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Appendix 3

ON THE PEDAGOGY OF ETHICS IN ENGINEERING DEGREES: RATIONALE, IMPERATIVES AND INTERNATIONALIZATION

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Abstract

Nations that are signatory to the Washington Accord (1989) accept that the teaching of ethics, in a professional context, is mandatory for undergraduate engineering curricula. The inclusion of ethics, in otherwise very tight curricula, is due to the changing role of engineering; in particular it reflects a greater public awareness of the effects of engineering processes. On the basis of this, it follows that engineers are required to demonstrate transparently responsible practice in the knowledge that they are indeed accountable for their actions. In most countries, this requirement is embodied in legislation. The teaching of ethics to engineering undergraduates is a relatively new concept. This paper provides an overview of one methodology, the “full submergence” technique, wherein engineers are challenged to respond to ethical conundrums in a high intensity project-based, block course. Over the last decade, this model has been successfully used in four countries.

Key words:

Engineering ethics, resource degradation, natural environment, engineering curriculum.

1. The setting:

At the close of the 20th Century, public perception of widespread environmental mismanagement (with resultant loss in biodiversity, and increasing pollution), was instrumental in the formulation of new *environmentally sensitive* legislation and professional codes. Codes of ethics that were developed by bodies such as the Institution of Engineers Australia and the Institution of Professional Engineers New Zealand, went well beyond the “code of practice” that had existed for decades, for unlike a code of practice, these codes of ethics incorporated a professional engineer’s obligation to both the wider society and the environment (I.E.Aust, 2000). Legislation, such as New Zealand’s Resource Management Act (1991), and Queensland’s Environmental Protection Act (1994) codified the manner in which natural resources were to be developed and managed. A most interesting inclusion in the legislation of both is a requirement for those wishing to undertake activities under the act to accept a *duty* towards the natural environment. At the time, this concept of *duty* in legislation was novel, for it implied a higher-level consideration and response to activities that are deleterious to society and nature. In other words, engineers, resource managers, developers and local authorities were required to exercise ethical judgment upon the effects of their activities. Furthermore, judgment was to be transparent (Buckeridge 2004).

The need to exercise *ethical* judgment in an increasingly secular world disadvantaged some practitioners who, without formal training in moral theory, lacked conviction (or empowerment) to make ethical decisions about resource use. This, in turn, led to international degree accreditation bodies (such as the Washington Accord), to demand that the teaching of ethics be mandatory within professional degree curricula. This has now been enacted in engineering degrees in all those countries signatory to the Accord¹.

¹ The Washington Accord facilitates cross-national movement of engineering professionals through recognition of the equivalency of the accreditation systems of organizations holding signatory status (and the engineering education programmes accredited by them). Signatories to the Washington Accord are Australia, Canada, Hong Kong China, Ireland, Japan, New Zealand, South Africa, United Kingdom and United States of America. Chinese Taipei, Germany, Korea, Mexico and Singapore are currently provisional members.

2. Just what is meant by ethics?

Although the concept of *ethics* is not new, there is no universally agreed code of ethics, i.e. there is no immutable formula that one may apply to unravel an ethical conundrum. This lack is testament to the nature of ethics, which are derived from the moral values of any particular group or society (Buckeridge 2002). As history shows, these values are constantly in flux. However, I have taught ethical theory to undergraduate engineers in some dozen countries, and have found that there is one important constant: students from all cultures tend to view what is right (and wrong) with remarkable consistency. This is not surprising perhaps, as moral theory is deeply imbedded in both Western and Eastern cultures. Confucius (5th Century B.C.) believed that reconciliation of one's own desires with the needs of family and community was morally good. This development of *good character* is similar to the views of Aristotle, who in the 4th Century B.C. wrote what are now known as "Virtue Ethics". However changing social structures (and values) led to the development of new moral codes, such as utilitarianism (wherein ethical decisions are based on consequences), deontology (based on an underlying rationale), or existentialism (based on the adoption of profound personal responsibility for actions).

In this paper, **ethics** is defined as: *the application of moral values within a professional context.*

3. The nature of ethical judgment

After a period of several years experience, engineering graduates may apply for corporate membership of the engineering profession. Irrespective of whether they are Chemical Civil or perhaps Electrical Engineers, the process will result in their being recognised as a professional *engineer*, i.e. no specific discipline is specified. However, the Code of Ethics is very specific about the duty of engineers to practice only within their area(s) of competence:

2. Members shall act with honour, integrity and dignity in order to merit the trust of the community and the profession;

3. Members shall act only in areas of their competence and in a careful and diligent manner;

Tenets 2, 3 of the Code of Ethics (I.E.Aust, 2000)

3.1 Duty of care: This leads to one of the first issues a young professional engineer may need to face: in situations where they are informally asked about some aspect of engineering that is clearly outside their area of expertise... i.e. they are asked, in a casual manner by an acquaintance, for engineering advice. There is no contract, and no money changes hands. Perhaps they do not wish to offend, and respond to the question along the lines of "it looks O.K. to me, good luck with your project". Are they then liable for damages if the project goes drastically wrong?

There are clear guidelines for engineers in this situation – engineers are duty bound not to provide advice outside their area of technical expertise; however, this case has further issues: if advice is *informally* given, and there are subsequent problems resulting in litigation, professional indemnity insurance will not cover legal fees, court costs and rulings. This is because no fee was charged for the advice (= service). If social pressure made it uncomfortable for the engineer to offer no advice at all, advice may be given, but with a clear

caveat that this was **not** professional advice... however even then there may be misinterpretation.

3.2 Duty and consequences: The above example provides an opportunity to explore the manner in which decisions may be made. If a deontologic approach is adopted, where the overriding principle is duty (or obligation), problems arise when more than one duty exists. For although there is a clear duty of care (as a professional), there may be other duties, some of which may conflict; these may include *obligation* as a neighbour, or to another party, who is unsympathetic to the person who sought the advice. A further approach involves assessment of the consequences of action (or lack of action). There may be a number of potential consequences, and these too may conflict. However, the principle of utilitarianism (i.e. moral theory based on consequences) is that the result should provide the greatest benefit for the greatest number. In almost all situations it is possible to rank the importance of consequences.

Rarely however, is application of one moral theory sufficient to solve complex situations. We know instinctively, for example, that the act of lying is generally unacceptable. Indeed this was the categorical opinion of Immanuel Kant (the most well known deontologist), who was very much opposed to utilitarianism. However most of us concede that there may be a (small) place for untruths, especially if it is to protect a greater good (utility); this interpretation is reflected in other moral theories, such as virtue ethics, where demonstration of good character is an overriding imperative.

A strength of the course is that it provides a non-threatening learning environment in which students are encouraged to debate issues such as this. Students generally show a rapid shift from apprehension to assertion.

4. What do engineering students think about including ethics in the curriculum?

Generally those students who choose to study engineering and technical programmes do so because they are “left brained” i.e. they are good at subjects such as mathematics and logic, but tend to be less comfortable with philosophy and the arts. Indeed, many engineering students have indicated that it is with some trepidation that they approach the “professional ethics” part of the course. However, feedback after the course has been overwhelmingly positive – independent student assessment of the course over the last decade has provided statements like:

“...the course provided an opportunity to develop new perspectives on life, the engineering profession and society”

“...(I am confident that) the course will lead me to become a more proficient, competent and resourceful global engineer” (Buckeridge and Grünwald, 2003).

The course “Ethics & the Professional” has been run at RMIT University, Melbourne, AUT University, New Zealand and Wismar University of Business, Technology and Design, Germany from the mid 1990s. Recently, on the basis of a successful track record in Germany, Østfold University College, Norway has also become involved. Independent, anonymous feedback from students consistently indicates strong support for the content, structure and the delivery of the course. Of importance is positive student feedback regarding the supporting text *Ethics & the Professional* (Buckeridge, 2002), which was written to provide a clear foundation from which students may attain an agreeable level of mastery in ethics theory.

5. The nature of the course

5.1. Course content: Both class and the text *Ethics & the Professional* are divided into five parts; Part 1 introduces morality and ethics from social and historical perspectives – the concepts of universal truth(s), justice and the codification of moral rules are provided a rationale for the development of diverse theories; Part 2 introduces these ethical theories, including any impetus (e.g. industrialisation) that led to their development; Part 3 contextualises ethics with a series of case studies; Part 4 provides a deeper consideration of professional ethics; Part 5 is comprises a series of questions requiring ethical judgment.

A key objective of the course is to get engineering undergraduates to contemplate ethical issues from a range of perspectives. In general, they should be able to conclude that one approach (or theory) cannot be applied to all situations. What is required then is for engineers to be able to navigate through the different approaches, combining or rejecting concepts as appropriate for a particular case.

5.2 Course structure: The course has been offered in two styles, as a block (i.e. a total immersion seminar running over three full days), or drip-feeding, as weekly lectures running over a full semester. Ocone (2005) suggests that the concept of a separate ethics course is flawed, and that ethics should be inculcated throughout the whole programme (i.e. in every course). However this is somewhat impractical, principally as many engineering lecturers are unsupportive of this – perhaps because they are uncomfortable with ethical theory, but also because they feel the time available for introducing ethics at any depth is insufficient². Student feedback however has overwhelmingly endorsed a block course. Indeed, if the course is to be run as a discrete unit, (and this appears to be the model most universities have adopted), then a weekly lecture is a poor instrument to provide continuity in what can be an intellectually demanding subject.

6. Closing comments

Those of us who provide degree opportunities in engineering have no choice other than to include ethics in our degree programmes. There will be debate about the nature of this component (content and structure) for some time, and this will continue until all lecturers are prepared to inculcate ethical theory throughout the programme. What is of interest is the approach to this issue by other disciplines, especially the sciences. Most science (and applied science) programmes have no ethics component. If we are able to conclude that science is a profession (and I accept this), then in a professional context, scientists can be expected to act responsibly; in addition, many will be *accountable* for their activities. In light of this, it is perhaps appropriate for us to consider the inclusion of mandatory courses on ethics in all science and technology programmes.

² An alternative approach, to have ethics theory taught by a lecturer from the Faculty of Arts is not an option either, as professional ethics is best taught in context, from/by an engineering practitioner. Although external academics are used by many engineering schools to provide “communication skills”, I am aware of significant negative feedback, primarily because of a need to communicate as *engineers* – this feedback has been both from engineering students and engineers.

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