Pacific Rim Mathematicians Coaxed from their Ivory Towers

Programs to yoke mathematics to industrial needs are booming across the Asia-Pacific region

Graeme Wake is an academic mathematician, but he is willing to get his hands dirty. He and a colleague recently devised an algorithm that optimises fertiliser use in New Zealand pastures. 'Cattle and sheep feed on grass, which makes it one of the most important industries for the country,' says Wake, a professor emeritus of industrial mathematics at Massey University, Albany, in New Zealand.

For Wake and an increasing number of mathematicians around the Pacific Rim, applying their skills to challenges in industry has become a cause. An 'isolationist attitude encouraged a generation ago is changing,' Wake says. 'Industry is learning that they can get value' from teaming up with mathematicians. In South Korea, when academics explain how maths expertise can boost competitiveness, 'the government is listening,' adds Hyungju Park of Ajou University in Suwon, South Korea. Other nations are joining the bandwagon, resulting in a wave of new institutes, grant programs, and brainstorming sessions in the Asia-Pacific region.

Some trace the movement's roots to 1968, when the Mathematical Institute at the University of Oxford in the United Kingdom organised a study group bringing together mathematicians and corporate representatives. It has percolated through the maths community in Europe and North America ever since. But until recently, Asia largely steered clear. At Japanese universities, for example, applied mathematicians have traditionally been members of engineering faculties, allowing those in maths departments to remain aloof from practical problems, says Masato Wakayama of Kyushu University in Fukuoka, Japan.

But the walls are crumbling. In 2011, Kyushu University set up an Institute of Mathematics for Industry (IMI), the first of its kind in Asia. Three years later, mathematicians from 11 countries formed the Asia Pacific Consortium of Mathematics for Industry. In June, converts in New Zealand organised their first weeklong mathematics in industry study group, bringing together academics and company representatives. And in July, South Korea inaugurated its Industrial Mathematics Ignition Program, with $2.5 million in grants distributed to 21 academic teams; at a follow-up symposium in Seoul on 21 and 22 October, overseas experts offered advice to the grant winners.

Industry sometimes needs convincing. As one of its first efforts to find corporate partners, Kyushu's IMI tried to place mathematics graduate students as interns at corporations. 'We sent 262 letters to leading companies. Only two replied and both refused,' Wakayama says. To jump-start the matchmaking, IMI faculty members worked personal connections and have since placed 50 students in internships. Those connections have helped forge collaborations to apply stochastic differential equations to manage financial transactions, group theory to improve computer graphics, and topology – the study of surface deformation – to optimise steelmaking.

The South Korean effort, in contrast, is geared more toward startup companies, which 'are showing tremendous interest,' says Park. Winners of the new South Korean grants are modelling how drugs reach target organs, developing new approaches to analysing big datasets, and delving into the complex geometry of computer animation.

In Japan, mathematicians are using topology – the study of surface deformation – to optimise steelmaking.

The study group held last summer in New Zealand illustrates another way to bridge the gap between maths and industry. 'A lot of companies don't want to employ highpowered mathematicians, but they have a short-term need for mathematical advice,' Wake says. For a $4000 fee, companies presented challenges. Academics volunteering their time brainstormed and developed possible solutions over the course of a week.

Among the companies seeking help in New Zealand was Auror, an Auckland-based startup specialising in antishoplifting software. The company collects industry and police data on shoplifters, their behavioural patterns, the types of products they steal, and daily and seasonal patterns of crime activity. Auror asked mathematicians to turn its data into algorithms to identify where and when repeat offenders are likely to strike. The firm joined the study group because it offered input from 100 or so of the country's top academic mathematicians, something that would have been difficult for a startup to arrange on its own. 'We got access to expertise we would not have otherwise had,' says Phil Thomson, Auror's CEO.

'Maths are ubiquitous,' says Wake, who argues that few endeavours couldn't benefit from mathematical analysis – even growing grass. Wake and his colleague 'went deep into systems biology' to turn such things as the chemical kinetics of fertiliser ingredients into equations, which AgKnowledge, a consulting firm in Hamilton, New Zealand, will put to use. By inputting data such as fertiliser cost, soil characteristics, and whether a farm is a dairy or livestock operation, 'We'll be able to make decisions about fertiliser use based on the economic outcome and not just guesswork,' says Doug Edmeades, AgKnowledge's managing director. 'It's impossible to do that without the mathematics.'

Dennis Normile

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