in China states 'Based at Nankai, face the whole country, and eye the world'. Some of the national research centres also provide infrastructure to the mathematical sciences presently being undertaken in Australia by AMSI. These include running summer schools (PIMS); programs to attract more young people to the mathematical sciences, and to stimulate their teachers by offering topical materials (CRM); graduate and post-doctoral internship program (MITACS). Another common role is to bring together researchers from academia, industry, and government laboratories for co-ordinated research programs on topics of national and international importance.

Theme 2: What is presently missing from the Australian landscape in mathematical and statistical research that could be addressed by research centre(s), and what additional benefits can be identified to best make our case?

In late 2012 the Department of Industry, Innovation, Science, Research and Tertiary Education released the report '2012 National Investment Plan'. This contains many policy recommendations which, from the viewpoint of the Mathematical Sciences, one can argue could best be implemented through a research centre. For example, on page 16, under the heading 'The Global Context' it is stated that 'Australia needs to be

a respected participant in the global research community so that we can (i) benefit from access to overseas research and expertise; (ii) be better able to focus international research and innovation effort on issues of importance to Australia; and (iii) be better able to leverage research relationships to progress broader foreign policy objectives of an economic and development assistance nature.' There is no doubt that overseas countries with research centres in the mathematical sciences benefit from access to overseas researchers and expertise to a greater extent than those without. This gives them an advantage in being at the forefront of developments in fast paced research areas, by having the services of international experts linked by a chosen research theme. These international experts may well give lectures, participate in collaborative research and/or mentor junior researchers. Furthermore, with the Asian Century upon us, there is a great opportunity to use a research centre to leverage research relationships in the Asian region. This is in keeping with the recommendation on page 39, under the heading 'The Decadal Outlook for Research', where it is noted that 'The emergence of new countries with significant research capability means that Australia will need to strengthen its collaborative relationships with these countries, while recognising that their emergence impacts on Australia's competitive position in the global research community.'

Generally, a research centre will optimise our ability to develop strategic and co-ordinated research partnerships. These partnerships will be both international and inter-disciplinary. Again from the '2012 National Investment Plan', under the heading of 'Complex, Interrelated Issues' on page 43, it is stated that '...complexity will require researchers from different fields of research, and different disciplines, to work together to explore the nature of the issues and the possible adaptation and mitigation strategies'. An excellent example of a co-ordinated, inter-disciplinary and international program in the mathematical sciences is the special year 'Mathematics of Planet Earth 2013'. The Australian efforts in this program have been organised by AMSI, and have involved the bringing together of a diverse range of scientists to participate in workshops, outreach events, and public lectures. These scientists were similarly diverse in their affiliation, coming from academia, government agencies and industry research groups alike. As a result new collaborative partnerships have emerged; different research sectors and the knowledge and skills they contain has been put on display; inspiration has been provided to the general public, students and early career researchers alike. The AMSI 'Mathematics of Planet Earth 2013' program has much in common with a semester long, or full year, program run by a research centre, and provides concrete evidence of the additional benefits that are forthcoming.

A research centre integrating different research bodies has the potential to encourage, enhance and provide practical support towards research translation. This translation may take many forms: it may be by way of inspiring and capturing the imagination of a new generation of researchers; the assimilation of new methodologies which may then be relayed to business and industry; by facilitating communications between theoreticians and practitioners.

Theme 3: What model of research centre(s) is best for our purposes, how

should the activities be structured, and what administrative and governing structures should be adopted?

It has been noted above that there are at least two models for a research centre in the mathematical sciences used overseas: a distributed model with activities carried out at various nodes, and a dedicated research station which can physically host programs. A third option would be to have a mixture of these two.

The panel members were unanimously of the view that the relatively vast distances within major centres in Australia, combined with the relatively sparse population density, makes a distributed model the best of the options for initiating a research centre. The reality is that many research strengths in the Mathematical Sciences in Australia are concentrated within one or two capital cities, so it makes sense — both financially and practically – to base research programs on those strengths at one of these locations. The distances between major population centres in Australia are not dissimilar to those on the west coast of Canada, and we note that the best known distributed research centre in the mathematical sciences, PIMS, is centred in this region.

In discussing a research station model, it was again the unanimous opinion that the business case would be greatly strengthened if such a venture were to be undertaken in partnership with other research groups with similar needs for a research centre. Theoretical physics was mentioned in this regard, as was theoretical computer science and government/ industry research entities in the mathematical sciences. Another idea that was discussed was to form a research station in partnership with a foreign country or association. Such a partnership would itself be a contribution to the recommendation in 'The Decadal Outlook for Research', that Australia will need to strengthen its collaborative relationships with countries of similar and emerging aspirations in research.

The main cost in initiating a distributed model research centre would be the salary of a Scientific Director, and administrative support staff. We say initiating here as it is envisaged that the pathway to a fully funded research centre will involve a dedicated Scientific Director, who would have to liaise between various interest groups in the mathematical sciences, and have a high profile in government. The Scientific Director must be a respected researcher on the international stage, and have a progressive outlook for the discipline in general. In the absence of a federal government grant for such a position, two alternatives were discussed. One was to levy the institutions which make up AMSI to sponsor this role, which would then become a part of the activities of AMSI, and to similarly seek contributing funds from existing themed research centres in the mathematical sciences. Another was to take advantage of a state government or institutional initiative, much like that responsible for the origins of AMSI itself. The business case here would be that this initial investment would be rewarded by the winning of future federal government funding of an ongoing research centre as part of the funding of research in the mathematical sciences in Australia. In this regards, data contained in the 2012 NSERC report 'Long-range plan for mathematical and statistical research in Canada 2013–2018' is relevant. Under the heading 'Funding thematic and collaborative resources' one reads that NSERC funded mathematical sciences institutes

have a total budget of $4.14 million in 2013–2014, and most significantly the total leveraging from provincial governments, universities, international agencies, commercial and industrial partners, and private contributions is four-to-one measured purely on the basis of cash flow.

Theme 4: How to go about implementing our recommendations.

Under the heading of the previous theme, it has been commented that to initiate a distributed model research centre, it would be necessary to find funds to cover the appointment of a Scientific Director and administrative support staff. Of course a fully funded research centre requires on top of that the cost of running programs. Moreover, it is noted above that the rationale for proceeding this way is for this to be a catalyst for future federal government funding of a research centre.

The latter requires lobbying government. In February 2012 AMSI organised a very successful lobbying exercise in Canberra as part of the program 'Maths for the future: Keep Australia competitive'. The keynote speaker was Professor Celia Hoyles, former mathematics advisor to the British Government. The 2011 Nobel Prize winner in physics Professor Brian Schmidt was the guest speaker at the conference dinner. Since that occasion there has been much positive attention paid to the mathematical sciences by the Chief Scientist's office. Keeping in mind that it is anticipated that a Scientific Director will be appointed before the research centre is fully funded, it is therefore recommended that the appointment of a Scientific Director and launch of the beginnings of a National Research Centre coincide with a similar lobbying exercise, involving for example directors of overseas research centres in the mathematical sciences as well as private sponsors to such centres being invited for the occasion.

The pathway to a research station is more complex to foresee, as here we have argued that partnerships with other disciplines or other nations are required. On the other hand strategic considerations like the leadership role possible for Australia among our neighbours with similar and emerging aspirations in research means that this must be followed through with urgency and conviction.