Global J. of Engng. Educ., Vol.5, No.1
Published in Australia

Problems and Solutions Associated with the Delivery of a Small Engineering Degree Programme

Paul Wilson
Yao Li
Christchurch Polytechnic Institute of Technology
Madras Street, Christchurch, New Zealand

Faced with changes in national qualifications, educational creep towards degree programmes, and difficulties in attracting students to diploma level programmes the Christchurch Polytechnic Institute of Technology recently developed and commenced delivery of a three-year Bachelor of Engineering Technology programme. This paper outlines some of the problems and solutions found in delivering a single undergraduate engineering degree programme in a predominantly vocational tertiary institute. The development and implementation of the programme is outlined, problems identified to date with delivery are summarised, solutions to some of these problems are discussed and one particular project is described in more detail. Future developments are identified and discussed. It is concluded that the progress in delivery and resolution of problems to date is satisfactory, and that ongoing or new problems will continue to be addressed.

INTRODUCTION

The engineering education continuum within New Zealand has traditionally had three levels of qualifications; trade qualifications, technician certificates and diplomas, and four-year professional engineering or, in some cases, technology degrees. Starting from 2001, the widely recognised and well-respected New Zealand Certificate in Engineering (NZCE) will be replaced by a new National Diploma in Engineering (NDE).

A qualitative review of these two-year qualifications shows that the new NDE will be less academically rigorous than the current NZCE. This reduction in academic content of the new technician qualification will only tend to exacerbate the existing gap in the engineering education continuum between the qualified technician and the professional engineer.

The Christchurch Polytechnic Institute of Technology (CPIT) is the largest polytechnic on the South Island of New Zealand and over the past five years has gradually introduced a number of degree level programmes. These programmes have been accredited by the New Zealand Qualifications Authority (NZQA) who are the approval authority for programmes offered by tertiary education institutes (with the exception of universities) within New Zealand.

It was recognised by the CPIT School of Electrotechnology staff that the looming gap in the engineering education continuum could be filled by a three-year engineering technologist qualification. The need for a three-year degree programme was further established by an increasing number of students looking to complete degree level engineering programmes who were not accepted into engineering programmes at Canterbury University due to their secondary school academic results.

This provided the stimulus for the development of the Bachelor of Engineering Technology (Electrotechnology), or BEngTech, programme [1]. This was formally accredited for delivery by NZQA in June 1999 for an intake of 40 students per year. The programme commenced with Year One being delivered for the first time in 2000, with Year Two commencing in 2001 and Year Three in 2002.

The establishment of a new engineering technology programme has and will continue to present some unique problems for the School, the Faculty, and the CPIT. It is, by any measure, a small programme of around 100 students within a faculty where the traditional focus has been on trade and technician level vocational training. It is the only engineering or technology degree out of only eight diverse undergraduate level degree programmes in an institute that has had little in the way of a high-level research history.

This paper outlines the development and implementation of the BEngTech, summarises some of the problems identified to date associated with the delivery of this programme within CPIT. The paper also describes how one of the solutions implemented has allowed multiple problem areas to be addressed.

DEVELOPMENT OF THE BENGTECH

Three major issues arose during the programme development process. These were:

- Industry needs.
- Content.
- Delivery.

Industry Requirements

Engineering technology degrees are much less common, certainly outside of North America, than professional engineering programmes. Great benefit was found during initial development in the American Society for Engineering Education (ASEE) Engineering Technology Councils (ETC) definitions of *engineering* and *engineering technology* [2]. Definitions of engineer and engineering technologist are also found in the United Kingdom in the SARTOR 3 documents and the Incorporated Engineer/Chartered Engineer definitions well described in Newton [3]. The fundamental difference in these definitions is that the education for an engineering technologist is of a more applied nature.

In order to confirm the type of work undertaken by an engineering technologist, the School of Electrotechnology spent some time holding discussions with various industry organisations in the Canterbury region – many of these organisations later supplied members for the Programme Advisory Committee. This work identified a number of particular generic requirements that were thought to exist to the required levels in the current professional engineering graduates who were primarily employed in the engineering technologist positions.

These five generic requirements are:

1. The ability to communicate effectively.
2. The ability to contribute to effective teamwork.
3. Basic management knowledge and skills.
4. Engineering ethics and professional issues.
5. The ability to apply their theoretical knowledge in an industrial context.

The ASEE education requirements for an engineering technologist and the SARTOR 3 requirements also correlated with industries' need for graduates with the abilities to apply their theoretical knowledge in an industrial context. All of the generic requirements issues were additionally validated by a British study on capability through engineering higher education [4].

The correlations emphasised the importance of ensuring that these industry generic requirements weregiven adequate coverage in the programme. Issues 1 to 4 have been incorporated into specific course objectives and learning outcomes. Issue 5 will be incorporated through the final year design project and, to a lesser extent, *mini-projects*, which are introduced in Year Two courses.

Each industry group also had a specific subset of engineering knowledge and skills that are essential for that particular area but which are typically of lesser importance to other industry groups in the electrical/electronic engineering field. This presented some problems in developing a programme where graduates need to be prepared to work in all of industry. This is discussed in more detail in the next section.

Content

Essential to a successful engineering technology programme are the foundation theories on which all further knowledge is built. These theories were already taught in the Diploma first year courses, albeit to a lower mathematical level and at a slower pace. The existing courses were modified in terms of depth and time allowed while additional courses in mathematics, basic management, and professional communications skills were developed.

By using existing courses from another degree programme for the management and communications subjects, albeit tailored for the engineering students through separate tutorials, the development of Year One content was reasonably straightforward. In addition to the foundation theories and industry needs, a number of professional skills that are essential for the modern engineering technologist were identified that need to be covered in the first year to allow them to be developed as the student progresses through the various courses on the programme. These professional skills are:

- The use of computers.
- Independent learning.
- Information retrieval.

- Problem-solving.
- Self-management.

Once again, many of these issues had been identified as being of importance in engineering education by other providers [5]. These have been incorporated into specific Year One courses such as Engineering Computer Applications with explicit course objectives and learning outcomes to be met.

Year Two and Three content is based around the concept of providing breadth in Year Two, then depth in Year Three. Engineering management is a common topic across both years while Year Two also includes engineering science and further engineering mathematics. The breadth component in Year Two is achieved through the coverage of the five major strands of electrical/electronics engineering. These are:

- Electrical engineering.
- Electronics engineering.
- Computer engineering.
- Communications.
- Control systems.

In Year Three, the students select two of the five strands where the specialist advanced technological concepts will be developed to produce a practical major for the degree. Year Three also provides for further development of the students' analytical and problem solving skills through the project and engineering management papers. However, the applied approach to engineering education raised some delivery issues that will be discussed in the next section.

Delivery

The major issues were those surrounding the delivery of a degree level engineering programme with a high level of applied content. Identified critical pedagogical issues were:

- Developing student skills and attributes that industries require.
- Assessment of applied content.
- Developing a holistic approach to teaching.
- Identifying strategies which promote deeper learning.

The programme development process has resulted in explicit course descriptors with clearly defined expected learning outcomes. These course descriptors clearly reflect the change in what will be taught in this degree. This is in addition to the fundamental knowledge that the learning outcomes cover, including those essential skills, abilities and attitudes identified through consultation with industry.

The change in content occurs from the very beginning of the programme and is clearly signalled in the induction programme run for new students in the week before the course commences. This change has required an appropriate balance between knowledge and applied skills to be established.

Traditional delivery and assessment methods did not match a significant proportion of this applied engineering programme. A major challenge was to identify teaching methods that allow the development of students abilities to think on their own, organise their work, take the initiative, solve problems, apply their knowledge and communicate effectively with their peers. Further, assessment procedures needed to go well beyond the traditional test/exam in order to gather reliable and valid data on student performance in the applied content areas as identified in the course descriptors.

A clear aim of the programme is to allow students to experience a learning and assessment environment that closely matches the real work context of engineering. This emphasis requires a holistic approach to teaching. It requires a focus on what deeper learning actually looks like and how that can be fostered in the applied engineering context. It required the development of assessment procedures that actually assist learners to develop and use applied skills and develop attitudes necessary for the workplace.

It is believed that the required teaching methods and assessment is being achieved through a higher coursework component in the summative assessment components for the courses, at least 50% in every course – and in some cases, particularly the applied skills courses, the course assessment is based solely on coursework, that is there is no formal final examination. Many of the courses, and in particular the engineering management courses, foster group work and require students to complete peer and self evaluations that are used to determine the final marks.

From day one in the laboratories, the students are expected to develop circuits using breadboard and components to foster applied hands-on skills. All students are supplied with a basic electronics tool-kit. During the Engineering Workshop course in Year One, the students are taught electronic construction skills that use printed circuit board design skills taught in Electrical Drawing.

The many years of accumulated expertise found in the School from delivering technician level programmes have been able to be directly applied to the BEngTech programme to ensure its applied focus. It is now apparent that the problem identification and solution implementation process used in delivering the BEngTech programme is also enabling the School to re-evaluate the delivery methods and assessment used in the Diploma level programmes that have led to some changes in these programmes.

ONGOING PROBLEMS

As of February 2001, Year One has been delivered for the first time in 2000 to an initial enrolment of 21 students from 33 applicants. Of the original 21 students, 16 have returned to commence Year Two in 2001 and a further four students have joined the 2000 cohort as direct entrants – either as diploma graduates or from various courses at Canterbury University. Twenty-four students have commenced Year One studies in 2001. In both cohorts, the mix of mature and ex-secondary school students is approximately 70%:30% respectively, with only a solitary female student enrolling each year – less than 5%.

The NZQA accreditation process includes assigning an external monitor for the first delivery cycle. A monitor visit is undertaken each year with a formal report being provided to both NZQA and the CPIT outlining any areas of concern. At the end of the first delivery cycle, this monitoring function is normally devolved to the CPIT.

The monitors visit in 2000 noted that, in general, the BEngTech programme is delivering the programme and outcomes as set out in the accreditation documentation. There are, however, some areas of concern for the NZQA monitor that correspond to ongoing problems for the CPIT programme. These are: staffing, student recruitment (particularly female students) and research.

Staffing

CPIT has determined that the Faculty, and therefore the School, must contribute 38% of income to cover overheads (which does not include IT charges) and development funds. The result of this requirement is that the Faculty must average a minimum ratio 15:1 EFTS (Equivalent Full Time Student) per staff member. The School of Electrotechnology has a budget of 308 EFTS that is split across trade courses (75 EFTS), Diploma in Computer Networking (65 EFTS), Certificate/Diploma in Electrotechnology (128 EFTS), and the BEngTech (40 EFTS).

However, other schools within the Faculty are often unable to meet the expected ratio due to occupational safety concerns and it is expected within the Faculty management that the School of Electrotechnology's ratio will better 1:15 wherever possible. Of the current 19 full-time staff members in the School, 11 teach on both trade and diploma courses while six teach on both diploma and degree courses. Two staff members teach on all courses – predominantly in the applied skills areas.

Part of the NZQA accreditation requirements are that staff teaching on the degree programme should have as a minimum a BE degree and preferably postgraduate qualifications. Two staff members have been appointed since 1999 to teach on the BEngTech, both of whom have postgraduate qualifications and are on research conditions. Another staff member is expected to be appointed to the BEngTech programme in late 2001. Other staff members are updating qualifications through undergraduate and postgraduate study and industry-based courses for specific areas of need – in particular the CISCO programmes to meet the burgeoning need for computer networking expertise and training.

Various contracts are in place for workloads for teaching staff within CPIT and in general staff not teaching on degrees have a maximum of 825 contact hours per annum while staff teaching on degrees, and on research conditions, have a maximum of 480 contact hours per annum. NZQA accreditation also requires that *the majority of staff teaching mainly on degrees shall be on research conditions*.

Through careful staff management and timetabling, the School at present manages to meet all of its various obligations. By averaging the total EFTS, a School staff student ratio of 1:16.2 is budgeted for 2001. With 44 EFTS enrolled in the BEngTech in 2001, the School is entitled to 2.93 equivalent full-time tutors (EFT). With three staff on research conditions, the School is therefore also maintaining NZQA degree staff requirements.

Retiring staff members have been offered *Research Affiliate* positions. The Research Affiliate is provided with resources by way of those expected for a full staff member, that is library, computer, and laboratory access, office space and such like but is not remunerated in any financial sense. The only obligation on the part of the Research Affiliate is to acknowledge the CPIT by way of association in any research outputs. This is expected to provide a small but valuable contribution to research outputs as noted in a later section.

Student Recruitment

CPIT has recently embarked on a deliberate policy of centralised *brand* advertising that has had a significant impact on funding availability for targeted advertising for specific programmes. This has been considered given the reported global decline in enrolments in engineering and technology courses [3][6]. A further aggravating factor is that New Zealand is currently in a demographic trough with respect to school leavers from Year 13, it has presented some difficulties for recruiting to the expected numbers. However, 2001 enrolments in Year 9 at secondary school are at record levels with all schools in the greater CPIT catchment area reporting increases of 10-25% over 2000. Unfortunately, this influx of students will not be ready for entry to degree courses for another four years.

Deliberate strategies employed by the School of Electrotechnology are centred on accessing technology streams at Year 12 and 13 in the secondary schools. This involves visits, information evenings, teacher training, and offering electronics courses for secondary school students at the CPIT to take advantage of the better facilities for electronics training in comparison to that available in the schools. A direct correlation can be made between these activities and the following year enrolments in 1998, 1999 and 2000.

In an effort to increase female student numbers in the School's programmes it is intended that two female staff members from the School will be making visits to female only schools within the Christchurch area during 2001.

The School is also currently working with the Department of Electrical & Electronic Engineering at the University of Canterbury in the development of a national camp for electronics students to be run annually. Industry funding has been made available and planning is in progress for the first camp, based on a robotics theme, to be held in July 2001. It is hoped that this type of combined activity will increase participation in education for a career in the electrotechnology field in Christchurch as a whole.

Research

Research was identified as a potential area for problems at the time of accreditation and continues to be an ongoing area of concern to the NZQA appointed monitor. NZQA provides definitions for categories of research [7]. These, in outline, are:

- Basic or fundamental: research undertaken to acquire new knowledge without any particular application in mind.
- Strategic: research to generate new knowledge in an area that has not advanced sufficiently yet to enable specific applications to be identified.
- Applied: research that tests or develops existing knowledge and is primarily directed towards specific practical objectives.
- Scholarship: research that is intended to expand the boundaries of knowledge.
- Creative: work that includes the invention and creation of new ideas, hypotheses, images, performances or artefacts.

Activities, which may be equivalent to research if they meet one or more of the definitions above, include:

- Consultancy.
- Professional practice.

The School of Electrotechnology intends to focus on the definitions of applied research, consultancy and professional practice.

The BEngTech programme is run within the Faculty of Applied Technology, which had no history of published applied high-level research that would meet any of these quite stringent criteria. At the time of the NZQA accreditation, it was noted that some research had been conducted but had never been published. To date, the following solutions in the research area have been, or are being, implemented.

A position of Research Leader for the BEngTech has been created and an appointment made, a Faculty Research Committee has been established, and a research plan for the School is currently being developed. There is currently one Research Affiliate where a recently retired staff member with an extensive industrial research background, and an existing external research grant, has accepted the position to develop a new product for the market.

Two conference papers have been presented that report on the research that had been undertaken up to the time of the NZQA accreditation in 1999 [8][9]. The development process of the BEngTech has also been presented as a conference paper [1]. Ongoing staff research being undertaken as part of postgraduate studies is also being published [10][11]. This will result in a small but growing number of acceptable research publications, albeit to date they are all primarily in the engineering education area – one in which the School has significant accumulated experience.

Unlike larger tertiary education institutions it is unlikely that there will ever be postgraduate research-based programmes offered within the School or Faculty. This will present additional problems for research activity as this implies that there will not be any postgraduate students conducting research under the direction of staff. To obviate this significant lack of potential research resource, it is intended to maximise the use of the BEngTech Year Three design projects, where possible and appropriate, to build research activity.

The School is currently in the process of undertaking a *capabilities* and *resources* stocktake to better enable the development of a long-term research plan. The principal areas found have been in the embedded microprocessor areas with several research possibilities already presenting themselves. An ongoing problem in terms of resources will be funding and a concerted effort is being made to establish working linkages with industry to improve access to external research funding. An example of the type of activity proposed is outlined below.

PARTOS-11

For some time, courses have been run on the diploma programmes on micro-processor, embedded, and real-time systems using the School's own 68HC11 training system. The 68HC11 kits have a number of expansion modules including displays, stepper motors, strain gauges, and a multipurpose module with a hexadecimal keypad, analogue and digital input/output, and breadboard for additional student development.

The real-time programming courses have been problematic. Anecdotal evidence shows that many of the students find the learning curve for Linux as, in some cases, more difficult than the real-time programming concepts that are the actual learning outcomes of this course. As similar learning outcomes were required for the computer engineering strand of the BEngTech a solution was sought which would also provide research outputs.

This project has been centred on the development of an efficient real-time operating system (RTOS) for the 68HC11. A RTOS is a system program that provides an interface between the computer hardware and application programs. These application programs usually have a number of distinct processes or task that should run concurrently. The central purpose of the RTOS is the scheduling of the computers' central processing unit (CPU) between these tasks.

The tasks to be scheduled are defined as *periodic*, or hard real-time tasks that have strict timing constraints, and *aperiodic* or soft real-time tasks that have no strict timing constraints. Missing a deadline for a hard real-time task means the system has failed. Many different scheduling algorithms exist and have been detailed elsewhere and have been implemented in commercial and academic RTOS [12].

One problem with these commercial and academic RTOS is that, in general, the RTOS will only implement scheduling for either periodic or aperiodic tasks, or it will implement sophisticated servers for both tasks. The development of the School's Periodic and Aperiodic RTOS for 68HC11 (PARTOS-11) has provided an ideal teaching platform. The advantages of PARTOS-11 for educational use over existing documented RTOS for the 68HC11 are twofold in that:

- The student can easily compare different RTOS scheduling algorithms using a single system.
- PARTOS-11 is small and therefore easy to learn but provides functionality comparable with other RTOS.

The hardware system used to develop PARTOS-11 is a 68HC11A1 in the expanded mode. Because of the small size (only 2.5 kBytes) of PARTOS-11 it can be used by most of the 68HC11 families in the single chip mode. The 68HC11 is a multi-purpose micro-controller that is widely used within the electronics industry in the Christchurch area.

A simple simulation application using CPIT 68HC11 kit modules has been implemented for use with PARTOS-11 that has three hard real-time and three soft real-time tasks. Any of the task parameters can be simply adjusted which allows the students to observe the effects of increasing loads on the performance of the RTOS. The C programming language was used both for development of PARTOS-11 and the simulation application.

The work on PARTOS-11 will provide multiple research output opportunities in the following areas:

- The pure research into a new and potentially more efficient RTOS for widely used micro-controllers.
- Applied research as the PARTOS-11 system will be used in the ongoing development of a sports monitoring system for use within the rugby environment. This project is being undertaken in partnership with an industry sponsor.
- Educational research into the learning benefits of the proposed simpler system for student learning as opposed to more complex commercial or academic systems. This will be achieved through surveys of students over successive courses during the next two years using the old and new teaching methods and systems.

In future work, PARTOS-11 will be applied to develop various embedded systems projects for further student learning opportunities. The current model will be extended in more powerful microprocessors and also applied in networked embedded applications. It is considered that all of these areas will provide many opportunities for research activities that will further advance the School's reputation.

The Renewable Energy Research Laboratory

The School was also fortunate in being able to offer a position, in a similar form to the Research Affiliate, to a recent immigrant with an extensive research and publishing history in the field of renewable energy, in particular photo-voltaics. Dr Fouad Abdalla wanted to develop a research laboratory in this field and after some debate the Faculty has established the CPIT Renewable Energy Research Laboratory (RERL) under his leadership.

This facility is expected to be completely self-funding and is currently only provided with resources to the level associated with a Research Affiliate. In its first twelve months of operation, the RERL, in conjunction with tenured staff input, has submitted funding applications for two large research projects and is in the process of working with a commercial partner in another research activity. It is expected that the RERL will eventually be able to provide ongoing research activities and outputs at the required levels.

USE OF TECHNOLOGY

As with most tertiary institutes there is a drive from management towards e-education (or e-learning or Web-based delivery or any of the other fashionable terms) on an apparent cost savings basis. The School has had some history of e-education in that it is has, for a number of years, offered a course in electronics for secondary school teachers. During this period, the demands of the e-learning environment exceeded the capability of the developing IT structures. This has lead to some staff holding the view that the CPIT centralised IT structure is restrictive and expensive. The current focus on e-education services is endeavouring to ensure support structures that better serve this new focus.

As a result, the School has taken a conscious decision to review the use of computers in education to develop a strategy to ensure the effective use of computers in supporting student learning [9]. This is as opposed to implementing systems with the expectation of some nebulous financial benefit. It is expected that this strategy will have the added benefit of leading to the development of expertise and research outputs in the field of engineering education as noted in the section above on the PARTOS-11 system.

Computers are currently used in the following forms:

- Engineering problem solvers through extensive use of MathCAD and Electronics Workbench for simulation. All BEngTech students are trained in the use of these packages in Year One and are expected (with assessment activities designed to force them) to utilise them throughout their studies.
- Educational tools through ongoing development of computer learning systems.
- Presentation tools through the production of lecture notes, PowerPoint presentations, laboratory demonstrations and the like. Again there is ongoing development in this area.
- Embedded systems through interfacing to many low cost microprocessor systems. The School has its 68HC11 based development system that has been incrementally developed over the last decade and has also recently been gifted a number of Mitsubishi M-16C micro-controller development kits.
- Information sources through access to on-line data books covering the full range of electronic products and requirements for students to access the WWW to complete assignments. All students are provided with access to the Internet and e-mail.

Computer use is emphasised through the requirement to produce integrated assignments. An example is to perform a circuit simulation then build and test the actual circuit and then critique the two sets of results.

As the previous education activities have been predominantly hands-on vocational training there is little history of computer use at the higher theory and practical levels. With the increased academic requirements of the BEngTech degree programme there are huge opportunities to develop a fully integrated educational environment that will closely resemble the modern industrial workplace. An example of this is the PARTOS system described earlier.

One ongoing area of concern is the large capital cost associated provision of hardware and with maintaining licences for software tools and packages as found in industry. The School is fortunate in having a good relationship with a number of suppliers and is able to get better than educational rates in many instances.

FUTURE DEVELOPMENTS

There are two significant future developments in store for the BEngTech programme.

Additional Courses

At present the programme is based solely on an electrical/electronics engineering focus. The CPIT School of Engineering, co-located in the Faculty of Applied Technology, is currently progressing plans for a mechanical engineering technology degree programme. It is expected that this will evolve around the existing programme structure with the addition of optional courses in all years. These are likely to include courses in mechatronics, production engineering, and manufacturing engineering. A number of existing courses may need small changes to make them more suitable for shared courses across the two engineering disciplines.

Industry has also indicated that an increase in content for both programming and data communications is required. At present, there appears to be little student demand for control systems engineering courses and as a result of these factors Year Three optional courses in Software Engineering, Digital Communications, and Computer Networking are being considered. It is hoped that the addition of these course will further increase student demand for the BEngTech.

Sydney Accord

The development and implementation of the CPIT BEngTech has occurred almost in parallel with the development by international engineering bodies of an international accord for engineering technology qualifications. This accord, to be known as the Sydney Accord, is at final draft stage and is similar in aim to the Washington Accord for professional engineering programmes but applies to three-year technologist programmes.

It is expected that the signatories will complete the process in June 2001 at a meeting in South Africa. Accreditation visits to ensure programmes meet the requirements of the Sydney Accord will commence in 2001 in New Zealand. It is anticipated that CPIT will receive provisional accreditation in April 2001 from IPENZ.

CONCLUSIONS

The CPIT has successfully developed and started delivery of a small engineering technology degree programme within the School of Electrotechnology. A number of problems have, and will continue to, arise that are associated with this programme.

To date, solutions for these problems have been found and implemented through careful and systematic analysis of requirements. A major problem area that will require ongoing attention is that of research activities to support the delivery of the BEngTech. It is believed that the current solutions for the research area will need to be continually refined to ensure optimal use of the very limited resources available.

A successful accreditation to the Sydney Accord will vindicate the development, content and delivery process undertaken by the CPIT School of Electrotechnology. It will also demonstrate that a small engineering degree programme is possible provided due care is exercised in the implementation and delivery within a larger umbrella of albeit lower-level tertiary engineering education programmes.

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BIOGRAPHIES

Paul Wilson received his BE(E&E) (Hons) degree from the University of Auckland in 1992 whilst serving as an electronics engineer with the Royal New Zealand Navy. He entered the world of academia in 1993 when he accepted a position with the Auckland University of Technology (AUT), where he was a team member of the development team for the AUT BE programme. In 1998, he accepted the position of Academic Leader for the BEngTech programme at Christchurch Polytechnic Institute of Technology (CPIT), where he led the development and implementation of this sole engineering degree within CPIT. He has been Acting Head of School of Electrotechnology since November 2000.

His research interests are engineering education and engineering education technology, computer engineering and robotics. He is a member of the IPENZ and a registered engineer.

Yao Li received his BS, MS and PhD degrees in electronics from Zhongshan (Sun Yat-sen) University, China, in 1981, 1984, and 1991 respectively. He was an associate professor of Zhongshan University in 1994 and a visiting scholar to Griffith University, Australia, from 1994 to 1996. After working with Temasek Polytechnic in Singapore for three years, he joined Christchurch Polytechnic Institute of Technology in 1999.

His research interests include sub-millimeter waves, far infrared, ohmic contacts of semiconductors, computation of electromagnetic fields, parallel computation, and real-time embedded computer systems. He is a member of the IEEE and the IEEE Computer Society.