Sculpting the sculptor
Designing a faculty support program for new CDIO member institutions

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*Conference Theme 5: **Faculty Development**.*

*This paper has a primary focus on **Standards 9 and 10**, but may have fleeting relevance to other standards as well*

1. INTRODUCTION

The University of Pretoria is a new member to CDIO but not new to engineering education. The drive to align our activities to reasonably correspond to international engineering education methods, is not an isolated incident, but part of a continuous cycle of didactic evolution. The CDIO initiative does however present an opportunity and impetus to this quest. The people factor in faculty members may at times leave some of them unconvinced and even unequipped to deal with the challenges modern engineering education presents. Changes are required from the methods lecturers themselves experienced as students and while most staff would readily acknowledge the fact that they are primarily engineering specialists and not didactic experts, the nature of the task at hand call for mastery of both disciplines.

This paper reports on an initiative at the University of Pretoria to identify faculty needs in this regard. It also reflects the necessary interventions to support faculty in not only changing their own approaches where necessary, but in taking the lead to ensure that our learners' abilities reflect the necessary competence.

There are no quick fixes in education. The intention of sharing our experiences here are not to imply universal applicability. This is not an attempt to define simplistic solutions either. This paper aims to:
  * highlight contributing factors;
  * identify methods by which needs and attitudes can be understood; and
  * elude to some concepts to be aware of when approaching CDIO adoption.

While this paper focuses on experiences at the University of Pretoria, It may be of help to other new institutions to prepare and support staff during the CDIO adoption phase.

2. FACTORS INFLUENCING CHANGE

"*Μμνεσο, τι καэ τэ μετατэτεσται καэ эπεσται τэ διορτοэντιэμοэоэ эλ εэτερэν эστιν.*"

. *(To change your mind and to follow him who sets you right is*

to be nonetheless the free agent that you were before)

Marcus Aurelius

Change is a constant factor in the lives of academics. Changes do not only involve people but the process of change also affects the way information is perceived and reacted upon. The mind needs to evaluate and encode new information in order to determine potential impact. Within new circumstances individuals may find themselves in a position where it is necessary to realign with the new reality. New insights and understanding are generated and often produce new questions. Individuals are enriched by these changing cycles producing, for example, psychological growth.

Change should therefore not be viewed as merely peripheral and circumstantial alterations, but as a valuable tool to foster growth. Changes and the resulting intellectual drift are vital in terms of growth, but often uncontrolled and involuntary. Intellectual drift is not a destination, but a constant or at least recurring cycle of definition, which leaves room within itself for some inevitable self-contradiction, redefinition and growth.

2.1 Receptivity
Receptivity is a term used to indicate the degree to which individuals would be willing to participate in a change process out of free will**.** It is vital to realise lecturing that staff are under tremendous pressure to perform on multiple areas. This debate is explained eloquently in the aptly named article by Richard Felder (1994) "The Myth of the Superhuman Professor"

Lecturers often do not obtain formal qualifications in teaching. As a result, many of them revert to teaching in a way that they have been taught. Not always text book stuff. Now, in a culture changing towards transparency and access, many feel insecure to expose their practice to the scrutiny of fellow lecturers and administrative colleagues. Change management strategies should allow for differences in personality types and their reactions to change.

Another dimension to receptivity is the locus of apparent need. Should change agents offer interventions on issues that faculty perceive as valuable in order to address an immediate need, individuals would be more likely to participate.

2.2 Change Adoption
Receptivity is also influenced by the effect of change on individuals and their ability to deal   with   change   in   a   manner   that   is   constructive. The main stages of Brock & Salerno's 1993 change cycle are repeated in table 1.

Stage	Feelings of:	Thoughts are:	Behaviour is:
Loss	Fear	Cautious	Paralysed
Doubt	Resentment	Sceptical	Resistant
Discomfort	Anxiety	Confused	Unproductive
Discovery	Anticipation	Creative	Energised
Understanding	Confidence	Pragmatic	Productive
Integration	Satisfaction	Focused	Generous

Table 1: The Impact of change (adapted from Brock & Salerno, 1993).

As seen in table 1, people who should find themselves in the early stages of the change cycle, experience feelings that will prohibit them from utilising the opportunities to work through those changes. The feelings of people who are experiencing the first three stages of change namely loss, doubt or discomfort, are not the type of feelings that foster thoughts conducive to the types of actions that will bring people to volunteer for developmental activities. Instead, Brock & Salerno (1993) suggest these thought patterns to be cautious, sceptical and confused.

In fact, as table 1 also indicates, the natural actions of these people are paralysed, resistant and unproductive; Not the type of person likely to experiment with CDIO initiatives.

By implication people that have progressed through to the stages of discovery, understanding and integration, may show energised, productive and generous behaviour that can be interpreted as indicators comparable to those of the attitudinal domain of receptivity.

Receptive attitudes are fertile ground and add value to co-operative learning environments which are common to CDIO. This correlates with the high value respondents give to networks and peer support. The collaborative nature of CDIO participation should be fostered!

Change, availability and opportunity per se can not be seen as determinants of whether people will utilise opportunities for CDIO or not. The key factor is the reaction to the change and the resulting attitudinal position within the change cycle.

Unless staff are made aware of this impact of change on their attitudes, their natural reactions to change therefore would indicate an inverse proportionality between the likelihood of volunteering participation and their exposure to change.
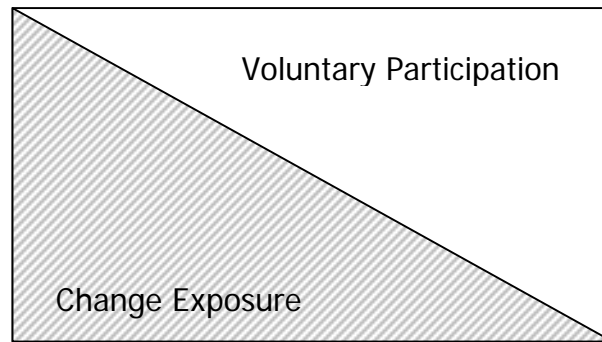
Figure 2: Inverse relation between change exposure and voluntary participation

2.3 How People React to Change

Different people have different capacities for dealing with change, but because people are most productive when they enjoy the activity they are busy with, it is beneficial to equip people to deal with change in a way that will still enable them to enjoy their task. The point where enjoyment is experienced is a dynamic one, and is dependent both on the skills level of the individual and on the challenge level of the activity at hand (Csikszentmihalyi, 1990). By implication change may leave staff members with a situation where the challenge is greater than the ability to deal with change. As a result, many may be left with feelings of anxiety and loss of control, which in turn leads to greater demotivation (Malone, 1981).

Change is at the heart of staff development. The increased tempo of change seems to call for an increase in developmental activity and lifelong learning.

3. CDIO RECEPTION

A number of staff members from the University of Pretoria attended the CDIO workshop in Pretoria during February 2005. Their reactions on CDIO is captured here together with their opinions as to the impact on their practice, some suggestions and ideas for future roll out and their requests in terms of assistance needed in order to fully incorporate CDIO into their practice.

3.1 First Impressions

Most people were soon to comment that it was nothing new. However when followed up with a question regarding examples of existing practice, the answers often tended to become more vague and comments like "Well, not exactly like that, but we do a number of projects, practicals and group work exercises". One individual said that it only enforced what he knew (from theory) should happen, but what could not realize as a result of practical constraints.

While there may be some doubt as to exactly how close the correlation between CDIO standards and existing practice may be, it is a very welcome phenomenon that nobody disagreed with the desirability of such endeavours.

For the sake of objectivity it should be repeated that only those whom attended the CDIO workshop were interviewed during this cycle, so should there be any individuals in outright opposition to the practice, they may very well not have been at the workshop and hence did not form part of this focus group.

The structure given to the quest towards ensuring qualified engineers with a more complete competence profile received regular mention. The resulting opportunity for subject specific didactic networking also received favourable mention.

3.2 Impact on Existing Practice
Other than reflection on existing practice and some good intentions, no hard evidence of changes in practice could be found. While it is unfortunate not to have generated enough momentum to translate into immediate activity, there were some individuals who claimed that the attendance of the workshop gave them the self-confidence to apply more boldly some active and experiential learning methods which they have been experimenting with.

3.3 Suggestions
There were a number of suggestions which could alternatively have been interpreted as excuses, but which may hold potential in terms of their impact as enablers of CDIO practice. They are listed below in no particular sequence.

- The natural flow and development of some mathematical models, leans itself more towards lots of in-class writing. Some lecturers feel that the discovery nature of answers could be lost in presentations where the visuals are pre-prepared slides/notes. More access to computers where models could be tested would be an improvement in this regard as the time lapse between the discovery of new possibilities and the opportunity for mathematical modelling and testing could enhance just in time learning and aid motivation of learners.
- More realistic and even real life examples should be used. The opportunity to share experiences with fellow lecturers in the same subject discipline is welcomed and while nobody as yet claims to have used the CDIO website as a vehicle for such collaboration, the potential of such activity has often been mentioned.
- Some lecturers feel that they are more than willing to use the CDIO standards as guidelines, but that they do not want an additional label attached to their modules. They prefer to use the CDIO information and approaches, but for now do not feel a need for 'baggage' which may distract student focus from their envisaged outcomes onto process issues.
- A more pronounced invitation for networking between staff members who facilitate the mastery of similar competencies was suggested. There may be a need for initial facilitated contact as people prefer to lurk rather than to take the risk of 'public' exposure. To get things rolling, a lecturer in the mechanical engineering faculty invites staff with an interest in Operational Research to contact him. I would be more than willing to act as initial contact for such interaction.

3.4 Current Hurdles

Similarly to the suggestions made above, some lecturers also identified a number of hurdles which they feel can/should not be addressed by lecturing staff alone. The hurdles identified here are items seen by staff as factors which works against the CDIO goals. While it is acknowledged that these hurdles may not always be as insurmountable as they are perceived by some and may not even be present at all institutions, the feeling is that their mentioning may hold true for a number of institutions as examples of reaction from staff.

- University administration requires formal qualifications which are linked to remuneration and seniority of appointment which sometimes keeps salted engineers in a position where they can not afford to join the university staff. At the same time junior people with formal qualifications are employed and in the process practical expertise becomes second and even third generation realities.
- Staff are often not utilised in exactly the field of their industry experience. One member of staff admitted that while he has extensive practical expertise in one area, his current lecturing is in a parallel yet different field. As a result he is hesitant to embark on practical work with students in this 'new' field, where he has no practical experience.
- Some modules are offered to all pre graduate students by a number of lecturers in different languages and time slots. The need for co-ordination and a history of difficulty with this module, makes some of these members of staff very hesitant to experiment.
- Time! To redesign the didactic approach to a course or module calls for increased time commitment from the lecturer. As a result of, amongst others, a recent subsidy cut by government, the workload on members of staff does not encourage huge time investments in redesign. Some members of staff are open about this reluctance while others deny or only grudgingly admit the premium on their own time as a factor in CDIO uptake.
- The engineering curriculum is heavily laden credit wise. As a result the amount of time available to students to spend on a particular component of study is by no means unlimited. Lecturers report that current contact hours are at times as much as 1:1 in terms of additional hours which could realistically be expected from students' own work. This limitation is often recognised for the sake of collegial relationships and not only as a reaction to student reaction.
- Undeniably linked to the previous point is the prevailing study culture amongst students. Some lecturers report a discrepancy between the workload claimed by students and the reality of time spent by their own children who happen to be engineering students. There may be unrealistic perceptions in the minds of students with regards to the amount of leisure time realistically available to engineering students.
- An issue that deals with culture is student perception regarding percentages. Over time students became used to a measure that were either indicated by official pass percentages or personal goals such as student that work to reach 75%. Few students are driven by a desire to achieve competence for the sake of competence and students are often more than happy to "write a subject off" with an acceptable grade while they still do not fully appreciate the value of a selection of work or the logic behind a particular approach. For many students it is enough to know "how" even while not knowing "why". A related result of this percentage driven culture is that students often stop short of real competence.

They make "mathematically based " decisions and neglect sections of work because of its relative value to achieve a particular grade. For example; a student would skip a practical in one subject in order to study for a written test in another module. When asked for motivation, students would claim that the test counts towards their grade, but since the practical does not, the practical does not warrant the time investment.

4.SUPPORT IMPLICATIONS

Different approaches to managing change exist. These should not be seen as contradictory or exclusive. They should rather be viewed as complementary, since people differ in their reactions to change.

From this investigation it would seem that there are a number of areas where initiatives to bring about change would be valuable in terms of CDIO goals.

- Staff members are willing to change but need access to support and resources. A culture of CDIO communities of practice needs to be actively encouraged.
- Staff members are mostly open about their initiatives and experiences, but are not likely to volunteer themselves as 'case studies'. By creating platforms for staff members to share their experience, they do not only get into contact with colleagues in similar situations, they also foster a culture of CDIO experimentation and action learning. Such platforms exist, but some pressure or accommodation from line managers could do well towards breaking inertia.
- Since many people claim that they do similar work, it may prove worthwhile to contact authors of engineering education papers dealing with work which seem to reflect CDIO standards, to ensure that these people are aware of CDIO as international 'holding company' of reality based engineering education. By doing so people may experience recognition for work well done and we may broaden our existing cadre of experienced practitioners.
- The CDIO website as a repository of examples, individuals and like minded institutions could do well to act as base for a CDIO community of practice. A list serve (with subject subdivisions?) for all staff members interested in CDIO should be investigated as junior staff members report that they do not feel free to ask or contribute via existing structures as this is seen to be reserved for CDIO or institution interests and not for individual staff members and their lecturing activities.
- A number of issues reside within the realm of University administration and individual staff members do not feel sufficiently passionate about CDIO practice to attempt to change faculty wide systems. Should universally important issues be identified (like possibly the identification of critical competence outcomes where mastery in sub areas are expected and not merely an average passing grade), CDIO endorsed recommendations to deans of participating institutions, could help to give prominence to the rectification of issues which may have become enshrined.

5.CONCLUSION

Good educational practice do not come by chance. It requires dedicated planning and diligence as well as a substantial time investment. Staff at our engineering faculties seem to be positively inclined towards CDIO practices, but the competition for the time of these lecturers are such that planned and dedicated support of such practice is needed to ensure uptake and growth. CDIO has done well in giving prominence to quality responsible engineering education. Now we need to capitalise on the existing and budding goodwill by not only supporting institutions at large, but also by supporting individuals. The nature of this support could take many forms, but individual staff members at institutions new to CDIO may welcome a strong hand in the back in order to face the challenges of change.