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The Quality Assurance of Engineering Programmes at the University of South Australia*

Kevin J. McDermott
Andrew Nafalski
Özdemir Göl
University of South Australia, Mawson Lakes Blvd, Mawson Lakes, Adelaide, SA 5095, Australia

Just as manufacturing has turned to Quality Assurance (QA) as the path to economic survival, so too have universities. This development has been fuelled by internal corporate values and the dictates of government and professional regulators. In the article, the authors sketch the birth and development of the quality movement and examine some of the drivers and implications for university schools of engineering. The particular approach being taken within the engineering schools at the University of South Australia, Adelaide, Australia, is described as an example. It is argued that contemporary QA emphasises replicability and traceability, rather than conventional English language concepts of quality, and that often critically important surveys of consumer needs have been mismanaged and/or misdirected. As a consequence, universities, among other organisations, have developed QA regimes that attempt closer and closer control of *production* in order to satisfy the needs of a diminishing pool of existing clients.

INTRODUCTION

The contribution of W. Edwards Deming to revolutionising Japanese manufacturing is the stuff of legend. Largely ignored in his home country at the time, his method was adopted enthusiastically at every level of post-war Japanese industry. As a direct result, traditional volume manufacturers in the West have struggled to retain markets in the face of a flood of quality products of proven reliability and attractiveness to customers. Belatedly, and piecemeal, western manufacturers have embraced Quality Assurance (QA) as the path of survival. But in doing so, they have treated as irrelevant or contravened many of Deming's Fourteen Points, which he insisted must be implemented as aspects of an indivisible method [1].

Deming's Fourteen Points can be paraphrased as follows:

1. Create constancy of purpose: improve to survive.
2. Adopt the new economic philosophy.
3. Cease dependence on inspection.
4. Do not award business by the price tag.
5. Forever improve production to decrease costs.
6. Institute training on the job.
7. Replace supervision by leadership and help.
8. Drive out fear so everyone can work effectively.
9. Break down barriers between departments.
10. Eliminate slogans, exhortations and targets.
11. Substitute leadership for numerical goals.
12. Remove barriers that rob workers and leaders of their right to pride of workmanship.
13. Institute a vigorous programme of education and self-improvement.
14. Put everyone in the company to work to accomplish the transformation.

Considerable impetus was gained when the International Organization for Standardization published the ISO 9000 series of quality standards (9001, 9002 and 9003) in 1994. These were formulated in such a way that they could be applied to organisations other than producers, though the terminology used made the application rough going.

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These standards provided a benchmark against which independent quality audits could be made, leading to certification as a quality registered entity. This had, and continues to have, significant ramifications on competitiveness in an oversupplied market. Most registered organisations report benefits in productivity and safety, as well as enhanced reputation [2].

All this may seem far removed from the traditional view of universities as ivy-clad, detached centres of unfettered scholarship. However, the reality is that universities, too, are competing for students, funding and sponsorship in an oversupplied market. Financial stringency has fuelled a revolution in which corporate values have replaced the old goals of collegiality and scholarship. Reputations for quality (to boost income) and productivity (to cut costs) are seen as the new keys to success for corporatised institutions.

DEFINING QUALITY

In common English usage, *quality* has a meaning well exemplified by the pre-mass production Rolls Royce motor vehicle, each one hand-crafted and individual, yet mechanically quiet with long term reliability, aesthetically pleasing, durable, with impeccable panel fit, luxurious interior and smooth finish (see Figure 1). One author has vivid memories of 1960s' US advertising campaigns, in which the name Rolls Royce was used as a quality benchmark. The most (unconsciously) ironic of these was the 1969 puff *Cadillac – the Rolls Royce of Automobiles!*

Quality may seem to imply goodness or merit but, in practice, the concept has been transmogrified into *replicability*. A typical contemporary definition of a Quality Management System (QMS) is the following:

> *The purpose of a QMS is to minimize the variability in the quality of an organization's products and services. The optimal QMS balances the need for an organization to maintain flexibility in the products and services it provides with the need for providing the appropriate level of discipline and control over the processes used to provide them. The goal of a QMS is to ensure the quality of the products and services consistently (through minimizing quality variability) meet or exceed customer expectations* [3].

Figure 1: Rolls Royce – a synonym for *quality*.

Most QA regimes have this character, including those (where they exist) in universities. It has only been with the advent of the revised standard ISO 9001 2000 that any formal mandate that improvement in quality should actually take place has emerged. This new standard replaced the set of ISO 9000 1994 standards on 15 December 2003. Table 1 lists a brief comparison of the two standards.

In many ways, the new standard is easier to work with, especially for non-manufacturing organisations, but its revamped five-element structure will cause headaches for entities whose QA regimes are written around the 20 elements of the 1994 Standard [4].

NATIONAL QUALITY IMPERATIVES

In Australia, successive Labor (social democrat) and Liberal (conservative) Federal Governments have pursued a path of economic rationalism. This has included a conscious process of corporatising public institutions, including universities, and decreasing public funding. At the same time, the corporatised institutions are subject to intense government direction. The government's national approach to university quality is typically draconian and multifaceted. The principal elements are detailed below.

Australian Qualifications Framework

To operate as a university or use the title *university*, an organisation must have the Commonwealth Minister's approval or be listed as self-accrediting on the register of the Australian Qualifications Framework (AQF).

Table 1: A comparison of the two ISO standards.

ISO 9000 series (1994)	ISO 9001 2000 (Supersedes 1994 standards from 15/12/03)
3 standards (9001, 9002, 9003)	Single standard
20 elements	5 elements Generic
Manufacturing orientation	Requirement for actual improvement

Australian Universities Quality Agency

The Australian Universities Quality Agency (AUQA) audits Australian universities' quality assurance arrangements on a five-yearly cycle, and also audits State and Territory higher education accreditation processes. Institutions are required to address any negative aspects of audit reports, or face the possibility of funding sanctions.

AUQA fulfils an analogous role to the independent auditing agency in the ISO 9000 regime, and notionally universities so audited could seek ISO 9000 registration. In fact, as far as the authors are aware, no Australian university has sought to register its QA process to this standard [5].

Graduate Skills Assessment

The Australian Council for Educational Research (ACER) has been developing the Graduate Skills Assessment (GSA) test of students' generic skills at university entry and upon graduation since 1999. The Commonwealth has been supporting the GSA project because it believes that the GSA will provide *an objective outcome indicator that can be applied across the sector to give some measure of the quality of the higher education experience* [6].

ACER has been undertaking studies to examine the validity of the GSA instrument, particularly any correlation between performance on the GSA test and factors such as university admission scores.

Australian Universities Teaching Committee

The strategic focus of the Australian Universities Teaching Committee (AUTC) is mainly on large collaborative projects that will enhance teaching and learning across the sector. There are currently nine such projects commissioned. The AUTC also supports a visiting scholar programme and the National Teaching Forum, and administers the Australian Awards for University Teaching (AAUT) to reward and publicise excellence in teaching. For example, in 2002, the University of South Australia (UniSA), Adelaide, Australia, was one of four recipients of institutional awards for its Learning Connection programme's approach to the provision of support services assisting student learning (AUD50k).

Course Experience Questionnaire (CEQ)

All graduates of Australian universities receive a uniform questionnaire in the first quarter after graduation that seeks to assess their perception of teaching quality at their host university. The processed results are made public and used widely for inter-institutional comparisons, ultimately affecting the ranking of universities. This has far-reaching consequences in university funding and demand for university places.

Graduate Destination Survey (GDS)

The Federal Government has been using a carrot-and-stick approach to fulfil its objectives for the higher education sector, while appearing to respect the integrity of universities and to honour the Constitution, which reserves education as a prerogative of the states. The reliance of universities on federal funds and internal competition between management, divisions and schools for those funds has led to a chronic state of dependency, vulnerability and prejudiced scholastic outcomes. The effects on engineering schools are illustrated in Figure 2.

The following partial extract from the Federal Minister for Education's 2003 policy paper is pregnant with promises of funding for conformance and threats for non-compliance and dogmatic in its demands.

> *A Learning and Teaching Performance Fund of $54.7 million in 2006, increasing to $83.8 million in 2007 will be established to reward those institutions that best demonstrate excellence in learning and teaching … In the first stage, institutions will be required to demonstrate a strong strategic commitment to learning and teaching. Institutions must have a current institutional learning and teaching plan or strategy. Evidence of systematic support for professional development in learning and teaching for sessional and full-time academic staff must be provided. Evidence*

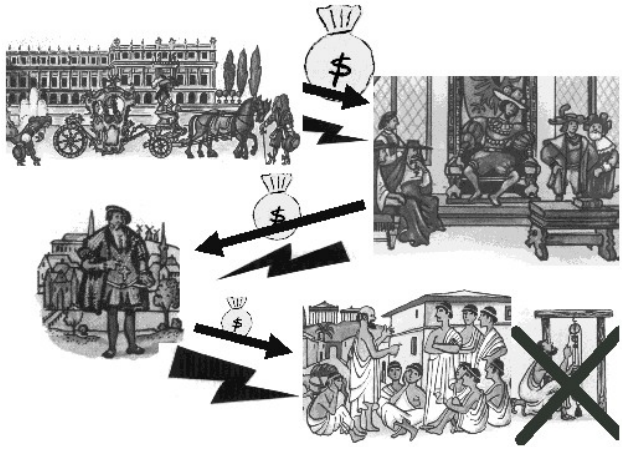

Figure 2: Dependency and vulnerability in higher education.

must be provided of probation and promotion practices and policies that include effectiveness as a teacher as a criterion for those academics with a teaching load are in place. There should also be systematic student evaluation of teaching and subjects that informs probation and promotion decisions for academic positions where the academic has a teaching load or expectation of a teaching load. These strategies, practices, policies and student evaluation results would be made publicly available on an institution's website. Once eligibility for funds is established through the first stage, institutional performance in learning and teaching will be assessed using a range of indicators, including student progress and graduate employment outcomes. These indicators will be developed in negotiation with the sector [7].

QUALITY IMPERATIVES FROM THE PROFESSION

The Institution of Engineers, Australia, (IEAust) accredits engineering degrees in Australia. Its current manual for conducting the accreditation process reflects a change from an inspection model to one in which the primary focus is on an institution's QA procedures and practices. The inspection model is still available for those institutions adjudged not to have a fully documented QA regime in place, but this can only be regarded as an interim measure. This requirement of the prime professional regulator increases the pressure on engineering schools to embrace the prevailing forms of QA [8].

UNISA DIVISIONAL PROCESS FOR MANAGING INFORMATION ABOUT PROGRAMME QUALITY

The UniSA's Division of Information Technology (ITEE), which embraces the engineering schools, has recently introduced a requirement for two kinds of reviews of programmes, to be conducted on a regular cycle.

Teaching Review

The teaching review focuses on student evaluation of teaching and employs two instruments (see Figures 3 and 4). All ITEE schools utilise the University's Course Evaluation Instrument (CEI) for student evaluation of courses, as well as the Student Evaluation of Teaching instrument (SET), which concentrates on teacher's performance. The Divisional Dean of Teaching and Learning, in conjunction with programme directors who, together with the Head of School, constitute a School's Teaching and Learning Committee (STALC), prepare two reports of the data collected. The first of these is a general summary of the data for courses in the programmes being evaluated within a school. This report is discussed with the STALC and, as a result, an Annual Programme Report (APR) is generated. If programmes are perceived to fall below a specified performance standard (fourth quartile), the documentation needs to be much more comprehensive, addressing remedial measures and quality improvement outcomes that are scrutinised rigorously.

The second, more specific, report is prepared for the Head of School as a basis for individual discussion with teaching staff. The Head of School is required to develop action plans in conjunction with individual teaching staff as part of the staff performance management process, and submit these to the Dean. A part of this process will be an ongoing monitoring plan.

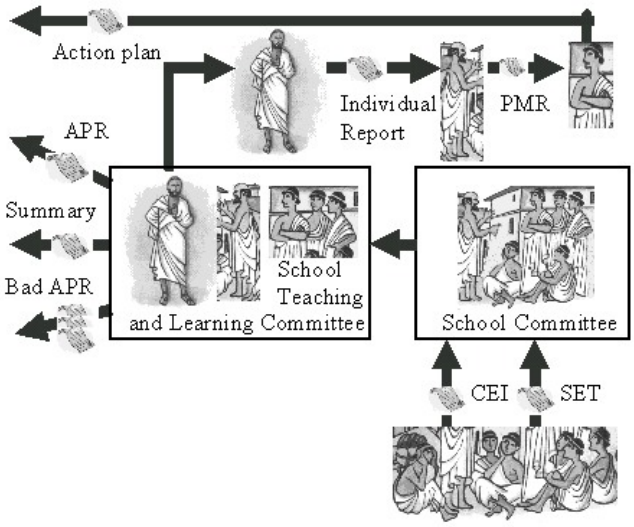

Figure 3: Teaching review at the UniSA (1)

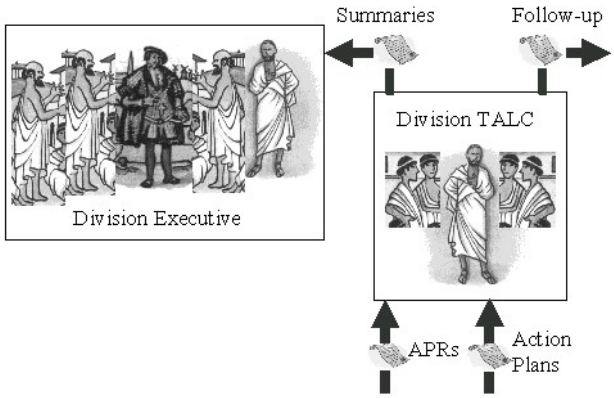

Figure 4: Teaching review at the UniSA (2)

The Dean provides a summary of the data collected and the action plans, and presents this to the Divisional Executive. A more general report is submitted to the Divisional Teaching and Learning Committee (TALC) for analysis. The Head of School is required to provide an update each semester to the Dean on the progress of the agreed action plan. The Dean reports to the Pro-Vice Chancellor (PVC) in charge of the Division regularly as a part of performance management reviews.

All UniSA academic programmes are scrutinised on a five-yearly programme review cycle to establish their viability on both the design and delivery levels. Detailed documentation must be produced focusing on quality maintenance and improvement measures and, in addition to internal processes, an external examiner is engaged [9].

Curriculum Implementation Review

The curriculum review focuses on assessment and teaching and learning practices (see Figure 5). Mapping tools have been developed in alignment with the University's teaching and learning framework. Once collected, the curriculum review data traverses an identical process to the data on teaching. It is envisaged that the data from both reviews will eventually be collected and collated simultaneously to avoid excessive reporting requirements.

Other Data

The annual review pro-forma currently being developed by the University's PVC for access and learning support requires the incorporation of a broader range of annual programme review data. So as to meet this requirement, the Dean will incorporate data from other sources, such as employment outcomes, equity data, progression and success rates into the teaching review documentation. The Dean will work with programme directors and Heads of School to identify critical issues identified from this wider range of indicators. Schools will be required to report on progress on these critical issues as a part of the regular School review process each year.

WHO ARE OUR CUSTOMERS?

The Federal Minister's assertion that quality of institutions is linked to their having student evaluation of teaching as a central plank in promotion decisions and the public dissemination of student evaluation results, and the central, indeed exclusive, student evaluation of teaching as the UniSA's measure of teaching effectiveness ignore any controversy on whether present students are, or can be, good judges of effective teaching.

A pilot study by one of the authors, not proceeded with, indicates that the opinions of present students are distinguishable and coherent across groups, but differ substantially from those of graduates and peers [10]. There might also be a different view by employers who are on record as requiring skills that are regarded as irrelevant by many students [11]. One of the most trenchant criticisms of the actual practice of QA in any institution is that frequently customer surveys are directed at the wrong group.

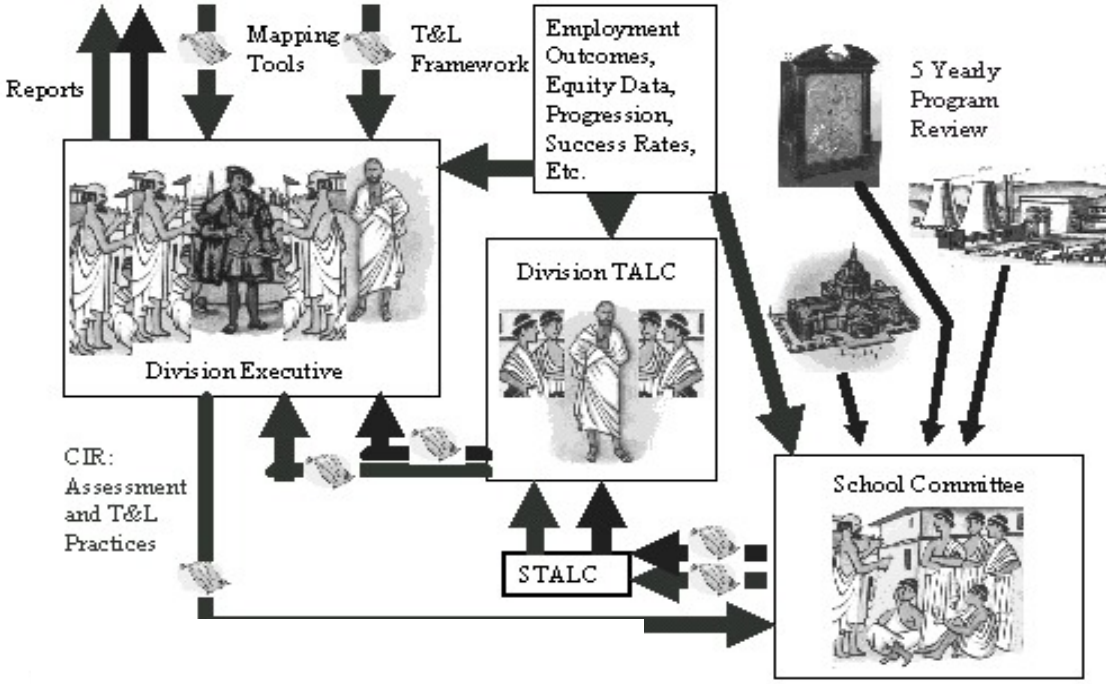

Figure 5: Curriculum review at the UniSA.

THE MECHANISATION OF TEACHING

There are benefits to be obtained from a well-designed suite of computer-aided learning tools. However, in a production model of the teaching and learning process, it is inevitable that management will favour the development and deployment of mechanised teaching methods for other reasons: reducing production costs and enhancing repeatability and, therefore, objectively measured quality (see Figure 6 for an illustration of the comparison).

This is only possible because of a view commonly held by administrators and students that the role of universities is to equip their graduates with the least possible range of known facts and skills to allow certification without actually blushing.

In the academic tradition, human teachers have provided role models and some connection to the fact that the practice and development of the professions have been, and will presumably continue to be, performed by human beings, at the instigation of human beings, and in response to perceptions of the needs and wants of human beings.

UniSA's forward planning envisages an increase in general (non-academic) staff to manage the delivery of mechanised teaching products, but no increase in academic staff to develop them [12]. This is, perhaps, an inevitable response to the QA framework within which the University is required to operate.

DEMING LARGELY IGNORED

It seems that for many producers, and this includes universities and government regulators who see education as a production process rather than the cultivation of excellence in learning and graduate sophistication, Quality Assurance is seen as conformity as evidenced by paper edicts, charting and statistical analysis. It is rare to see the *softer* parts of a production or educative process promoted or evaluated in the quality effort. But the Deming Method is, in fact, heavily weighted towards the *softer* functions in an organisation, and Deming himself was emphatic that the Method was not divisible [13].

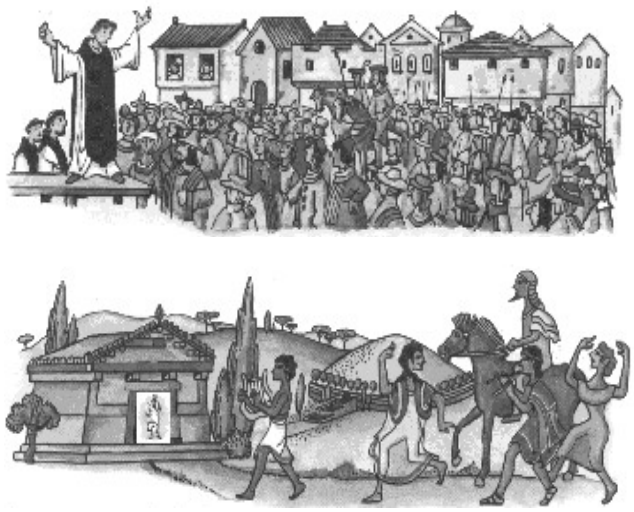

Figure 6: Quality teaching versus populist teaching.

Of Deming's Fourteen Points, seven are very much employee relations oriented, namely:

6. Institute training.
7. Institute leadership.
8. Drive out fear.
9. Break down barriers between staff areas.
10. Eliminate slogans, exhortations and targets for the workforce.
12. Remove barriers to pride of workmanship.
13. Institute a vigorous programme of education and retraining.

Deming's so-called Seven Deadly Diseases can be paraphrased as follows:

1. Lack of constancy of purpose.
2. Short-term thinking.
3. Personal performance reviews.
4. Mobility of management.
5. Management only by visible figures.
6. Excessive medical costs.
7. Excessive liability costs.

Of Deming's *Seven Deadly Diseases*, three involve employee relations, specifically points 3, 4 and 6.

It is a juggling act for universities to try to implement Deming's edicts in the contemporary environment of corporatisation and globalisation. In the case of the UniSA, senior management is clearly seen as embracing many of Deming's postulates for effective corporate management, although others are seemingly ignored or contravened. This is almost inevitable given the present QA culture, but should be vigorously challenged. If universities cannot apply rigorous thinking to sociologically and economically vital issues such as this, then who can?

CONCLUSION

There is widespread evidence that quality is a marketable commodity, and this has relevance to contemporary universities. However, the QA regimes common in universities have more to do with control than improvement and may, through

excessive overheads, prove more of a hindrance than a help in achieving what is commonly understood by the term *quality*.

Perhaps a thoughtful re-reading of Deming's seminal work on the management method might lead to a redirection of energies to ensuring that the right customers are surveyed, that change is only incorporated for the sake of improvement, and that obstacles to the achievement of academic goals are removed.

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BIOGRAPHIES

Kevin McDermott is a graduate of Adelaide University, Kettering University and the University of Southern Queensland. He is a Fellow of the Institution of Electrical Engineers, the Institution of Manufacturing Engineers and the Institution of Engineers, Australia. He worked in the electronics, telecommunications and automotive industries before being allured to academic life in 1973. Among other positions, he was Chair of the Curriculum Committee of the South Australian Institute of Technology from 1988 to 1990. In 1996, he resigned from his position as Head of the Engineering Discipline and Deputy Campus Director of the Whyalla Campus of the University of South Australia.

He is currently a company director, an education and engineering consultant, an arbitrator and mediator, and an Adjunct Associate Professor in the School of Electrical and Information Engineering at the University of South Australia, Adelaide, Australia.

His major research interests are in electrical machines and drives, and the education and formation of professional engineers. Most of his publications are in the area of engineering and university education. Active in professional society affairs, he is an International Membership Advisor of the Institution of Electrical Engineers.

Andrew Nafalski's career spans over 30 years in academic and research institutions in Poland, Austria, the United Kingdom, Germany, Japan and Australia. He holds BEng(Hons), MEng, GradDipEd, PhD and DSc degrees. He is a Chartered Professional Engineer and Fellow of the Institution of Engineers, Australia, Fellow of the Institution of Electrical Engineers (UK) and Senior Member of the Institute of Electrical and Electronic Engineers (USA). He is currently a Professor and Head of School of Electrical and Information Engineering at the University of South Australia in Adelaide, Australia.

His major research interests include: computer-aided analysis and design of electromagnetic devices, electromagnetic compatibility, low frequency noise, applications of modern magnetic materials and electromagnetic technologies, computer-aided testing of magnetic materials and magnetic measurements, and innovative methods in engineering education. His teaching areas cover: fundamental electrical engineering, network theory, electrical design, electromagnetic compatibility, information technology and programming techniques, numerical methods in electrical engineering and electromagnetic energy conversion. He has published some 170 articles, books, textbooks and software sets in these fields.

Özdemir Göl has had extensive experience as an engineering educator in addition to his substantial industrial experience. His academic career has included appointments in electrical engineering at universities in Turkey and Australia. He is the holder of MESc, ME and PhD degrees, all in electrical engineering. He is currently an Associate Professor and discipline head of Electrical Engineering at the University of South Australia, Adelaide, Australia.

His research interests have been focused on electrical machines and drives, and include modelling and simulation of electrical machines using numerical methods and the application of mathematical techniques to design optimisation of electromagnetic devices. He is particularly interested in the design and development of novel electromechanical energy conversion devices, which integrate emerging active materials and non-conventional topologies.

He has a strong interest in innovative approaches to engineering education and has published widely in this field. His teaching responsibilities have included courses in electrical machines, engineering design and virtual instrumentation. He is the author and co-author of some 150 publications.