Change Strategies for Educational Transformation

Carl Reidsema[1], Roger Hadgraft[2], Ian Cameron[1], Robin King[3]

1. University of Queensland, St. Lucia, Australia, c.reidsema@uq.edu.au, itc@uq.edu.au
2. University of Melbourne, Melbourne, Australia, roger.hadgraft@unimelb.edu.au
3. University of Technology Sydney, Sydney, Australia, robin.king@uts.edu.au

***Abstract**: The authors present a position paper suggesting that while there is evidence for change within engineering curriculum towards best practice, there are significant barriers primarily at the operational level which bring into question the likelihood of more widespread adoption of hard won gains. It is argued that transformational change is required which "(a) alters the culture of the institution by changing select underlying assumptions and institutional behaviours, processes, and products; (b) is deep and pervasive, affecting the whole institution; (c) is intentional; and (d) occurs over time" (Kezar & Eckel 2002) and that change leadership of this nature must be distributed, not solely laid at the feet of Deans and Vice Chancellors. A strategy for change is presented based on observations and evidence from the ALTC project "Design based curriculum reform within engineering education" and the recently completed ALTC Discipline Scholars' Survey of Engineering Academics grounded in the research for transformational change within businesses, universities and teaching and learning. This model for change proposes the development of a network of change agents built on a brokerage model to improve best practice and leadership capacity through systematically and directly engaging with the strategic/tactical and operational levels of engineering faculties.*

Plus ça change, plus c'est la même chose (The more things change the more they stay the same)

For those of us who immerse ourselves in the engineering education literature, the following introductory quotation appears as a recurring theme:

> *Financial pressure, growth in technology, changing <academic> roles, public scrutiny, changing demographics, and competition in the world both within and beyond our national boarders (sic) make change an imperative for higher education (Kezar* & Eckel *2002).*

What is also quite noticeable is the consistency within the literature regarding the general characteristics of the problem space (Royal Academy of Engineers 2007):

1. *engineering courses, and universities in general, are seriously under-funded;*
2. *funding and ranking-driven focus on research in many universities is constraining the development of innovative learning and teaching in engineering;*
3. *course content is not reflecting the real requirements of industry with little opportunity for students to gain practical experience of industry as part of their education;*
4. *there is a need to enhance the development of practical skills but not at the cost of losing a strong theoretical base;*
5. *incentives for innovation in the provision of tertiary education, including new providers, and new forms of course design and delivery are needed (Group of Eight Australia 2008);* and
6. *the Australian government is systematically driving the agenda for better accountability and improved quality in teaching from all Australian universities (Vardia and Quin 2011).*

There is much to be done. The 2007-8 review led by the Australian Council of Engineering Deans (ACED) recommended (King 2008):

1. increasing the public understanding of engineering and the work of engineers, particularly in schools;

2. clarifying educational outcomes and standards required for practice at all internationally recognised levels of engineering;
3. developing best-practice engineering education to ensure the required outcomes and reduce attrition;
4. attracting a higher proportion of women and other under-represented groups;
5. increasing staffing and material resources for delivery of high quality engineering education; and
6. promoting stronger collaborative links with industry.

Work has proceeded in several of these areas, and much has happened to support the improvement of T&L in engineering, including increases in:

1. curriculum innovations, including courses that introduce and engage first-year engineering students in all disciplines to the practice of engineering, as well as others such as UQ's Project Centred Curriculum in Chemical Engineering (Crosthwaite, et al. 2006) and Problem-based Learning (PBL) adopted at various institutions such as CQU, VU, RMIT, and UniSA;
2. technology-enabled learning spaces designed for active learning, across the sector, many supported by the Government's Infrastructure Redevelopment Fund;
3. the creation of chairs in engineering education in increasing numbers, and more academics being promoted on the basis of expertise in education practice and research; and
4. T&L Induction programs, with acquisition of formal educational qualifications, such as Graduate Certificates, being mandated for (new) staff as part of probation in an increasing number of universities.

However, there are valid reasons to be concerned that these gains have not acquired a degree of cultural acceptance to be considered institutionalised (Goldsmith et al. 2011, Boshier 2009). Even if universities are noted for their slow uptake of innovations (Getz & Siegfried 1997), if we were to consider the following list as a rough vision of engineering education best practice, can we be confident that current institutional strategies will deliver the required changes?

1. Teaching and educational research is accorded institutional weight in promotion, commensurate with its budgetary value and impact.
2. There is a proper balance of theory and practice in the undergraduate curriculum taught primarily through active learning methods as academic conceptions of teaching become more learning and student focussed.
3. There are more active learning spaces (studios/labs) than passive teaching spaces (lecture theatres).
4. There is no shortage of up to date and industry-standard technology (equipment and software) integrated and supported within the curriculum and available for student learning.
5. There is a one in three chance of bumping into an industry adjunct in the hallway who is supporting the provision of authentic educational experiences.

Despite ALTC funding of L&T projects in engineering exceeding $2M since 2006 and continuous efforts by ACED, Engineers Australia (EA) and the Australasian Association for Engineering Education (A^2E^2), why has change not proceeded more rapidly nor manifested itself more deeply within the curriculum? And what can be done to maintain the momentum of the change process now that future national funding for innovation and development of T&L practice and related research, and leadership capacity building is uncertain, given the winding up of the ALTC.

Barriers to change

Much of the literature on the need for change within the engineering curriculum has placed the responsibility for this at the strategic level (Vice Chancellors and Deans) and the tactical level (Associate Deans and Heads of Schools). There is, however, a growing body of evidence that supports the contention that the primary barriers to change reside within the tension between the *beliefs* and consequent *actions* (or non-actions) of academics at the operational (curriculum) level of the institution. This constitutes an argument for reconsidering how we can best facilitate the change process.

A recently completed ALTC-funded project "Design based curriculum reform within engineering education", sought to discover through examining the current state of teaching Engineering Design in four Australian universities, the extent to which teaching reflected best practice, and a preliminary

understanding of what constrains the development of this. The reasons are complex, but the resistance to change seems to coalesce around academic beliefs within the following areas:

1. Institutional Expectations: promotion/progression incentives focused on research, with concomitant disincentives to focus on teaching;
2. Pedagogical: belief in the knowledge transmission approach to teaching as being most appropriate;
3. Epistemological: (the nature of knowledge):
   a. belief that knowledge is an independent entity rather than co-constructed; and
   b. belief in the engineering science paradigm as representing what engineering is in the real world.

Data from structured interviews of 16 unit coordinators at 4 universities, suggests that the majority of lecturers were simply unable to envision alternative ways of teaching their unit except to increase the number and size of laboratories, or to increase the numbers of tutors (Goldsmith et al. 2011). An evaluation of the course materials for the 13 Engineering Science units of study under investigation revealed that the dominant pedagogical model was that of the traditional lecture/tutorial structure with little evidence of learning and assessment activities incorporating the PE2 (Engineering Ability) and PE3 (Professional Attributes) elements of the EA Stage 1 Professional Competency standard (Engineers Australia, 2010). At least one reason for this non-inclusion was revealed in a recent survey of over 600 respondents covering all major university clusters such as the Go8, ATN, IRU and non-aligned institutions, and over 15 engineering sub-disciplines indicating that over 45% of academics had either no knowledge or only a passing awareness of the EA Stage 1 Professional Competency standard (Cameron 2011).

These results would appear at the very least to indicate a specific knowledge deficit which may be amenable to a more direct and concerted form of engagement in assisting academics with conceptualising curriculum change than that currently managed through occasional workshops, T&L development seminars and training courses. However, it is much more likely that this lack of knowledge is an indication of a more entrenched set of beliefs based on assumptions which require transformative change as *beliefs are pragmatically bounded by the individual's sense of what is possible, plausible and desirable* (Pickering 2006).

To suggest that transformative change is required is, of course, not new. It is implicit within the reports previously mentioned and can be clearly inferred from the 2008 ACED –led Review of Engineering Education funded by the ALTC, where a conclusion was drawn that *sustaining change in engineering education requires vision, leadership, stakeholder engagement and resources* (King 2008). An even more explicit inference of the need for transformation change was made by (Sheppard et al. 2009):

> *we are not persuaded that incremental improvements to the current model will result in engineering education that is aligned with the work of, and demands on, the new-century engineer.*

Making change

The difficulty we face, however, is that *transformational change is unfamiliar to most higher education institutions* (Kezar & Eckel 2002). Such change: *(a) alters the culture of the institution by changing select underlying assumptions and institutional behaviours, processes, and products; (b) is deep and pervasive, affecting the whole institution; (c) is intentional; and (d) occurs over time* (ibid).

There is positive evidence that a strategy for change that engages more directly with the operational level would be welcomed by academics. Within the recent survey of engineering academics, when asked about what would be beneficial for the teaching role, 77% of respondents rated *face-to-face opportunities to informally discuss teaching and learning issues with colleagues* as desirable or highly desirable. In addition to this, academic willingness to contribute to the advancement of teaching and learning in the higher education sector was rated at over 70% towards either very willing or willing to *share teaching materials with colleagues* or *contribute to the scholarship of teaching and learning via publications* (Cameron et al, 2011).

A strategy for change that merely concentrates more attention on already overworked academics is, however, unlikely to succeed. Effort must also be made in addressing the beliefs, practices and priorities of our colleagues at executive (strategic/tactical) levels who are charged with leading, managing and communicating the development of the institutional structures and activities that support

the educational function. Within the literature, there is a consistency in identifying those areas of support structures that need attention, suggesting that they are:

> *... tenure and promotion policies and procedures, hiring practices, academic structure, funding, and facilities. These barriers are mutually supportive which compounds the challenge* (Strong 2005).

In addition, the clarity of the mission that is being communicated to academics at the operational level appears unclear. Nearly 50% of respondents to the sector wide survey were either unsure of their institution's valuation of teaching and learning performance with regard to promotion or held a belief that it was considered to be unimportant (Cameron et al. 2011).

There is an abundance of literature on transformational change emanating from the business sector. This is unsurprising if for no other reason that businesses thrive or succumb (often dramatically) in-line with their capacity to redesign themselves in the competitive market. A successful transformational change process appears to go through a series of eight distinct stages (Kotter 2007):

1. Establish a sense of urgency,
2. Form a powerful guiding coalition,
3. Create a vision,
4. Communicate the vision,
5. Empower others to act on the vision,
6. Plan for and create short term wins,
7. Consolidate improvements and produce more change, and
8. Institutionalise new approaches.

Kotter insists that these stages should be worked through in sequence and cautions that the urge to skip steps to try to accelerate the process consistently causes problems. Since the success of a given stage depends on the work done in prior stages, *a critical mistake in any of the stages can have a devastating impact* (Kotter 2007).

While Kotter's work was observational, a similar, albeit more rigorous research investigation on critical success factors for transformational change within the university sector revealed that while there was no clear evidence of temporality, the same critical success factors emerged with slightly different terminology (Kezar & Eckel 2002):

1. Implement robust design (Kotter's vision/urgency/effective communication),
2. Develop collaborative leadership,
3. Gain senior administrative support,
4. Provide staff development, and
5. Achieve visible actions.

Noting the remarkable similarities between the two models and considering the primacy of contextual accuracy we will adopt Kezar's model because regardless of the perceptions of institutional drift towards managerialism (Deem 2005), universities are not, and will likely never be corporations (Getz & Sigfried 1997).

We do, however, note Kotter's first and most important critical success factor *Establishing a sense of urgency* as something which is not emphasised in Kezar's work and which is striking in its apparent absence across all levels of the higher education sector and in particular with respect to change within engineering education. Our conclusion is that a successful change strategy must contribute to the creation of a sense of urgency.

Where the two models begin to converge is around the necessity and trend towards change that adopts a collaborative leadership approach involving *stakeholders throughout the organisation in the change process* rather than relying *on a willing president or strong leadership* (Kezar & Eckel 2002). Kotter's conception of this collaborative leadership (which he calls a powerful guiding coalition) whilst not excluding the senior management within the existing hierarchy *includes members who are not part of senior management; it tends to operate outside of the normal hierarchy by definition* (Kotter 2007). He says that if the existing hierarchy was working well there would be no need for a major transformation. *But since the current system is not working, reform generally demands activity outside of formal boundaries, expectations and protocols* (Kotter 2007).

Our argument is that we must pursue transformational change (TC) in the teleological planning sense rather than accept the uncertain argument that incremental change will somehow see us see us through. The recent research literature suggests that the results of change provide the structural reformation which we desire and not vice versa (Marshall 2011). This then begs the question: Who is responsible for leading this change and how do we translate the positive beliefs and good will that has been identified into action that leads to more rapid and effective change? A necessary condition must be that we begin by proposing a tentative model for change that will afford all members of the academic enterprise states the opportunity to exercise the *largely tacit expectations of responsibilities for leadership and management … inherent in each of the roles of all staff regardless of the level or nature of their appointment* (Marshall 2011).

We envisage a *national guiding coalition of educational leaders*, which has carriage of this transformational change. Specifically, this nationally distributed group of people will provide the substantive leadership role. It will establish the *sense of urgency* in partnership with the strategic and tactical levels as well as external stakeholders such as EA and industry representatives, as explained in the next section. This group is also responsible for leadership capacity building at the tactical level. It will directly engage with the operational level, ensuring good communication and transparency of process through direct staff development opportunities as well as collaborative projects across schools.

Our proposed change model

> *… leadership is exercised when persons … mobilize … institutional, political, psychological and other resources so as to arouse, engage, and satisfy the motives of followers.* (Burns 1978)

The current landscape provides a unique and timely opportunity to form a national guiding coalition to provide leadership in improving engineering education across Australia. The coalition would build upon the academics who have benefited from the ALTC and the prestige and influence this has brought T&L. This leadership capacity will most certainly dissipate if it is not reinforced and strategically distributed across the sector.

The immediate primary goals of this coalition must be to establish the sense of urgency and refine the vision more clearly. We need to grow "teacher-leaders" to become the next generation of change agents to enable sustainable change. Otherwise we risk fragmentation and diffusion of the gains made by the ALTC and risk over-reaching by excessively directing our efforts into top-down initiatives with no anchor into the operational level of innovators and implementers.

From Figure 1, we propose the establishment of teams of experts who will act as local, regional and national pedagogical assistance teams. These teams will engage with the operational level to foster and provide support to teaching academics helping to facilitate the uptake of new pedagogies and the use of best practice engineering education techniques and tools. This mode of "face-to-face" direct engagement will encourage risk taking and provide the ability for each institution to pursue change in a targeted and limited domain (Pickering 2006).

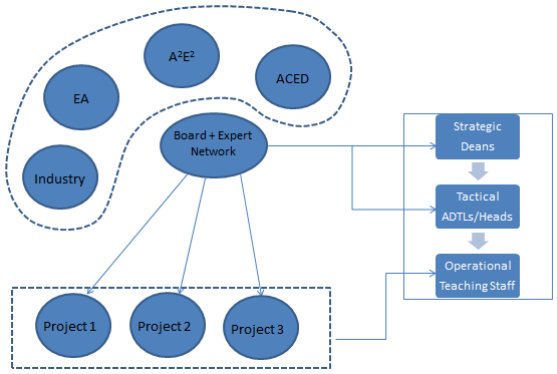

Figure 1 Transformational Change Model

Coordination through a "Board" of established change leaders will provide the planning and communication channels between the strategic/tactical and operational levels of a single institution and allow for proven "evidence-based" change to be adopted by partner institutions. A brokerage model (Jackson 2003) will be implemented to help develop the network of experts by allowing us to align strategic change goals with the professional goals of both experts and collaborating academics through exposure to best practice and incentives such as funding opportunities to adopt these practices.

A key step is to formulate the "powerful guiding coalition" by engaging the major stakeholders: Deans and Associate Deans, Engineers Australia, Industry and A^2E^2. The Australian Council of Engineering Deans (ACED) has already committed to the implementation of the recommendations of the 2008

review (King 2008). The support of Engineers Australia and industry is also essential to develop this sense of urgency. Australian companies are in the middle of a skills shortage, exacerbated by booms in urban infrastructure and mining. Developing graduates who can be productive more quickly is an obvious way of addressing this skills gap. Fortunately, we already have in place effective relationships between ACED and A^2E^2, A^2E^2 and EA, and EA and Industry. Now we need to mobilise these relationships to form a Board and Expert Network to provide national leadership.

Over the past two years, the ALTC has funded ACED to run (collaboratively with the ICT Dean's Council (ACDICT)), a "Discipline Support Strategy (DSS)" for Engineering and ICT. Whilst many of the academic leaders (such as Associate Deans) have supported the DSS and its activities, it has neither the power, nor resources, to facilitate transformational change. The ALTC has, however, provided funding (supplemented by ACED and ACDICT) to maintain and build these activities, in the form of a Discipline Network, through to late 2013.

This network should become a national collective resource for shaping our future, that engages with all levels of engineering faculties, primarily at the operational (course) level. In order to do this we will need strategic (executive), tactical (ADTL/Heads) and operational (course coordinator) interfaces in order to formulate a collective and agreed vision, agree on change targets, implement best practice across the sector and consolidate gains provided by the ALTC funding. Although steps are in progress through the Discipline Support Strategy and the Discipline Network, more is needed to build the national coalition.

Because the funds we need may or may not be forthcoming from the government, it is critical that we engage industry as the only stakeholder with both the willingness and capacity to fund the work we need to do (Goldsmith et al. 2011). One possible way to mobilise industry to contribute to the engineering education coalition would be to align with the agenda of the Australian National Engineering Taskforce (ANET) formed in 2009 as a coalition of organisations (APESMA, Consult Australia, ATSE, Engineers Australia and ACED) committed to advancing the interests of engineering beyond what each of them can do separately.

The transformational change model we propose will be in keeping with best practice engineering design as it allows us to achieve the long term goal of a National Centre for Engineering Education through a design based research and an evidence based approach that emphasises leadership capacity through guided cross-institutional collaboration. Some progress has already been made in this regard by the Discipline Support Strategy and the joint Engineering Australia-AAEE workshops on accreditation and curriculum design.

Conclusions

The authors present a position paper suggesting that while there is evidence for change within the engineering curriculum towards best practice, there are significant barriers primarily at the operational (curriculum) level which bring into question the current degree of cultural and institutional acceptance of hard won gains in the improvement of engineering education.

We argue that transformational change is required which *(a) alters the culture of the institution by changing select underlying assumptions and institutional behaviors, processes, and products; (b) is deep and pervasive, affecting the whole institution; (c) is intentional; and (d) occurs over time* (Kezar 2002) and that change leadership of this nature must be distributed across the organisation and not solely laid at the feet of Deans and Vice Chancellors.

A strategy for change is presented based on observations and evidence from the ALTC project "Design based curriculum reform within engineering education" and the recently completed ALTC Discipline Scholars' Survey of Engineering Academics grounded in the research for transformational change within businesses, universities and teaching and learning. This model for change proposes the development of a network of change agents built on a brokerage model to improve best practice and leadership capacity through systematically and directly engaging with the strategic/tactical and operational levels of engineering faculties.

References

Boshier, R. (2009) Why is the Scholarship of Teaching and Learning such a hard sell? Higher Education Research & Development, Vol. 28, No. 1, pp. 1–15

Burns, J.M., (1978) Leadership, Harper Collins

Cameron, I., Reidsema, C., Hadgraft, R. (2011) Australian engineering academe: a snapshot of demographics and attitudes, AaeE Perth Australia (under review)

Crosthwaite, C., Cameron, I., Lant P., Litster, J. (2006) Balancing Curriculum Processes and Content in a Project Centred Curriculum: In Pursuit of Graduate Attributes, Education for Chemical Engineers, Volume 1, Issue 1, 2006, Pages 39-48

de la Harpe, B., David, C., Dalton, H., Thomas, J. (2009) Are confidence and willingness the keys to the assessment of graduate attributes?, ATN Assessment Conference, 19-20 November

Deem, R., Brehony, K. (2005) Management as Ideology: The Case of 'New Managerialism' in Higher Education, Oxford Review of Education, Vol. 31, No. 2 (June), pp. 217-235

Engineers Australia, 2010, "Appendix B: Guide to assessment of eligibility for membership (stage 1 competency)", www.engineersaustralia.org.au, accessed 11 August 2011.

Getz, M., Siegfried, J. (1997) Adoption of innovations in higher education, Quarterly Review of Economics & Finance; Fall, Vol. 37 Issue 3, p605-632

Goldsmith, R., Reidsema, C., Campbell, D. (2010) Best practice or business as usual. AaeE conference, Sydney

Goldsmith, R., Reidsema, C., Campbell, D., Hadgraft, R., Levy, D. (2011) Designing for the Future, AJEE, Vol. 17, No. 1

Group of Eight Australia, (2008) Investing in all our people: Submission to the review of Australian higher education.

Jackson, N. (2003) Engaging and changing higher education through brokerage, Ashgate Publishing, USA

Kezar, A., Eckel, P. (2002) Examining the institutional transformation process: The importance of sensemaking, interrelated strategies, and balance, Research in Higher Education, Vol. 43., No. 3, June, pp. 295-328

King, R., (2008) Engineers for the Future: addressing the supply and quality of engineers for the 21st Century, ACED

Kotter, J. (2007) Leading Change: Why Transformation Efforts Fail, Harvard Business Review.

Marshall, J., Orrell, J., Cameron, A., Bosanquet, A., Thomas S. (2011) Leading and managing learning and teaching in higher education, Higher Education Research and Development Vol. 30, No. 2, pp. 87-103

Pickering, A. (2006) Learning about university teaching: reflections on a research study investigating influences for change, Teaching in Higher Education, Vol. 11, No. 3, July, pp. 319-335

Royal Academy of Engineers (2007). Educating engineers for the 21st century. London: Royal Academy of Engineers

Sheppard, S., Macatangay, K., Colby, A., Sullivan, W. (2009) Educating Engineers: Designing for the future of the field. The Carnegie Foundation for the Advancement of Teaching, Jossey-Bass San Francisco, Ca.

Strong, D Stiver, W. (2005). Engineering design competency: perceived barriers to effective engineering design education. In Brennan R. &Yellowley I. (Eds.) 2nd CDEN Design Conference Kananaskis Alberta

Vardia, I., Quin, R. (2011) Promotion and the Scholarship of Teaching and Learning (HERDSA)

Acknowledgements

The authors acknowledge the financial support of the Australian Learning and Teaching Council and wish to thank ACED for their ongoing role in supporting and guiding the work of the authors. The views expressed in this paper do not necessarily reflect the views of the ALTC or ACED.