



**Nalini Joshi\***

## **The Impact of Advanced Physical and Mathematical Sciences to the Australian Economy**

There has been a succession of reports released recently, which should be in the armoury of every mathematical scientist in the country. Are you looking for punchlines that you can convey to a journalist or a member of parliament? Or, for quotes to add weight to an argument for further investment in mathematical sciences and its benefit to society? The latest reports have delivered information and data that have been worth their weight in gold.

You have probably read recent news headlines, one of which was ‘Physics, chemistry and mathematics add billions to the economy, report finds.’<sup>1</sup> This was a news item about the report ‘The importance of advanced physical and mathematical sciences to the Australian economy’ released by the Australian Academy of Science on 25 March 2015. It was commissioned by the Office of the Chief Scientist and the Australian Academy of Science and prepared by economists from the Centre for International Economics.<sup>2</sup>

It focuses on ‘advanced physical and mathematical sciences’ (APM), that is, on physics, chemistry, the earth sciences and mathematical sciences and on their applications in the past 20 years. The main finding (stated in the foreword) of this report is

The direct contribution of the advanced physical and mathematical sciences is equal to 11% of the Australian economy (that is, about \$145 billion per year). Along with the direct contribution, the report estimates additional and flow-on benefits of another 11%, bringing total benefits to just over 22% (around \$292 billion per year).

The report’s investigations started with a study of the share of the APM sciences in the 2006 Australian and New Zealand Standard Industrial Classification (ANZSIC), in which there are 506 industry classes. The National Committee for Mathematical Sciences was asked to recommend mathematical scientists to take part in the initial workshop to consider how much and to what extent APM plays a role in each classification. We proposed Professor Nigel Bean (Adelaide), Mr

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<sup>1</sup><http://www.abc.net.au/news/2015-03-25/sciences-sector-add-billions-to-the-economy-report-finds/6345648>, accessed 25 March 2015.

<sup>2</sup>The report can be downloaded from <https://www.science.org.au/publications/science-impacts-economy>.

Stephen Horn (SSAI) and Professor Geoff Prince (AMSI), who took part in this two-day workshop. Further industry consultation was undertaken to clarify and support the outcomes.

In a previous NCMS column ‘How mathematical sciences add value to the national economy’<sup>3</sup> I described the methodology and measurement of direct and indirect value added to the economy in the Deloitte assessment of the economic impact of mathematical sciences on the Dutch economy. The methodology of the Australian report is similar, except for the fact that APM disciplines were considered as a multidisciplinary enterprise, rather than as separate disciplines. Rather than repeat a description of the methodology, I will highlight some of the distinctive findings of the Australian report here.

1. Employees who hold a non-school qualification (NSQ) in the APM sciences are broadly spread across the economy (p. 31). In particular, 538 out of the 717 ABS industry classes from the 2011 census had at least one employee with a NSQ in the APM sciences. In other words, ‘APM scientific skills are valuable to businesses in many parts of the economy, whether or not those businesses are strictly science-based.’
2. In Australia, the APM sciences feature more prominently in: the mining sector (including oil and gas extraction, iron ore mining and gold ore mining), the finance sector (including general insurance and banking) and the communications sector (including wired telecommunications network operations) (p. 55). Pathology and diagnostic imaging services is also prominent, occurring in the top six industry classes.
3. While the direct impact of the APM sciences on the economy was \$145B, its flow on or indirect impact on all industries (whether or not they use the APM sciences) and to consumers added another \$147B to the economy (p. 60).

As mathematicians, we know the depth and importance of mathematical sciences to many areas in our lives. The report’s authors repeatedly state that the figures reported above are *underestimates* of the true value added by advanced physical and mathematical sciences to our economy. While no report is perfect, I for one am grateful to have this one in the arsenal I can pull out to convince people who may never have studied any mathematics beyond high school that mathematics is not only worth pursuing but is essential for the economic health of our society.



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<sup>3</sup><http://www.austms.org.au/Publ/Gazette/2014/Sep14/NCMS.pdf>