

Catalyzing Cultural Change in a Research Intensive University

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Abstract

The University of Queensland, a comprehensive, research intensive university, has established a Catalyst Centre in the School of Engineering, "to catalyze the development of a more diverse working, learning and research culture within engineering". The Centre is an incubator which fosters new modes of teaching and learning and conducts innovative socio-technical research focused on the many challenges facing engineering in the context of global changes in society, the environment and emerging technologies. The Centre provides a practical model for changing the culture from within in a research intensive university.

Background

In 1998, the School of Engineering commissioned an independent review of the state of the culture in the School. The resultant Diversity Report made some 63 recommendations concerned with creating a more holistic culture in the School. A core recommendation was the formation of a Catalyst Centre as a day-to-day focus for implementing the recommendations of the Diversity Report. The other recommendations were grouped into headings and included; a team-based approach; communication, consultation and transparent processes; valuing teaching; inclusive staff and student recruitment; links with industry; support of new staff; network of women staff; career development for general staff; work & family, fresher support and tone setting; support of indigenous and international students; gender, cultural and disability awareness and research in diversity issues.

Independently, the University of Queensland and Thiess Pty Ltd formed a Strategic Learning Partnership in 1999, for the "joint development and delivery of commercially focused education and research and development programs for industry, using the facilities and expertise of Thiess and the University". Through the Thiess-UQ partnership, a Chair in Engineering Education and Professional Development was established in 2000. The creation of this Chair was seen by the School of Engineering as pivotal to developing innovative responses to the many challenges facing engineering education in the context of global changes in engineering and technology.

The Thiess Chair provided the opportunity to create a Catalyst Centre as the operational mechanism through which to engage staff and students in this process of innovation and development. As a consequence, the Catalyst Centre was formed in May 2001. It embodies the essential objectives of the proposal in the Diversity Report but places them in broader, more pragmatic context. But while the Diversity Report and the Thiess Partnership respectively provided the impetus and the opportunity, the Catalyst Centre also draws on a rich history of innovation and scholarly activity in engineering education across the School. This included a significant input into the establishment and conduct of the National Review of Engineering Education held in the mid-1990s (IE Aust, 1996). Thus the Centre is a culmination of initiatives and activities as much as it is a new creation.

Centre Mission, Goals and Values

The mission of the Centre is to catalyze the development of a more diverse working, learning and research culture within the School, and as appropriate across the Faculty of Engineering, Physical Sciences and Architecture, and in its industry partners. The Centre is an educational incubator which models new modes of teaching and learning for staff in the Faculty and stimulates discussion of engineering, technology and social issues. It fosters cultural change through the agency of the staff and students who participate in its programs and projects. Through partnerships with industry and the community, the Centre facilitates innovative, lifelong learning programs and enterprise development strategies that address the challenges facing engineering and related industry sectors. Empirical research and policy development into the social and behavioral dimensions of engineering, professional development and practice underpin the work of the Centre.

The Catalyst Centre has five overlapping and interdependent goals outlined below.

1. Create new modes of engineering education and continuing professional development delivery and thus provide an exemplar for cultural change in engineering education.
2. Support the School (Faculty) to implement progressively the strategies in the Diversity Report, especially as they relate to staff and student recruitment and support mechanisms, social, gender, cultural and disability awareness and communication.
3. Develop the Thiess-UQ Strategic Learning Partnership and create new learning partnerships and alliances with other industry, schools and community groups.
4. Conduct socio-technical research and consultancy into engineering work practices and culture in relation to formal and workplace learning.
5. Build a network of national and international research groups with complementary strengths in the field.

The Centre fosters communities of innovative practice with an emphasis on diversity and inclusiveness both in the School and in partner companies. It aims to develop a scholarly environment that encourages and supports a more diverse range of participants and contributions. It facilitates the wider engagement of university staff with industry.

The activities of the Catalyst Centre are guided by a set of core values and principles listed below.

- Value people, diversity, inclusion
- Agility and innovation
- Collaboration and teamwork
- Soft and hard systems thinking
- Client focused and entrepreneurial
- Life-cycle perspective; sustainability
- Partnering / shared risk / mutual benefits
- Integrative, holistic
- Engagement and communication
- Triple bottom line; balanced score card

The fact that it has an explicit values statement says something about the orientation of the Centre. It reflects much of what the Centre is about.

A Point of Difference

The Catalyst Centre differs from conventional engineering or technology based research centres in several fundamental ways. It is a small, agile learning nucleus within a larger organization and it does not depend upon particular pieces of sophisticated experimental equipment. Its *modus operandi* is organic, situated and contingent. It is part of the community of practice not remote from it. The Centre takes an integrative approach to work, learning and innovation drawing on the work of the Institute for Research in Learning and Xerox PARC (Brown and Dugid, 2000).

The Centre is focused on people, process and practice rather than on equipment and facilities. For people from the physical sciences and engineering conditioned to research being located in traditional laboratories, there is not much to see at the Centre. Much of the research and other work of the Centre (and its precursors) is conducted in the field, *in situ* in real workplaces. This is nothing new for our colleagues from the social sciences. However, working in a strong physical sciences culture, this lack of tangible experimental artifacts makes the task of communicating what we do very difficult. Taken together with the use of qualitative modes of inquiry from the social sciences, this makes our work both confronting and superficially easy to dismiss, as it does not fit the prevailing paradigm.

Further, the Centre relies on *working through* people rather than by *employing* large numbers of people to achieve its ends. It has very modest resources – people and facilities. Using the catalyst metaphor it deploys these limited resources to transform a relatively large organization. It is a highly leveraged operation with a limited number of core staff supplemented by associates co-opted from various Schools, Centres and Institutes within the University and from external organizations. This mechanism provides the “intellectual horsepower” while simultaneously generating enthusiasm and advocates for the diffusion of new practices into the Faculty. It allows staff to co-create and experience the future now, while still operating under the existing paradigm. It is a low risk strategy that delivers options for the future.

Socio-Technical Research

In a research intensive university, it is critical that the Catalyst Centre be seen as a research centre as much as a teaching and learning development Centre. Given the very orientation of the Centre, the distinction between research, teaching and development activities becomes blurred at times, as all three are understood to be interconnected and interdependent.

The Centre conducts research on the interplay of social and technical mechanisms associated with the uptake of new technology and the development of more effective work and learning practices. This involves multi-disciplinary research teams with members drawn from engineering, the social sciences, the arts and education. Current research topics include diversity issues; technical communication; knowledge acquisition, interpretation, application and retention; workplace learning; reflexivity and socio-technical aspects of design engineering, design management, systems engineering and product development.

This research is a natural extension of the research work of the people who have come together in the Catalyst Centre. For nearly a decade the Engineering Practice Research Group - a precursor of the Catalyst Centre - conducted observational studies of engineering and other designers doing their work using methods from the social sciences to gather and analyze data. The foci included the role of communication and physical artifacts in collaboration (Logan and Radcliffe, 2000; Radcliffe, 1997), tacit knowledge (Wong and Radcliffe, 2000) and virtual teams in rehabilitation medicine (Logan and Radcliffe, 2000). These empirical studies were complemented by the development of the theoretical underpinnings of professional practice and the formation of engineers (e.g. Holt and Radcliffe, 1991; Holt, 1996; and Solomon, 1997).

Over the last five years, a series of studies have been undertaken into strategies for developing reflexive habits in engineering students (Jolly and Radcliffe, 2000). This collaboration between anthropology and engineering is continuing as a key part of the Catalyst Centre, with a focus on developing these abilities from the earliest stages of the course. Through the PRIMED project - *Personal Reflexive Instruments for Monitoring Expertise Development*, a suite of resources to assist students and faculty with developing reflexivity was created (Jolly, 2000). An emerging area of research is in technical communication, a collaborative research project between the Departments of Chemical Engineering and English.

A significant area of R&D collaboration continues with the university library in the area of web portal development, metadata and knowledge management. Major achievements thus far have been the Australasian Virtual Engineering Library (AVEL) with over 4000 records and wide national and international recognition (Radcliffe *et al*, 2000). An offshoot of this is AVEL-SD and the Sustainable Knowledge Network.

New Ways of Learning

The Undergraduate Site Learning Program (USLP) is currently the flagship baccalaureate program operated out of the Catalyst Centre. This innovative program blends elements of formal study with a 12 week industry placement. Unlike co-op programs the students are enrolled in a full program of study while on a full-time placement. This is made possible by a novel pedagogical model that aligns the workplace activities with the formal learning program. By placing traditional courses in the workplace context, the program aims to enhance the people and

business skills of its graduates without compromising their technical knowledge. On the contrary, the knowledge they gain is knowledge-in-action and the other experiences broaden their understanding and their networks. This process is supported by a new course called Professional Development, which forces the students to reflexively analyse their broader learning in terms of the development of desirable graduate attributes.

The USLP has run successfully for 2 years with 36 placements across 12 companies, in 22 workplaces in the disciplines of mining, minerals processing, civil, environmental, mechanical, chemical, materials, and software engineering. Many of the students have been located in geographically remote sites and two were placed in the USA and France. The program is under continuous evaluation and improvement. The workplaces, mentors and students are de-briefed. The industry response has been very positive. Many students have been keen to take on this challenge, although it is not for everyone. We have learnt many lessons which contribute to the on-going development of this program.

The USLP received a national award from Australasian Association of Engineering Education in 2000 for Innovation in Engineering Education.

Impacting the Culture

New programs like the USLP challenge many cherished beliefs and deeply held assumptions of individuals and institutions. They provide a discontinuity in the regular teaching and learning process sufficient to reveal hidden aspects of practice and to raise questions. They open the way for a discourse which engages the faculty member on their ground. Specifically it has provided a practical platform of exploring ideas about the meaning of flexibility in teaching and learning.

The challenge for faculty is to adopt a flexible learning strategy, which we define as a student-centred approach. The primary question shifts from "what am I (teacher) going to do?" to "what is the learner doing or engaged in?" The change in mindset is fundamental. Faculty are sometimes surprised that students can learn and achieve high grades without the benefit of lectures. To assist course coordinators involved with the USLP (and faculty more generally), the Centre created the Flexible Learning Strategies program. This is a series of seven, 3 hour workshops distributed across the semester. Staff work together based on action learning principles to develop a more student-centred (flexible) approach to their course design and delivery.

The USLP has broken through a barrier that limits all engineering programs - the percentage of female students participating. In Australia, the percentage of women entering engineering programs has risen to a peak in the low 20% and is either stationary or falling. In some disciplines like environmental or biomedical engineering, however, the female / male proportions approach 50:50. In others like mechanical, the numbers are around 10%. In the two years of operation of the USLP, 42% of the participating students (15 out of 36) were females. This is more remarkable when you consider that it commenced with mining engineering and has spread to civil, chemical, mechanical and other disciplines. The percentage rose from 33% in year one to 46% in the second year. Although the numbers are small this suggests that there are aspects of the program that appeal to women.

This relates to the Centre role in implementing the Diversity Report to ensure that the operational environment does not constrain people - students, faculty, staff - in being full participants in the shaping of new ways of being in an engineering school. The procedural and administrative aspects are relatively straight forward to change. Changing behaviours and attitudes is something else. Some excellent examples of more diverse and inclusive engineering work environments are emerging in pockets of industry. Through exposure and staff exchanges these exemplars will contribute to the catalytic process of growing radical change essentially from within.

Another operational discontinuity that can be exploited to bring about cultural change is the new accreditation requirements. Similar to ABET 2000, the Institution of Engineers, Australia has adopted new accreditation requirements for engineering programs with a focus on outcomes and graduate attributes. The Value Added Career Start (VACS) Project, just completed in the Catalyst Centre, has created a suite of learning modules to assist students to develop desirable graduate attributes across the curriculum. To complement the creation of the VACS Modules, the Centre has begun facilitating workshops on Graduate Attributes for faculty to embed these ideas in a new conceptualization of the emerging role of faculty in a knowledge based economy.

Developing Partnerships

The Centre is developing a network of intra-university projects as well as national and global collaborations with other universities, enterprises and community groups with complementary interests. This collaboration will include participation in symposia, sharing of resources, joint research and developmental projects with two or more sectors represented, exchanges of staff and students, international workshops and formal learning partnerships.

Not only has the Thiess-University of Queensland Strategic Learning Partnership enabled the Catalyst Centre to be formed, it also provides a robust model from which we can learn about the operation of successful partnerships. This formal alliance is based on the principle of shared inputs and mutual benefits. The relationship provides the University with a test-bed to develop, evaluate and improve "industrial strength", genuinely flexible, lifelong learning programs. The Thiess-UQ Partnership was recognized with a Business-Higher Education Round Table Innovation Award in November, 2001.

Closure

While the Centre is still in its infancy, its achievements thus far (and those of its precursors) have achieved a high degree of peer recognition. The early success of its programs suggest that this model for fostering collaborative innovation in engineering education has potential to be developed further.

As the number of faculty involved in Catalyst Centre research, teaching and development, increases the nature of the operation of the Centre will change. It faces challenges similar to those of any start-up or small enterprise as it grows, in particular inadequate resources and over extension. Managing relationships across an increasing complex network of participants in different sectors and geographically dispersed is a particular point of vulnerability. The anticipated growth of local, national and international networks over the next year will bring similar growing pains. The Centre must develop sustainable means to harness these additional inputs while still maintaining a sense of cohesion as an agile learning organisation.

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