# AMSI News

## Mathematics and National Prosperity

In the mid 1990's I had trouble engaging any politician or senior bureaucrat in a discussion on the strategic importance of mathematics education. Now only ten years later, I am happy to observe that the situation has improved. Several senior employees of DEST and other federal departments are keen to make better use of the country's mathematical and statistical expertise, to improve the provision of mathematics education and to protect our universities' mathematics instructional programs. In July 2005, the first AMSI/MASCOS Industry Forum was opened by the Hon. Ian Macfarlane MP, Minister for Industry, Tourism and Resources. In his introduction, he said,

"*Coming from an engineering and farming background I know too well the every day importance of mathematics in our working lives. Mathematics, in one shape or another, stretches across industry from BHP to the corner store, from miners to medical researchers. It's a building block to business.*"

Importantly, over the term of the Hon. Dr Brendan Nelson as Minister for Education Science and Training, we had an ally in DEST who took a strong personal interest in our efforts to improve mathematics education, particularly with the establishment of ICE-EM. Dr Nelson's recent article, "Supporting the Mathematical Sciences - Education for the Future", *Aust. Math. Soc. Gazette* **32** (2005), 227–232 outlines several other supportive initiatives. We look forward to working with the new minister The Hon. Julie Bishop, who is well regarded. We congratulate Dr Nelson on his appointment to the position of Minister for Defence and we hope to collaborate with his department. For there are many ways to employ mathematical sciences to improve national security. This was a major reason for U.S. President George W. Bush announcing in his national address during the economic downturn of 2002, a significant budget increase in support of mathematics.

In order to remain competitive, we must adapt to the changing landscape of the global economy. This will require us as a nation to embrace mathematics and statistics as part of our culture. International investment is guided by huge data sets including market prices of materials, real estate, shares and financial derivatives; interest rates, currency exchange rates, production rates, incomes, consumer behaviour, telecommunications traffic patterns, travel patterns, political opinions, demographic details, land use, health status and in the near future, genetic profiles. National economic success and national security rely on an ability to analyse huge data sets, to turn them into useful decision-aiding measures. Our capacity will not be helped by a relatively low number of enrolments in mathematics major programs. We face a critical shortage in mathematically trained graduates, at least for the next 5 years. I predict that with the increased government and community awareness of the role of mathematical sciences, we will then experience a strong turn-around.

As stated recently by several commentators from within the engineering profession, there is likely also to be an under-supply of engineering graduates, especially those that are well trained in mathematics. For Australia to be competitive, it must maintain a portfolio of industries that includes both manufacturing and service, as well as raw material production. In all industrial sectors, we will have to be self-reliant in intelligent design of high quality innovative products and efficient processes. Ultimately, products are made of physical materials, often synthetic materials with new physical properties. Traditionally, engineers have been taught the dynamics of solids and fluids so that they can predict the behaviour of materials in new situations. For example, the flow of standard fluids, from situations as diverse as airflow over an aeroplane wing and water tumbling over a dam wall is described by the Navier-Stokes equations. These are important examples of non-linear partial differential equations. A conceptual grasp of these is achieved only by a considerable amount of mathematical training. Unfortunately, in many cases modern engineering education is deficient in these traditional areas.

While working in an American university, I taught mathematics to engineering students. I noticed that they had been encouraged to study more mathematics than is commonly taken by their Australian counterparts. In recent years, many Australian engineering programs have reduced the mathematics requirements in favour of management, communication and marketing courses. In two of our sandstone universities, engineering students are compelled to take an unusually high number of mathematics courses, even by American standards. However, the most common program structure now includes only three mathematics courses beyond secondary education. This is certainly not sufficient to enable engineers to successfully model mechanical behaviour of new materials. Many of our engineering colleagues share my concerns but opinions are divided.

At last week's wonderful MISG in Auckland, I was reminded how much engineers and mathematical scientists actually enjoy working together. In some of our universities there are very strong relationships between the engineering departments and the mathematics and statistics departments. However, such relationships can change whenever a new Dean arrives. We must have regular meetings with our engineering colleagues to learn how we can better serve their needs. If we are to adapt to the real world, it is time for a serious re-inspection of our university mathematics offerings, both for mathematics majors and for the technical professions.

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For current events and developments, see the websites http://www.amsi.org.au and http://www.ice-em.org.au.