BALANCING PEDAGOGY AND STUDENT EXPERIENCE IN FIRST-YEAR ENGINEERING COURSES

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Abstract
Engineering graduates increasingly require greater appreciation of the social and environmental context in which they practice. Engineering programs must respond to these new demands by threading these broader contexts throughout the courses and embedded them within the development of the graduate capabilities. Students are also increasingly influential in the evaluation of course quality and their experience in their undergraduate program. Responding to these and many other global drivers and influences, we have examined a number of approaches in course design and delivery, particularly in the first year of the program, including problem based learning, project based learning, context based learning, multi-disciplinary integrated programs, and engineering systems based courses. Opportunity created by change, workplace culture, professional development, and ownership and values of academic staff all play an integral role in course design and implementation.

Keywords: Engineering education, Course experience, Learning design, CDIO

Introduction

It has been demonstrated that the net student experience in an undergraduate engineering program can be reported to be somewhat negative despite positive evaluations of teaching in individual units of study. Internal research within the Queensland University of Technology (QUT) indicates that the first year of an undergraduate engineering program can have the most significant impact in terms of the student experience. The first year program serves a number of purposes which typically include:- a cultural and social transition for school leavers into higher education; the laying of the academic foundation upon which the individual grows and attains the desired graduate attributes as set by the program and by institution and professional accrediting bodies (eg. ABET, Engineers Australia); and the beginning of formative development as a professional and citizen of tomorrow.

In many instances, there is a growing disparity in the academic requirements assumed by first year engineering courses, and the knowledge and skills of those entering engineering programs. It would be a difficult proposition to defend the notion that these issues are the same as, say, 20 years ago. Influenced by changes in family culture and values, social environment and pervasive technology, we also observe changes in generational characteristics of students entering first year courses with the shift from *Generation X* to *Generation Y*, and the upcoming *Generation Z* and *New Silent Generation*. Furthermore, industry bodies, professional societies and academics are recognising that, in general, engineering graduates require a greater appreciation of the social and environmental context in which they will ultimately practice their profession. Indeed, a significant number of graduates will hold positions in senior management and of prominent leadership within 20 years of graduating from their undergraduate engineering degree.

This paper discusses a number of approaches in course design and delivery which have been examined to address the issues described. Paradigms such as problem based learning, project based learning, context based learning, multi-disciplinary integrated programs, and systems based courses all attract proponents. However there is also much scope for detractors or impediments to implementing such paradigms. Issues to do with resourcing for large classes, the robust embodiment of required technical and generic objectives, and the perception of "soft" science present hurdles in terms of promoting the concepts and implementation of the paradigms.

In recognition of differences in terminology used throughout higher education, both within Australia and around the world, the following glossary is provided.

Table 1. Glossary

CEQ	The Course Experience Questionnaire (CEQ) is designed and administered by the Graduate Careers Council of Australia (GCCA). They are distributed to new graduates each year through their respective universities. The CEQ seeks graduates' opinion to do with the quality of the undergraduate program they have just completed.
Course	At QUT, a Course is the collection of units which forms the entire program (undergraduate Bachelor's degree for example). A QUT student must satisfactorily complete 384 Credit Points (32 Units) of formal study to qualify for graduation. Some institutions use the term Course to refer to a Subject or Unit. For the wider audience, this paper adopts the use of Course to denote a single unit of study or subject.
DEST	Australian Government Department of Employment, Science and Training
Faculty	At QUT, Faculties typically comprise a number of Schools. The Faculty of Built Environment and Engineering at QUT has three Schools: School of Engineering Systems, School of Urban Development and the School of Design. Some countries such as the U.S. refer to faculty being the individual academic staff members. In Australia, we typically refer to these as Academics.
GCCA	Graduate Careers Council of Australia. The GCCA is responsible for designing and administering the Course Experience Questionnaire (CEQ) and Graduate Destination Survey (GDS) for each university graduate.
GDS	The Graduate Destinations Survey (GDS) is designed and administered by the Graduate Careers Council of Australia (GCCA). They are distributed to new graduates each year through their respective universities. The GDS captures information to do with employment or study status following graduation.
School	At QUT, a School is the fundamental organisational teaching unit comprising a group of academics and led by a Head of School. Other institutions may have Departments as this organisational unit.
Unit	At QUT, a unit is the fundamental delivery package of content. Full-time students typically undertake eight units per year. Some institutions may refer to these as Subjects and some refer to them as Courses. At QUT, units are standardised in size for undergraduate programs to be 12 Credit Points each.

Influences and Drivers
There are many drivers that influence curriculum design and implementation. In February 2006, Boles et al conducted a workshop in which the participants were asked to list influences on undergraduate program design and learning experience[1]. These influences have been included in Table 2 and were reported by Boles et al [1]. The authors have added "Workplace Culture" to explicitly highlight a significant internal influence which requires careful consideration and will be discussed further in this paper.

Table 2. Influences on Engineering and Learning Experience[1]

Internal	External
Students	Social and Cultural Issues
Staff	Employment and Skill Demand
Resources	Environment
Industry Direction	Government Legislation and Governance Protocols
Professional Requirements	Political Agenda and Community Expectations
Organisational	Standards and Policies for Good Corporate Management
Workplace Culture	Globalisation

One could consider the internal influences as being 1st-order in that they directly influence program design and implementation. These include staff and workplace culture, facilities, finance, faculty structure and leadership, university reputation, university location, student capabilities and their engagement.

The external influences may be considered as 2nd-order as they indirectly influence program design and implementation, usually through the corporate environment which, in turn, influences parameters and frameworks under which programs are designed and delivered. Governments can have significant influences through policy, legislation and funding mechanisms. Institutions need to respond to such also through influencing program design and implementation.

These internal and external influences might be a reasonable indictment of reality, however, many academics regard professional bodies such as Engineers Australia (EA) and ABET, and engineering employers, as being the ultimate curriculum stakeholders and therefore have the most significant influence on program design and implementation. This influence can be a help and a hindrance. Outdated criteria for accrediting engineering programs based on heavily prescribed technical content are held on to as a present day mantra can stifle progress. However, Engineers Australia and ABET have redefined the accreditation criteria with a focus on educational outcomes defined in terms of graduate capabilities [2][3].

Another significant driver being introduced in Australia at present is from the federal government's higher education reform agenda. The policy paper, *Our Universities - Backing*

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1 Boles, W., Campbell, D., Iyer, M., Murray, M., "Designing Engineers or Designing Programs?", Teaching and Learning Forum, TLF2006, University of Western Australia, 1-2 February 2006.

Australia's Future was enacted in legislation in 2003 and is being progressively implemented [4]. One aspect of this reform is linking university funding to a set of performance indicators through the *Learning and Teaching Performance Fund*. These indicators are summarised below in Table 3 [5].

Table 3. Summary of Performance Indicators and Data Sources [5]

Performance Indicator	**Definition**	**Data Source**
Progress rates	Student load passed as a proportion of load attempted each year	Data supplied by higher education institutions to DEST
Attrition/retention rates	Proportion of students in a particular year who neither graduate nor continue studying in an award program at the same institution in the following year	Data supplied by higher education institutions to DEST
Graduate full-time employment	Proportion of graduates in full time employment of those who are available for full-time employment	GCCA Graduate Destination Survey *(GDS)*
Graduate full-time study	Proportion of graduates in full-time study	GCCA Graduate Destination Survey *(GDS)*
Graduate salary	Starting salaries of graduates	GCCA Graduate Destination Survey *(GDS)*
CEQ overall satisfaction	Graduates' overall satisfaction with the quality of their program*	GCCA Course Experience Questionnaire *(CEQ)*
CEQ good teaching	Graduates' satisfaction with their program in terms of feedback, assistance, interest shown by teaching staff*	GCCA Course Experience Questionnaire *(CEQ)*
CEQ generic skills	Satisfaction with their program in terms of imparting analytical, communication, problem solving, team work skills etc*	GCCA Course Experience Questionnaire *(CEQ)*

*A response of 3, 4 or 5 from a possible range of 1 (strongly disagree) to 5 (strongly agree) is deemed to indicate broad satisfaction.

Progress rates and attrition/retention rates are linked directly to data provided to DEST by higher education institutions. The Graduate Destination Survey (GDS) objectively provides statistics about graduate employment and starting salaries. The Course Experience Questionnaire (CEQ) is more subjective and provides a numerical evaluation based on graduates' assessment (1 to 5 scale) of overall satisfaction, good teaching and generic skills.

Demographic factors (such as age, gender, non-English speaking background, student mix) and macroeconomic factors (such as local labour market situation) are decoupled from the raw performance indicators based on linear regression methods with the view of producing scores supposedly reflective of university performance. This score is used to rank institutions based on performance relative to other institutions. A component of funding is linked to this ranking [5].

One outcome of the Australian federal government's review is that the overall rankings of universities are highly sensitive to CEQ data. However, it has been our experience that the correlation is poor between students' internal assessment of teaching and courses, and the overall CEQ score. In short, even though students are at least satisfied with individual teachers and courses, they do not necessarily deem that they have had a good experience in their overall program.

Addressing the Challenge

In reviewing and proposing substantial changes to our programs, in terms of design, curriculum, delivery and assessment, a number of questions and issues are raised. Over the last five years, we have engaged in a number of innovative program reviews and developments, some of which have been driven pro-actively by academics and some which have been in response to organisational directives.

The following examples are presented and will be discussed in terms of the pedagogical values, resource implications, staff attitudes and development needs, and "political" constraints and impediments. These examples are presented in chronological order beginning with the First Year Engineering Review (2002) leading up to current implementations and current thinking for future developments.

First Year Engineering Review (FYER)

In 2002, QUT embarked on the First Year Engineering Review (FYER – pronounced as *fire*) in response to indications that students commence their engineering programs with enthusiasm; however their desire is dashed by having to sit through the more traditional classes in basic sciences. This has contributed to the evidence that students report a negative course experience in their first year. The objective of this review was to explore the prospect of an integrated approach to the basic sciences incorporating authentic engineering learning. The review was conducted by a working party which included academic staff from engineering and the support disciplines of mathematics, science and information technology. The desired outcomes of the review and resulting program changes were:

1. Improve student learning, experience and retention.
2. Ensure that first year is enjoyable, interesting, motivating and stimulating for students.
3. Ensure the foundation technical and graduate capabilities are developed.
4. Motivate collaboration between teaching staff across faculties participating in the delivery.
5. Improve marketability of our engineering degrees.

The resultant first year program proposal considered a number of options comprising mixes of different sized courses which essentially adopted a Problem Based Learning (PBL) approach to multi-disciplinary learning. The final proposal centred around two 24 credit point courses (double the standard size of courses at QUT), one in each semester, each of which used a major, real-world, case study to base PBL activities. The case studies were intended to trigger and drive the technical content along with graduate capability development. The majority of the contact learning would occur through workshops on specific technical topics as they are posed by the case study – just in time.

It was acknowledged at the time that this approach requires much resourcing (due to the many workshops required, each with a relatively small number of students). It was further acknowledged that this approach, although having the potential of achieving superior educational outcomes, was very dependent on the drive of the academics involved in the working party. Significant professional development and commitment from the many other academic staff members required for the program would be critical. It must be said that the PBL approach attracted many detractors in terms of a perception that it is a “soft” approach to engineering education.

This proposal was reviewed by external reviewers, mainly from local industry, and was unanimously supported subject to full funding of the program. One particular company offered to fund the inaugural year of operation of the FYER implementation should it successfully pass through all QUT approval processes. However, the question of sustainable funding, given the high resource dependency, and the observation that other large PBL-based courses were being rejected at higher university committees, led to the loss of support of this proposed program to progress to university committees.

Work Integrated Learning

The Faculty of Built Environment and Engineering at QUT has been implementing a teaching and learning development project on Work Integrated Learning (WIL) aimed at enhancing students’ learning outcomes from the workplace components of their programs. The main framework involves facilitating a change in the students’ position from detached observers to involved performers and active learners. This reflects the contemporary transition from an industrial to a knowledge-based economy and society. The project’s approach considers facilitating students’ progression to build knowledge and capabilities through the integration of academic and workplace curricula, thus improving their standing within the novice-expert dimension.

The WIL program is framed around a set of workplace objectives that students must address in the workplace. In developing the workplace objectives, a number of frameworks were considered that represented various viewpoints of stakeholders. In addition to the guidelines of Engineers Australia accreditation criteria and the QUT Graduate Capabilities, the findings of the “Employability Skills for the Future” study [6], conducted by the Australian Chamber of Commerce & Industry and the Business Council of Australia were considered. This study presented an international overview highlighting similarities in generic employability skills. Further, the workplace objectives were reflected in the program objectives, ensuring a continuum of purposeful outcomes for all engineering students.

To ensure students developed meaningful learning outcomes, each of the workplace objectives was then phrased in accordance with Bloom’s Taxonomy of Educational Objectives [7]. Underpinning this is the need to provide students and industry supervisors with clear learning objectives that can be measured against carefully designed criteria and standards.

Implementing such a program requires appropriate resources to first help students prepare for the work experience, and then assist them during their work. This needed to also be followed by support for the reporting process. This presented challenges in both human resources as well as the administration needs. There is also the need for appropriate assessment. Not only to set criteria but to also be able to provide staff time for assessing student reports and evaluating them against the set criteria. There was no formal acknowledgement of staff participation in this process.

The professional skill development is regarded as crucial to informing industry hosts, with confidence, of the precise capabilities of students at any given point in the program. Since students may undertake their workplace learning at different stages of their program, the interaction between the work environment and the student (during the industrial experience) will depend on the knowledge and skill level they have at that time. That skill level would also be a factor in determining the tasks that they might be given at the workplace. This continues to be a challenge, especially when it comes to involving industry staff in the assessment process.

Currently, work integrated learning courses have been incorporated in a newly structured program. It is hoped that through this change, more resources will become available to support the program.

Integrated Curriculum

The Faculty of Built Environment and Engineering at QUT went through a substantial restructure three years ago with a view to streamlining administration, budgets and interaction of academics across the Faculty. This operational change in turn assisted greatly with a restructure of all undergraduate programs taught across the Faculty. The overriding objective was to develop programs that were integrated and yet adaptable to changing student and industry needs.

There are 19 different disciplines in the Faculty, covering a wide range of engineering majors together with design disciplines (architecture, industrial design, etc) and urban development disciplines (construction, urban planning, property, etc). It was recognised that not only did all the engineering majors require students to begin to acquire common generic capabilities in first year, but that those capabilities were needed in all 19 disciplines across the Faculty.

The outcome was the creation of two courses in which all first year students from all Faculty disciplines enrol. The first one, in first semester, is called "Introducing Professional Learning" with the course code BEB100. The second one, in second semester, is called "Introducing Sustainability" coded BEB200.

BEB100 provides an introductory level exposure to skills and knowledge in information literacy, communication (oral, written and graphical), team work, ethics, and cross-cultural issues. A critical aspect of this course is the core project of which the teaching, practice and assessment of those skills and knowledge are hung.

All the engineering students spend some weeks investigate matters pertaining to waste management and transport and prepare an individual written report on their investigations. This provides the basis for classes and exercises in information literacy and technical report writing. After this task has been completed, the students are gathered into groups of five students per team, and together must build upon what they investigated to design, build and test a real model device. This task enables classes and activities on team work, and on oral and graphical presentation. Ethical and cultural matters are explored through requiring the teams to consider and to write about issues they would need to consider if the waste management facility was proposed for construction in a sensitive indigenous area in Australia and in another country in which bribery of local politicians is the price of business.

An important aspect of the restructure of the Faculty's programs was the development of a common format to all of its programs. The engineering programs now offer eight courses common across the programs, including BEB100 (and BEB200) described earlier, statics, materials, introductory electrical engineering, and mathematics; most of these courses are studied in the first year of the program. A further 16 courses are devoted to providing the necessary discipline specialisation, primarily in 2nd and 3rd year. The remaining eight courses are studied primarily in the 3rd and 4th year of the programs and are available for students to choose either two four course minors or one eight course second major. The second majors can be taken from ones available in engineering, information technology (for software engineering students), or in health (for medical engineering students). If a student opts for two minors, their first minor must involve a research project, a work-integrated course (described in the following section of this paper) and two specialisation courses. The second minor is constrained to courses outside of engineering to permit broadening of the students' knowledge and abilities. Minors in law, business, design, humanities and science are available to students.

The thrust of these changes has been flexibility to allow students to come together more in the first year, but also flexibility to allow them to interact with other widely divergent disciplines in preparation for professional practice.

Context Based Learning

In light of the resource intensiveness of the proposed Problem Based Learning FYER program, setting the context within each course and within each lecture can be a very effective way of engaging students with minimal modification to conventional lecture-based delivery. This was found to be particularly useful in core courses which are delivered to a wide range of engineering disciplines, many of whom would otherwise question the relevance of the material to their discipline. Context based learning is now used widely, particularly in text books.

Based on simple, every-day, real world observations, and by posing the questions, "*Why does …?*" or "*Why are there …?*" (eg. *Why are there four wires on some power poles?*). This approach is designed to stimulate the inquiring nature of learners. This approach was trialled for one module within the introductory electrical engineering course at QUT in 2006. This course is core to all engineering disciplines at QUT and had an enrolment of 377 in that instance. From a delivery point of view, it was found that the students became active drivers of the topics. Having posed the original prompting question and context by the instructor, the students predominantly posed the follow-up questions and guided the content in close alignment with the module curriculum. The outcomes included:- an increase of lecture attendance (up from less than 50% to around 75%), predominantly positive comments on the teaching style – particularly in comparison to other teaching styles experienced by the students in that course, a higher percentage of students who engaged with the topics during lectures, and associated tutorials, problem classes and laboratories.

Overall, a high impact in the student experience in this module was made with minimal resourcing. Unit curriculum was not affected nor was the assessment. Changes were only made in teaching style. This amounts to only minor changes to formal unit documentation (if any) but does require greater creativity in terms of learning resources. Engaging other academic staff in context based learning seems to hit a chord with a greater percentage of academics and tends to be accepted more readily than other approaches which are often perceived to be “soft”, such as PBL.

Engineering Systems as a Teaching Philosophy
The concept of Engineering Systems is one that has garnered much impetus in recent years, with organisations such as INCOSE (International Council on Systems Engineering)[2] and CESUN (the Council of Engineering Systems Universities)[3] leading debate and interaction between university bodies and industry. Broadly speaking, engineering systems is concerned with addressing the issues facing professional engineers, being mindful that problems requiring engineering solutions not only involve technical issues traditionally asked of engineers, but also involve concerns such as resource depletion, environmental, sustainability, economic and social impact. By instilling awareness of these areas into our students, they will not only make for better engineers in the 21st century, but will also be better prepared for the management role into which many of them progress [8].

Within the QUT School of Engineering Systems, we believe that, further to engineering systems being a discipline, the underlying principles form the foundation of a genuine teaching philosophy. It has become apparent that adoption of engineering systems as a teaching philosophy requires a paradigm shift in the way we engage with our students, especially during their formative years of study. From a QUT perspective, it has been suggested that we can accomplish this through inclusion of “structured general education electives within the standard program supplemented by a change in teaching philosophy; one that stresses integration of material and a more holistic approach that takes into account the societal context of technological solutions” [9].

Such a shift in teaching methodology fits well within our current system – all of our current engineering programs have a course on sustainability (BEB200 mentioned earlier) – and there is a culture of integrated treatment of this issue across all studies. It also ties in closely with Context Based Learning, but instead of a merely technical examination it approaches the problem from a holistic viewpoint.

As such, it requires only minimal resourcing. The issue becomes primarily one of the engagement and conviction of existing staff as to the validity of this approach. There again can be a perception that the adoption of such a philosophy is too “soft”, diluting the technical knowledge for “touchy-feely” subjects. Whilst this attitude will no doubt always exist in some quarters, it has been observed that by explaining the concept to academic staff, many realise that they have already practised engineering systems as a teaching philosophy – they just didn’t know it!

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[2] http://www.incose.org/
[3] http://www.cesun.org/

Discussion
These program developments are summarised below in Table 4 in terms of their implementation status; our experience and assessment of staff ownership and empowerment; needs for staff development; and implications in terms of resources required for implementation.

Table 4. Comparative Assessment of Program Innovations

	Implementation Status	**Staff Ownership and Empowerment**	**Staff Development Needs**	**Resource Implications Ranking (5 highest)**
First Year Engineering Review (FYER)	Designed, endorsed by industry groups, ultimately blocked for approval passage beyond the Faculty	Low	High	5
Work Integrated Learning (WIL)	Designed, trialled, implemented with modification (first engineering students Semester 2, 2007)	Moderate	Moderate	3
Integrated Curriculum	Third iteration of delivery, substantial revisions with each iteration	Low	Moderate	4
Context Based Learning	Trialled	High	Low	1
Engineering Systems Approach	Conceptual phase. Still be proposed and workshopped by broader academic community.	Moderate	Moderate	2

The FYER proposal was the most radical proposal of the five presented and would require a high level of resourcing and a range of staff development programs. Because the delivery style departed substantially from that which was traditionally being delivered, the need to share the vision espoused in the overarching principles was important. Thus a range of staff development opportunities was recommended. Proposed activities included: interaction with other universities and staff either through invitations of high profile engineering education specialists, or through visits of faculty staff to other institutions; support for continued interaction between staff and cross-university development activities; and interaction with professional learning designers. Workshops for staff on targeted areas such as project based learning, assessment, coordinating and teaching large classes, and making the most of tutorial and practical classes were also identified as being required.

Academics were very resistant to the “problem based learning” philosophy as it was perceived as being a “soft” science and runs the real risk of not delivering on the technical objectives required of the unit of study. Ownership resides with relatively few academics and there was a high reliance on the passion of those particular academics to ensure the program was delivered in the manner intended and delivering all stated learning outcomes. Despite industry offering significant funding for the initial delivery of this program, the proposal ultimately did not gain the necessary academic committee support to proceed with the approval process.

Context Based Learning is an approach which has the greatest alignment with the teaching practices of many academics and can make a reasonable impact in terms of improving the course experience of students. The close alignment means that the resourcing implications are minimal, the academic ownership is already high and a relatively small degree of staff development is required for academics to develop a greater degree of explicitness in setting the context of topics both at course level and also within the context of the entire undergraduate program.

The Engineering Systems approach as a teaching philosophy is still at a conceptual phase. It is viewed as an approach that helps to develop capabilities of our future engineers. It also draws upon the virtues of context based learning and many of the principles espoused by the FYER program. However, it is also seen as an approach that is likely to gain greater ownership of academics than FYER did, and it would require less resourcing than the PBL aspect of FYER.

Leadership and Culture

In an environment of change, it is particularly important to promote and foster a workplace culture to enable and empower academic staff to create, embrace and lead innovation in program development and delivery. A sense of ownership and belonging is a critical motivator in the engagement of academics. In the case of the Faculty of Built Environment and Engineering at QUT, the Faculty has been undergoing a substantial organisational re-structure which continues to have a significant impact on the workplace environment. Schools have been re-defined and resources have been re-organised. In a climate of organisational change, how does a community of scholars maintain, or indeed, inspire innovation in program development and delivery?

The Management Team in the School of Engineering Systems is employing a Values Driven Leadership approach to establish a productive and motivational workplace culture, and to allow communities of practice to form and thrive.

We often hear companies espousing that their most valuable asset is their people – yet if you ask staff if this is their perception, all too often the resounding response is “No”. Herein lies a gap in values – *do what I say*, not *do what I do*. At its core, Values Driven Leadership is about not only talking the talk, but *walking* the talk. In creating a sense of belonging, a sense of identity and a sense of purpose, management begins to walk the talk and bridge the values gap [10].

One example of how we have employed Values Driven Leadership within the QUT School of Engineering Systems, is of the annual performance reviews (PPRs) of our academic staff. During all PPRs, the importance of the individual’s contribution in one or more of the academic areas, and the fact that both their contribution and the person are valued, is explicitly emphasised. This helps in developing a sense of identity and contributes to the sense of belonging and ownership in the direction of our School.

Development, *in collaboration with the staff*, of a values statement has also been another mechanism to demonstrate how a workplace culture can be influenced in a positive sense without any major overheads. A seemingly trivial statement, containing nothing spectacularly different from any other values statement, can have a real power to instil values of "respect for others, openness, transparency, listening and hearing, honesty, integrity and trust" as well as "commitment of passion for our work, a determination to succeed, and engagement across and beyond our Faculty" [10].

These initiatives, along with weekly social functions, weekly discussion based lunch meetings, professional development retreats, staff profiling and an inclusive School Management Team, have all contributed to increased engagement in all activities within the School, and a greater sense of ownership and belonging by academics.

Conclusion

An astute understanding of the internal and external drivers and influences can greatly inform course and program design, and to maximise the likelihood of successful development, approval and implementation. This paper has set the context, particularly in Australia at present, in which student course experience has become a widely recognised motivator for innovation in pedagogy, particularly in the first year of an engineering program. Without becoming consumed in the debate around the Australian Government Higher Education Reform agenda, it should be recognised as a vehicle for change. Change creates opportunity. When the objectives and outcomes of all stakeholders are met, there exists a wider window of opportunity to new and creative approaches to programs and courses.

Our First Year Engineering Review proposal, at the time, showed the greatest promise and was very creative in striving for the desired outcomes. However, this was prior to the higher education reform agenda and prior to our Faculty restructuring. We were not in a change culture. The successive initiatives described in this paper have been a result of creative attempts to achieve at least some of the desired outcomes within various constraints, and taking advantage of opportunities as they arise. Now with the higher education reform agenda, and the change culture within our Faculty, the window has opened to initiatives such as the Integrated Curriculum and the Engineering Systems approach.

We have seen that new program and course designs must be supported and owned by a critical mass of academics for (a) support in the approval and developmental processes, and (b) whom ultimately will be involved in delivering the courses. Changes can introduce complex dynamics which impact on workplace culture. This should not be ignored or treated in isolation when making whole-sale changes to programs and courses. The principles of Values Driven Leadership and eliminating the values gap can, in part, facilitate academic communities of practice to establish and strengthen, thereby providing the environment to support changes to programs and courses in response to these global drivers and influences.

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Biographical Information

Duncan Campbell is the Alternate Head of School for the School of Engineering Systems at Queensland University of Technology (QUT), Brisbane, Australia. He is particularly passionate about maximising the student experience within engineering programs, whilst achieving the best possible outcomes in terms of graduate capabilities. Duncan also plays a key role in embracing and developing communities of practice through the principles of Values Driven Leadership.

Wageeh Boles is an Associate Professor in the School of Engineering Systems. He is the current President of the Australasian Association for Engineering Education (AAEE) and has previously held positions of Assistant Dean - Teaching and Learning and Assistant Dean - Student Services, Faculty of Built Environment & Engineering. In 2006, Prof Boles was appointed as an Expert Assessor for the Carrick Institute for Learning and Teaching, and has been the recipient of distinguished teaching and learning awards such as the Engineers Australia – Australasian Association for Engineering Education Award for Excellence in Teaching and Learning in Engineering Education (2004); the QUT Outstanding Academic Contribution Award, Teaching Performance & Leadership (1999); and two Outstanding Teaching Assistant Medals, University of Pittsburgh, USA, (1987&1988).

Martin Murray is a Senior Lecturer in the School of Urban Development at Queensland University of Technology (QUT), Brisbane, Australia. He has a distinguished record in teaching and learning including an Australian Government Carrick Award for outstanding contribution to student learning; QUT Teaching Fellowship; and QUT Faculty of Built Environment and Engineering "Excellence in Teaching" Award.

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Doug Hargreaves is the Head of the School of Engineering Systems at QUT, Brisbane, Australia. He is a mechanical engineer having published over 100 refereed papers on Tribology (friction, wear and lubrication). He has also written about 30 papers on engineering education. Since becoming Head of School he has developed and implemented a model of leadership that he refers to as Values Driven Leadership.

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