High flyer: kiwi researching aircraft design at MIT

Reprinted from:
AWIS newsletter
Issue 1, p.1-2
March 2003

AWIS member Karen Willcox, professor of Aeronautics and Astronautics at the prestigious U.S. university Massachusetts Institute of Technology (MIT), began her science training with a BE in Engineering Science at Auckland University. Karen has provided her profile for our AWIS in Schools project, and is making a big personal effort to increase the number of women in science and engineering. Karen has said that so far she's not having much success in her own lab at MIT! Liz Carpenter asked her a few questions .....

What does your current job involve?
My job as a professor is about 50% teaching and about 50% research. On the research side of things, I advise graduate students for their theses (currently I have four students) and I do some research myself. My research is basically all computational and based around aircraft design. I also have research collaboration work with Boeing and NASA. I teach both undergraduates and graduate students. I love teaching the undergraduates as I really feel like a teacher and a mentor. Although I work long hours and have to travel a lot, I love what I do. I don't really have a boss, no-one tells me what to work on. The only responsibility I have is to show up and teach class. What I do the rest of the time is completely up to me.

How did you come to be where you are today?
I first became interested in Engineering in my final year at school when two ex-students came to my school (St. Cuthberts) and talked about their careers as engineers. Until then I wasn't sure what I wanted to do - except that I'd always wanted to be an astronaut. During my BE degree my interest in planes and space engineering continued, but I wasn't sure what I wanted to do. So, I moved to the Massachusetts Institute of Technology MIT (Massachusetts, USA) and completed an MS and PhD in Aeronautics & Astronautics. For my PhD I modelled the interaction between the flow and the blades in the compressor of an aircraft engine. In between my Masters and PhD, I worked at NASA Dryden on computational modelling of flows on the nose cone of an F-18.

What research projects do you have with Boeing and NASA?
Once I completed my PhD I began working at Boeing on the Blended-Wing-Body (BWB) project doing optimisation design work. This research is continuing as collaborative work since I started as a professor at MIT in July 2001. We are looking at ways to integrate the technical (i.e. engineering) and financial aspects of the design. When an engineer is making a decision about how the wing should look, right now she thinks about aerodynamics, structures, controls, weight, mission requirements etc. We are trying to create a way for her to also be able to throw in cost, revenue and risk to help make the best decision. I have one student working on this project, plus I spend several weeks at Boeing in California each year.

Karen's office comes complete with model aeroplanes. This one is from Boeing's Blended-Wing-Body (BWB) project, one of her industry collaborations at MIT. Photo: Aaron D. Mihalik, The Tech, MIT

With NASA, I am involved in the Quiet Aircraft Technology programme. The aspect I am working on is trying to predict and reduce airframe noise. Even if an aircraft had silent engines, it would still make a lot of noise caused by the air rushing over it, especially on landing. We are trying to develop computational models to help us understand what causes airframe noise and to find quieter designs.

How do you feel about the relationship between industry and academia?
One of the things that really amazes me about MIT is the amount of interaction we have with industry. Some of it is

in the form of funding for research, like my relationship with Boeing, but there is also a lot more. We really think of industry as being our 'customer' for the students we turn out, and so we get a lot of industry input on our curriculum. For example, industry stress that they expect their engineers to not only have a good technical background, but also to have an understanding of teamwork and excellent communication skills. As a result, we try to explicitly teach these things in our undergraduate classes. We have lots of guest lectures and seminars from people in industry. We also try to help our students find summer jobs in industry. A lot of these things are enabled by a strong alumni network.

Will we ever see you back in NZ?
I would really like to return home one day. You never know what the future holds, but coming back to NZ is always something I have in mind. One of the wonderful things about an academic career is the flexibility it offers - I am spending one month at home over our summer, plus if I decide to come back, a job at a NZ university will be a good option for me.

Do you have any suggestions for how we can encourage young women to consider a career in engineering? Would you recommend it?
Engineering is a wonderful profession with many exciting opportunities. One of the things that I think is really neat is that almost anything you can think of has engineering involved. This gives you a way to combine your job with something you are really enthusiastic about, for example aircraft, sailing, cars, environment, ... the possibilities are endless! I always loved maths when I was at school. Engineering gives me a way to apply maths and science to real problems. The School of Engineering at Auckland has some wonderful liaison officers to help encourage more women. I think one of the keys to attracting more young women is to put them in touch with role models and let them see the exciting things other engineers are doing.