SURREY CENTRE FOR EXCELLENCE IN PROFESSIONAL TRAINING & EDUCATION (SCEPTrE)

UNIVERSITY OF SURREY

End of Project
REPORT

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Teaching Ethics to Engineering Students

A Feasibility Study on the Development of a Cross-Disciplinary Enquiry-Based Learning Undergraduate Provision in Ethics for Engineers

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“Professional Engineers work to enhance the welfare, health and safety of all whilst paying due regard to the environment and the sustainability of resources. They have made personal and professional commitments to enhance the wellbeing of society through the exploitation of knowledge and the management of creative teams.”

Royal Academy of Engineering, ‘Statement of Ethical Principles’.

Preface & Acknowledgments

I am grateful to Prof Norman Jackson, Director of the Surrey Centre for Excellence in Professional Training & Education (SCEPTrE) for providing me with this opportunity to expand my experience in teaching ethics to undergraduates and for his continuing support and ideas. The SCEPTrE staff and the other Fellows 2006-2007 have also helped facilitate this study, especially through the lunchtime meetings, and stirred both the imagination and a pragmatic sense of things.

Colleagues in the European Institute of Health & Medical Sciences (now part of the Faculty of Health & Medical Sciences) have over several years helped shape my experience in teaching ethics to healthcare professionals.

In Engineering I would particularly like to acknowledge the encouragement of Prof Mike Kearney (Dean, Engineering), Prof Ugur Tuzun (Chemical Engineering), Prof Roland Clift (Environmental Engineering), Dr David Carey (Electronic Engineering) and Dr Julie Yeomans (Materials Science), as well as, of course, the Professional Year Tutors who kindly agreed to be interviewed.

Executive Summary

For an immediate grasp of the findings and recommendations of this feasibility study go to sections 3.3, 6.1 and 6.2.

1 THE PROJECT

1.1 Context and Objectives

The project is a small scale inhouse feasibility study on the development of a cross-disciplinary enquiry-based learning (EBL) undergraduate provision of ethics for engineers. (The original conception was broader, aspiring to embrace provision in departments in Healthcare and in Management, but this was fairly soon whittled down as being far too ambitious for a three-month undertaking.)

The specific goal is to begin to create the conditions for a flexible EBL university-wide undergraduate provision in ethics, while at the same time undertaking a feasibility study into the form of delivery this might take. The general goal is to enrich students' experience and make them better prepared for the real world of their professional careers, with its responsibilities and its inevitable complexities and social dynamics.

Professional training across the board increasingly attaches importance to an ethics dimension, and in engineering is now emphasized both by the Engineering Council and the Royal Academy of Engineering. Such an emphasis has obtained in the healthcare professions (nursing, medicine, physiotherapy, etc) for about 20 years, and in some cases has been included in statutory training requirements. Accountancy and auditing, social services, and policing also came round over a decade ago to the recognition that ethics must be included.

1.2 Summary of Empirical basis of this project

The empirical and documentary work done for this project is as follows:

- My own teaching of ethics to a variety of engineering students in the University, as well as my experience of online provision of ethics material
- Interviews with three University Tutors (Professional Training) in Engineering
- Interviews with some Senior Academics of the University
- Interviews with representatives of two major professional Institutions in engineering (Civil Engineering, Computing Science)
- Examination of official documents relevant to ethics (including Codes of Conduct) to be found on the websites of engineering Institutions, Engineering Council (UK) and the Royal Academy of Engineering
- Attendance at a Royal Academy of Engineering workshop on teaching ethics in engineering
- Opinions and evaluations from independent experts in engineering, other professions and ethics
- Discussions and workshops with SCEPTrE colleagues.

I emphasize that this is not intended as a survey-based research project. As already stated, it is a small-scale feasibility study for the University of Surrey, and aims to initiate a stakeholder dialogue, and in this Report this dialogue commences by means of reflections on 'off the top of the head' thoughts of three Professional Training tutors. The interviews are not intended to be 'objective' or 'detached', because I deliberately engage with the interviewees to make suggestions and answer their own questions about ethics provision. A shortcoming of this project is that I was able, in the short period available, to interview neither engineering students nor engineering employers. This would undoubtedly prove very important and I hope to rectify this with further work in the near future.

1.3 Prior experience

This project builds, in addition, on the experience I have gained in teaching ethics since I first taught Moral Philosophy at Cardiff University in 1985-86. At the University of Surrey, since 1998, I have been teaching ethics at various levels (UG, PG and CPD) across the university, in disciplines as diverse as healthcare, computer science, political science (PIPS) and engineering; and at other institutions both nationally and internationally. I am co-organiser (with Dr Verena Tschudin) of the annual International Summer School in 'Teaching Ethics' for UG/PG/CPD educators of healthcare professionals, at EIHMS (now absorbed in the Faculty of Health & Medical Sciences), which has been developing diverse ethics teaching methods. I am the originator of ethics delivery tools such as 'REPVAD' and Anonymised Shared Reflection. I have also taught ethics to social workers, and to police officers as an occasional Visiting Lecturer at Bramshill Police Staff College, Hampshire.

Most recently, the professions in science, technology and engineering are recognizing that excellence in professional training involves ethical awareness and knowledge. I have spoken on ethics at meetings of professional bodies in science and engineering, and also taught ethics to computer science, biomedical engineering and

electronic engineering students at the University of Surrey. (I am also chair of a faculty Ethics Committee, and member of a local hospice ethics committee.)

I see this as an opportunity for the University to sustain and enhance its leadership in professional training and education by explicitly developing an ethics dimension across the engineering (and other professional) disciplines in new areas and new ways.

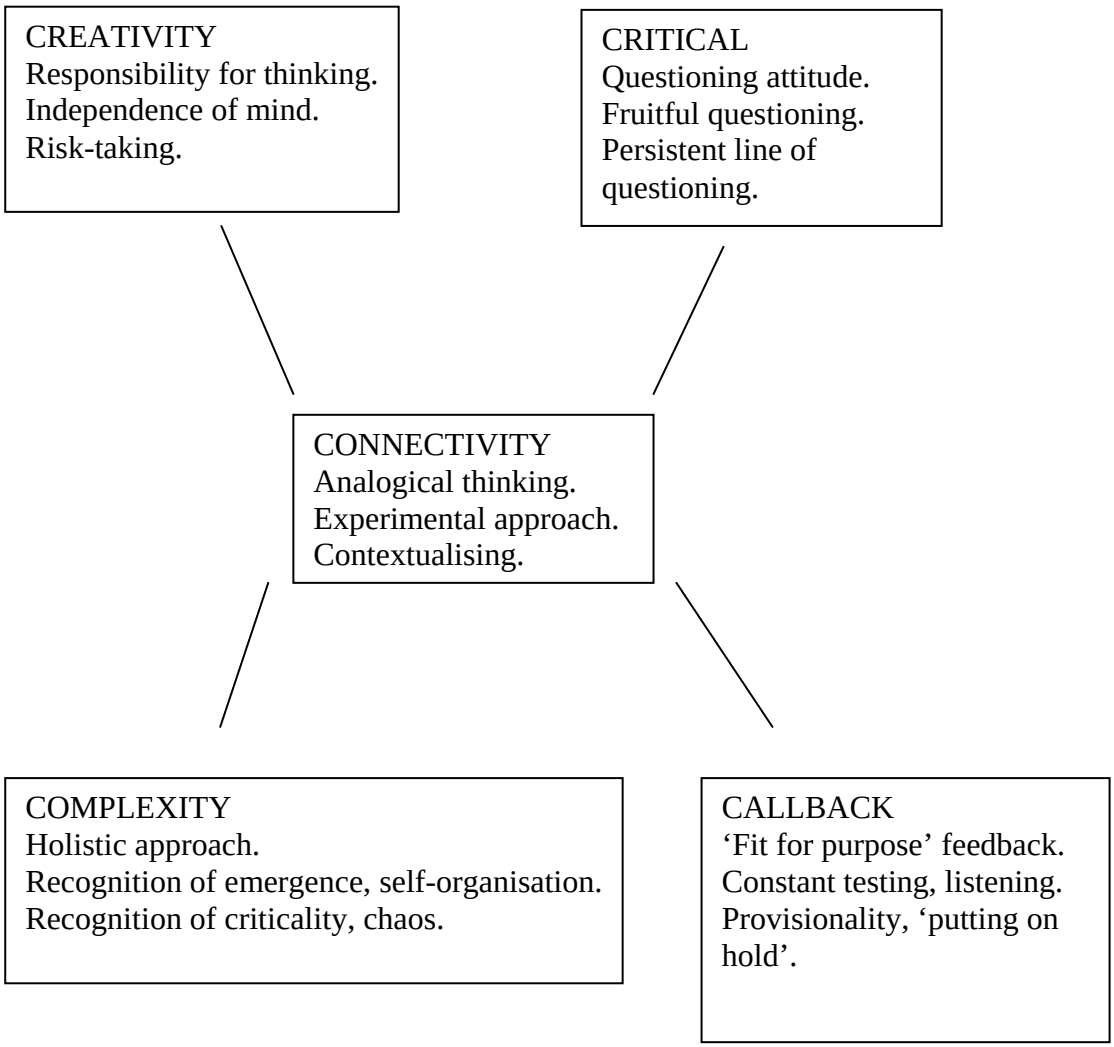
1.4 Enquiry-based Learning

An Enquiry-Based Learning (EBL) approach is most suitable for this project in two regards:

- Ethics teaching/learning in particular lends itself extremely well to an EBL approach, because of the inquiring, problematic and negotiating nature of the questions and answers posed.
- Quite diverse disciplines can pose and explore ethical questions in the flexible space created by EBL style provision.

As part of this project I gave considerable thought to what defines EBL and propose an exploratory map in Diagram 1 below, for use in staff/student development workshops.

Diagram 1: Exploratory map of EBL - 'The Five C's' proposed by Geoff Hunt



I learned a great deal from deploying EBL during an Anglo-Japanese 'Young Scientist Workshop' (sponsored by Clifton Scientific Trust), held at SCEPTrE, in which I had he opportunity of deploying EBL during a week long 'climate change, health and ethics' group that I facilitated (see Hunt, 2006c). Since these were school-leavers, their minds were very open and inquisitive and had not been socialised into the closure of a 'technical mode of thought'.

Experience shows that during coaching and mentorship ethical questions often emerge, since trainees and mentees have a (supposedly 'naïve') questioning attitude that may be lost once socialized into an established profession that is still partly working with outdated general assumptions in a fast-changing world.

1.5 E-Learning and PDP

Ethics requires one-to-one and group discussion, preferably face to face. However, interactive digital technology has proved to be an important support for students exploring ethical issues, enabling for example bulletin board/chat room enquiry and debate between people in different locations, professions and cultures, and when students are on a work-based programme or placement.

Personal Development Plans (e.g. as components of learning contracts) can and should include the development of an ethical awareness of professional practice in a wider inter-agency, inter-professional, social and global context. The proposed EBL module will enable students to use aspects of their work as a vehicle for their individual development. They could be exposed to a range of interactions incorporating ethical aspects, including personal goal-identification, self-assessment questionnaires, time-lines, self-reflection activities and participation in learning sets. (See: University of Surrey. *Personal Development Planning*. Compiled by Penny Burden & Anne Lee. August 2006.)

1.6 Rationale

The proposed project is important to a contemporary, complex and socially engaged experience of professional training and education, which enriches students' confidence in and ability to contextualise and creatively progress their professional work. Lecturers and tutors who are already teaching or facilitating ethical aspects of practice (e.g. in healthcare) recognize that ethics can no longer be delivered by standard lectures but must engage the students in inquiry and questioning and must be unobtrusively supported by digital technology.

In view of the changing social pressures on professional practice in diverse disciplines (pressures such as competitive globalization, and commercialization) and the attendant risks (litigation, reputation damage, etc.), an awareness and understanding of ethical parameters are vital. Recent events have indicated how important it is for professionals to work with an ethical understanding e.g. the stem cell research in South Korea and the clinical trials with monoclonal antibodies in UK left a lot to be desired in respect of ethical understanding. However, ethical awareness is not about professional defensiveness and risk-management but is positively important for human flourishing.

An awareness of the ethics of research, its priorities and values, also properly begins at undergraduate level. Ethical understanding cannot be left untouched until the postgraduate training and education experience.

1.7 The Concept: Flexispace

The main concept to be explored and developed in this Fellowship period, in negotiation with colleagues and students, is my notion of an educational 'flexispace'. This project may be conceived as seeking a 'proof of concept'. I define a flexispace as a form of educational provision for introducing a dimension of learning that emphasizes interdisciplinary conceptual exploration and negotiation, deploying an 'open space' and 'process' format as opposed to a fixed format such as a traditional

'module'. ('Flexispace' is not primarily a physical location or locations, but a multi-dimensional space for learning.)

It may be contrasted with a (fairly) rigid teaching/learning structure such as a traditional module that is:

- single-discipline-based
- information (facts) and/or determinate methods based
- didactic from a teaching point of view and passive-absorptive from a learning point of view (sometimes referred to as 'information-transmission').
- largely non-negotiable (non-critical) with regard to basic assumptions
- delivered through a fixed structure/process based on set criteria, involving discrete allocation of location, time, performance, assessment etc.
- formally validated and credit-bearing
- perceived as either 'compulsory' or 'optional'.

The 'Ethical Awareness' flexispace would:

- Be interdisciplinary; giving opportunities for students in different disciplines to share, challenge and gain wider context
- Emphasize questioning and mutual understanding of assumptions, values, fundamental conceptions, wider contexts (social, cultural, global etc.) patterns of thought, and attitudes
- Emphasize the openness, dialogues, self-confidence, reflexivity and questioning of EBL
- Be egalitarian, negotiating and active listening in spirit
- Be delivered through a open, student-led and flexible process, with general guidance
- Not necessarily be validated, and not necessarily independently credit-bearing (feasibility to be investigated with Centre for Learning Development, Heads of Departments, module organizers, etc.)
- Be neither compulsory nor optional in standard curricular senses; but 'available' and 'recommended'. (For example, credit could be reflected in negotiated criterial adjustments to assessment of the students' Professional Training Report.)

Of course, this contrast is overdrawn, since contemporary modular structure does usually make provision for some flexispace and increasingly so, depending on the academic/professional discipline. A flexispace is not meant to be a substitute for traditional methods of delivery, but is meant to supplement and enhance them where appropriate to do so, as in the case of raising ethical awareness. In a sense, a flexispace weaves around the more 'traditional' and fixed structures and processes (modules etc.). To use a physiological metaphor: if we think of modules as bones that articulate with one another through contact at the joints, then a flexispace is the synovial fluid that provides agility, freedom of movement, and space and nourishment for growth and adaptation.

The flexispace is not entirely new in conception, but may be new in the way certain existing features of teaching/learning are brought together. Elements of flexispace may be drawn from some existing models such as mentoring, workshops, seminars, remedial learning, chat rooms/bulletin boards, learning sets, personal

development plans, and various CPD-type formats. An online framework would provide an anchor.

2 Official Development of Ethics in Engineering

I have garnered information from both the Engineering Council (ECUK) and the Royal Academy of Engineering, which are across-the-board engineering bodies. At this general level there are two other bodies of particular note in the UK: The Engineering & Technology Board and the Engineering Professors' Council (Table 2), but I have not referred to them any further in this Report. The Higher Education Academy provides support for learning and teaching in engineering through its 'Engineering Subject Area', but it does not yet specifically pay attention to ethics, although it is clearly aware of its growing relevance.

Table 2 Engineering Regulatory, Standards & Education Bodies

Engineering Standards Body	Address	Principal Document	Other Info
Engineering Council (ECUK) http://www.engc.org.uk/	246 High Holborn, London WC1V 7EX. Tel 020 3206 0500	'Guidelines for Institution Codes of Conduct'	
Royal Academy of Engineering (RAE) www.raeng.org.uk	29 Great Peter St., London, SW1P 3LW. Tel 020 7227 0500	'The Statement of Ethical Principles'	
Engineering & Technology Board (ETB) www.etechb.co.uk/	Also at: 246 High Holborn, London WC1V 7EX. Tel. 020 3206 0400 Email: info@etechb.co.uk	'Science & Society' (response to consultation) http://www.etechb.co.uk/_db/_documents/Call_for_Evidence_Science_&_Society.pdf	
The Higher Education Academy Engineering Subject Area www.engsc.ac.uk/	Sir David Davies Bldg, Loughborough University, Leics LE11 3TU Tel. 01509 227170 Email: enquiries@engsc.ac.uk	Journal: 'Engineering Education'; bulletin and newsletter.	Delivers support for learning & teaching
Engineering Professors' Council www.epc.ac.uk/	Contact: School of Engineering (D3) University of Surrey Guildford GU2 7XH Tel 01483 689536		Treasurer and Surrey contact: Prof M Huxley, University of Surrey.

2.1 Engineering Council UK

The Engineering Council is the regulatory body for engineering, and has a Royal Charter. It operates by licensing 35 engineering Institutions (see 2.3 below). I have studied the EC's documentation relevant to ethics (and I have a scheduled meeting with the Chief Executive, Andrew Ramsay, in August 2007).

The statutory position of engineers is not like that of e.g. doctors and nurses because registration is not legally required in order to practice. Still, currently, there are approaching 250,000 ECUK-registered engineers and engineering technicians. The Engineering Council is encouraging engineers to register, either with Chartered or Incorporated status. The Council has recently (2007) reported on its survey which shows that 'registered engineers and technicians are outperforming their non-registered counterparts across a wide range of skills'. These skills include 'evaluating/improving health and safety systems'- which arguably falls within (or is at least related to) ethics (see 3.26 below). If I may speculate: ethical awareness may increasingly be seen to be of importance in gaining Chartered or Incorporated status. At the very least, this opportunity exists for the ECUK.

The ECUK was involved in and proactively supports 'The Statement of Ethical Principles' of the Royal Academy of Engineering (see below 2.2). The ECUK's June 2007 edition of *The Register* states: 'Engineers carry a heavy burden of responsibility to society. As key resources dwindle and the need to tackle climate change becomes ever more pressing, this burden is growing ever greater'. This responsibility is acknowledged in UK-SPEC, which is the ECUK standard for assessing individuals for professional registration (www.engc.org.uk/ukspec/default.aspx). UK-SPEC requires that professional engineers show a 'competence' which includes working within the Codes of Conduct, and registrants are expected to have the education and experience necessary to 'undertake engineering activities in a way that contributes to sustainable development'.

As required by its Charter, the ECUK provides a brief 'Guidelines for Institution Codes of Conduct' (Appendix 1 below) to be used as a template for its licensed Institutions to follow in drawing up their own codes.

The Institutions figuring in my project are all licensed by the ECUK.

> **'Engineers carry a heavy burden of responsibility to society. As key resources dwindle and the need to tackle climate change becomes ever more pressing, this burden is growing ever greater', Engineering Council UK.**

2.2 Royal Academy of Engineering

The Royal Academy of Engineering (RAE) provides 'The Statement of Ethical Principles' (reproduced in my Appendix 2), prepared in collaboration with ECUK and approved by all 35 of ECUK's licensed institutions. This Statement is broader than the Codes set down by the separate engineering Institutions. The principles are enumerated under four main headings: 1) accuracy and rigour; 2) honesty and integrity; 3) respect for life, law and the public good; 4) responsible leadership – listening and informing. The last requires that individual engineers should 'actively promote public awareness and understanding of the impact and benefits of engineering achievements'.

The RAE's 'Teaching of Engineering Ethics Working Group' designed an 'Engineering Ethics Curriculum Map' (2005a). This provides a broad framework for provision of ethics to engineering students from Level 1 to Level 4 (BEng, MEng). However, it seems to me that the map falls short of the promise held out by the ramified implications of 'The Statement of Ethical Principles'. The framework is

largely modular in structure and begins in large part with the well-worn 'theoretical framework' borrowed from moral philosophy of deontology, rights, utilitarianism, autonomy/consent and virtues. This is the same framework that is well-worn in other professional disciplines such as healthcare ethics. (For reasons I explain elsewhere, I think this highly abstract approach is of very limited use in teaching ethics for practice to any professional group, including engineers.)

> **'Evidence has shown that the introduction of engineering ethics as a significant theme in the curriculum provides distinctive added value. The curriculum is enriched and made more relevant to the practice of engineering. Additionally, this theme contributes to other learning outcomes by helping students to improve core skills such as communication, reasoning, deduction and reflection. Generally students enjoy activities and learning associated with this theme', 'Curriculum Map', Royal Acad Eng.**

The RAE framework incorporates the placement year (See Table 2.2). It does not give any guidance on how this is actually to be implemented, taking into account the positive and negative factors identified in my Report (below).

The same working group carried out a survey (2005b) of current teaching of ethics to engineering students in UK universities – sent to 263 Heads of Engineering Departments, with 56 replies. Those surveyed were asked how far they deliver the learning outcomes mentioned in the 'curriculum map'. The results were: Hardly at all 6, Some delivery 26, Significant delivery 13, Substantial delivery 4, Delivery of nearly all learning outcomes 4, Other 3. The Report points out: 'Given the high degree of self-selection involved in the returns, this suggests that ethics teaching has taken hold in only a small proportion of [Engineering] Departments'. When asked about what would help most in terms of delivering the teaching, many replied 'wider availability of UK based case study material'.

Table 2.2 RAE Curriculum Map (a section only)

	Learning Outcomes	**Content**	**Process**
MODULES	1. Identify ethical issues related to an engineering situation 2. Suggest ways to address ethical issues in engineering 3. Illustrate the ethical dimension of practical engineering	Ethical cases in engineering. Further use of the ethical framework introduced at Level 1	Existing modules modified to include topics and exercises which address ethical issues from a practical standpoint. Dilemma training. Traditional engineering exercises given ethical twist. Group work. Use familiar, non-specific engineering situations by way of introduction, for example plagiarism /cheating, principles of negotiation
PLACEMENT PREPARATION		Professional practice of self and others. Being able to differentiate between the good and bad employer	Intensive workshop for placement preparation. Presentations where students defend a pro/con stance on an issue, Role playing scenarios

It is not clear to me what some items mean e.g. 'Professional practice of self and others', while others have the taste of judgementalism ('Being able to differentiate between the good and bad employer') which may be inappropriate for a student on placement. The comments made on 'Assessment' in the 'Map' are discussed in my section 3.213.

2.21 Workshops

I attended The Royal Academy of Engineering's one day workshop on 'Ethics in Engineering Practice' on 13th June 2007. Presentations were followed by small group discussions. Katy Roelich of Arup spoke about ethical aspects of 'Environmental Engineering' with an emphasis on transparency, identifying possible harms, and fairness in decision-making. Andrea Simmons, a consultant, spoke on 'Ethics in Security Consulting' and considered the Code of Ethics of the Information Systems Security Association (ISSA), and Chris Nott told us about 'Ethics and Professionalism in IT', while Robin McKenzie explored 'Doing Manufacturing Ethics'. A recurrent theme of the presentations and discussions was the utility of, and current paucity of, case material.

Also as part of this feasibility project I attended a workshop of the National Conference of University Professors, at the Royal Academy of Engineering, on 28th June 2007, on the theme 'Interprofessional Collaboration for Sustainability: A Challenge for Interdisciplinary Education and Research'. Speakers included Prof Charles Engel (see 4.4 below), and also Prof Hugh Barr of Westminster University. A

presentation by Prof. Peter Guthrie of Cambridge University (Building Design Education) explained the use of role-play for engineering students, in which the students played stakeholders in a three-day negotiation over a proposal for a new local waste incinerator. Prof. Guthrie suggested that engineering courses need to be 'completely redesigned' around the concept of 'sustainability'. He emphasized that engineers need to go beyond the stock mindset of 'meeting the specification'. The role-play was assessed as follows: 50% for the problem statement, 20% for participation, 30% for reflection.

2.3 The Professional Institutions

Institutions represent specific engineering professions, such as Chemical Engineering, Civil Engineering, Mechanical Engineering, and accredit programmes of education in those professions (Table 2.3). These have varying degrees of 'interest' in ethics, and some have well-developed codes of conduct, committees dealing with ethics and a number of other ethics advisory documents. I arranged meetings with personnel at both the Institution of Civil Engineers and the British Computer Society, in order to sound them out on the options for providing ethics teaching for engineering students.

Table 2.3 Relevant Professional Institutions in Engineering (EC Registered)

Professional Institution	**Address**	**Committees**	**Principal Document**	**Other Info**
British Computer Society - BCS www.bcs.org	HQ Address: 1st Floor, Block D, N Star House, North Star Ave.,Swindon, SN2 1FA. 01793 417417	"Ethics Forum"; "Ethics Expert Panel"	"Code of Conduct"; "Code of Good Practice"	
Institution of Chemical Engineers IChemE www.icheme.org	*1 Portland Pl, London W1B 1PN* HQ Tel: 01788 578214 (London: 020 7927 8200)	"Ethics Communication Group"	"Code of Conduct Compliance Certification"	Link to PCaW+; Eng ethics group; ethics articles; recommends Barnard's book
Institution of Civil Engineers ICE www.ice.org.uk	*1 George St., London SW1P 3AA.* Tel 020-7222-7722.		"Code of Professional Conduct"; "Advice on Ethical Conduct"	
Institution of Mechanical Engineers IMechE www.imeche.org.uk	*1 Birdcage Walk, London SW1H 9JJ.* Tel 020 7222 7899.		Code of Conduct (as element of By-Laws)	'The Mentor' doc at 'MPDS' section of website.
Institution of Engineering & Technology IET (prev. IEE) www.theiet.org	*Savoy Place, London WC2R 0BL Tel* 020 7240 1871		"Rules of Conduct"	
Institute of Physics www.iop.org.uk	*Institute of Physics 76 Portland Place London W1B 1NT Tel: 020 7470 4800 Fax: 020 7470 4848*	"Ethics Cttee"	"Code of Conduct"	Charter, Byelaws, Regulations.

+ Public Concern at Work (public disclosure legal advice centre, and a charity)

2.31 Institution of Civil Engineers

I met with Paul Taylor of the Professional Conduct Department, Institution of Civil Engineers, and three of his colleagues, in their London offices. I explored my ideas with them in the context of their own profession. The following represents, I believe, some of the views expressed.

Ethics must be 'embedded', like health and safety is, and should not be 'ring-fenced' as a separate subject or module. It should be 'drip-fed' to students throughout the educational programme.

So important is ethics for professional status that it ought to culminate in an examination after graduation and before the professional qualification (such as chartered status), and obtained through the professional institution. Architecture might provide a model, in some respects: Chartered UK members of Royal Institute of British Architects (RIBA) must either have passed RIBA validated exams, Parts 1, 2 and 3 or have a qualification that is recognised under the European Directive 85/384/EEC plus over five years professional practice. A person must also be registered with the Architects Registration Board (ARB) (www.arb.org.uk) to practise under the title 'architect' in the UK.

The problem with introducing ethics in the placement year is that not all civil engineering students do it; so it should be introduced integrally from Year 1. This will encourage students to see professionalism as consisting of four parts: technical knowledge and skills, health and safety, professional ethics, and commercial/business skills. It was noted that 'Business Ethics' is not really a separate subject, since a lot of ethical issues in civil engineering would fall under that rubric.

One way to introduce it gently is to expand on the Health & Safety provision in the curriculum. Consider how Health & Safety was introduced historically into engineering education, since that could provide one with a model for change. One would have to get the staff 'on board' and one way to do this might be to offer workshops in 'professional ethics'.

The Institution of Civil Engineers is highly motivated in promoting ethical awareness. Among its documents are the 'Code of Professional Conduct', 'Advice on Ethical Conduct', and 'Guidelines for Making a Complaint about the Conduct of a Member of I.C.E.'.

2.32 British Computer Society

I also met with Dr Penny Duquenoy of the British Computer Society (BCS). She is Senior Lecturer in Computing Science at Middlesex University, Chair of the Working Group on 'Computers and Social Accountability' of the International Federation for Information Processing (www.ifip.or.at) and Manager of the 'Ethics Forum' of the British Computer Society.

Dr Duquenoy emphasized that ethics was very important for the BCS and that it certainly extended beyond an understanding of legal and regulatory matters. She drew my attention to the BCS Expert Panel on ethics, which reviews the BCS *Code of Good Practice* and a *Code of Conduct*. The latter (Version 2 of September 2001), is quite a substantial document of 3 pages containing 17 clauses divided into the following main sections: The Public Interest, Duty to Relevant Authority, Duty to the

Profession, Professional Competence. Clause 1 if of particular interest since it acknowledges professional judgement:

> "You shall carry out work or study with due care and diligence in accordance with the relevant authority's requirements, and in the interests of system users. If your professional judgement is overruled, you shall indicate the likely risks and consequences.
>
> - The crux of the issue here, familiar to all professionals in whatever field, is the potential conflict between full and committed compliance with the relevant authority's wishes, and the independent and considered exercise of your judgement.
> - If your judgement is overruled, you are encouraged to seek advice and guidance from a peer or colleague on how best to respond."

The Code of Good Practice covers *inter alia* programme/project management, relationship management, security, safety engineering, change management, and quality management.

Dr Duquenoy attached particular importance to the development of a 'truly' professional understanding and approach on the part of computer science students, and this must be rooted in actual practice. The placement year was suitable for my proposal of an 'ethical awareness' flexispace. She stated that the objective of ethics provision for undergraduates is to raise awareness of issues that surround them as *practising* professionals in the real and complex world (as opposed to abstractions from the classroom). In an 'ethical awareness' framework trigger questions for students should include conflict of interest scenarios (as mentioned in Code), asking them 'How would you handle it?' Responsibility is at the heart of ethics. Case studies are also a vital tool.

Students should learn to deal with diverse and sometimes difficult situations in a constructive and helpful way. They should also, in practice, know when to stop in pursuing an ethical point. Tutors will have to 'flag up early warnings to placement employer that ethics is a component of the student's learning at work'. For example, students could be asked to look for any ethics-related policies at the company, including compliance with laws, such as the Disability legislation.

Dr Duquenoy also drew my attention to the activities of the organisation 'Public Awareness of Science & Engineering (PAWS), which promotes use of drama and arts in engineering education. See: http://www.europaws.org/

3 INTERVIEWS WITH TUTORS (PLACEMENTS)

3.1 Interview schedule

I interviewed separately three Senior Tutors (Professional Training) in the School of Engineering of the University of Surrey at some length (one hour 15 minutes, one and half hours, and two hours), using an interview schedule of questions (see Box 3.1 below) and a tape recorder. The questions were meant as 'triggers' to initiate free-ranging discussion and exploration. My primary aim was to obtain information and the opinion of the tutors on:

- What forms of ethics provision already existed for UG students, if any.

- Whether there was a need for, or any advantage in, some form of 'ethical awareness' provision, as broadly proposed.
- What would be the most practical and/or desirable way of delivery (if there were some need/advantage).
- To explore their current understanding of 'ethics' (in relation to engineering).

I emphasized that this was a *feasibility* study, and that nothing was fixed in advance, and that I would wish to work with them throughout in a collaborative manner in developing such provision, if it was regarded as useful.

Box 3.1 Interview Schedule

1 Do you feel there is a need for raising the ethical awareness of your UG students?

Definition: *Ethical awareness = an acknowledgement of, and ability to reflect on, professional practice and policies through concepts such values; harms/benefits; rights and duties; hazard, risk and safety; professional and corporate responsibility; employee and public accountability; duty of care and negligence; privacy and confidentiality; sustainability and precautionary principle; inequality and justice; honesty, integrity and scientific truth*.

2 How/when/what sort of ethical issues are considered in your current undergraduate curriculum?

3 Should awareness of ethical responsibilities and skill in dealing with ethical dilemmas be part of the professional formation of our students? If so what forms might this preparation take?

Prompts:
- Prior to professional training
- During professional training
- When they return to university after their training

4 What sorts of ethical dilemmas/issues do students encounter when they are on their professional training year?

5 What kind of format might be suitable/not suitable for delivery?
(*i.e. how could it be implemented?*)

6 What difficulties or obstacles might need to be overcome?
(*e.g. preparation, resources, assessment.*)

7 Any further comments or questions?

The interviews took place between October and December 2006. Tape-recording was with permission and an assurance given that tape recordings would be used only by the interviewer, recordings would not passed on to third parties, anonymised as far as possible in the subsequent report, and destroyed on completion of the project. Since this project is an inhouse feasibility study for the purpose of curriculum development it was decided that approval from an ethics committee was not necessary. Before the interview started the interviewees were provided with a one-page summary of the project, and a brief verbal explanation.

Although this was not strictly speaking a *research* project, with a fully developed research method, I chose to use a 'constant comparison' approach, reading and comparing the interview transcripts, and selecting and arranging emergent themes (See Box 3.2 for list). I have avoided ascribing the interviewees' statements and the themes to a named tutor since I am only interested in the general views of tutors as such, not in individual strengths or weaknesses.

3.2 Analysis of Interviews

The text of this analysis of the themes takes the form of my *reporting* on the interview discussions, and *reflectively* doing so. Verbatim comments by Tutors appear in quotation remarks. This approach seems fitting for a feasibility study, in which I am a partner with my colleagues in an ongoing discussion.

Box 3.2 Emergent themes

1. Current provision for ethics?
2. Accreditation
3. What is ethics? Need to raise ethical awareness?
4. Student intake, placements and motivation
5. Legal Issues
6. Health & Safety
7. Raising concerns
8. Environmental issues
9. Beyond legalism?
10. Supervisory system
11. The placement experience
12. Placement year: the best place for ethics?
13. Assessment
14. Online provision
15. Integrate or add on?
16. Staff prepared for ethics?

3.21 Current provision for ethics?

Ethics as a domain of inquiry relatively distinct from law and professional regulation is on the whole not provided for in professional training in engineering and sciences. Computing Science has some elements of ethics, under the rubric of 'professional issues' at UG level, but even here the general understanding of the domain is largely cast in terms of the legal/regulatory requirements. These are, of course, vital to

professional educational and training, and I intend to cover their basics in any provision which results from this study. But ethics has a far greater scope. There appears to be even less UG provision in Electronic Engineering and apparently none at all in Chemical Engineering yet. The last has Health and Safety in chemical engineering practice well covered. Throughout there is a tendency to cast ethics in terms of what is expected by the professional bodies in their accreditation process.

All the interviewees stressed that they think ethics should be *integrated* into the various programmes, rather than appearing as separate modules or units. Thus in Computing Science, I was told, lectures on systems analysis and design, and data-basing, bring in ethical issues as they emerge.

Note that at PG level the situation is somewhat different. In Computing Science there is a Masters level course in professional issues in which distinctly ethical concerns are covered, and I have contributed lectures to this course. I am also teaching 12 hours of ethics in Nanoelectronics at Masters level, in A.T.I.

> **"Already doing quite a lot [of ethics], integrated into modules. Undoubtedly, it could be enhanced", Tutor.**

3.22 Accreditation

The University's engineering degrees are accredited by the relevant professional 'Institutions'. There are 'Codes of Conduct' (as required by the Engineering Council) on the websites of the British Computer Society, the Institution of Chemical Engineers, the Institution of Civil Engineers, the Institution of Engineering & Technology (previously the IEE), and the Institute of Physics. On the website of the Institution of Mechanical Engineers there is a 'Code of Conduct', which is an element of the Institution's By-Laws, and has a disciplinary tone.. One tutor emphasized the relevant Institution's Code of Conduct as an important source of ethical guidance for students, another did not know if his Institution had a Code of Conduct, and a third could not remember the name of the relevant accrediting Institution. All emphasized the importance of getting the 'ethics' right if the accrediting body required it, since without accreditation there could be no course to offer.

In my opinion the domain of ethics does not end, nor arguably even begin, with a professional body's Code of Conduct, yet the very idea of such a Code did appear in the interviews as the natural centre of gravity, and therefore it could fruitfully be taken as a point of departure in developing 'ethical awareness' provision.

In Computing Science, The British Computer Society (BCS) accredits the University's UG courses, the students all join the BCS as 'student members' (paid for within the department), and they therefore sign up to its Code of Conduct. In Electronics Engineering courses are accredited by the Institution of Engineering and Technology (IET). Chemical Engineering courses are accredited by the Institution of Chemical Engineers and the University's students are 'encouraged to be members but it's not mandatory for a placement'. Furthermore, the placement experience can contribute to what they will one day need to get 'chartered' status as chemical engineers. The interviewee agreed that this was a 'carrot' for motivating students to do well in the placement year.

> **"Get that one wrong, lose your accreditation, lose your ability to market yourself… So, we are very cognisant that these things are important.**

Our students need to be aware of frameworks, many of which have now become legal requirements, which people have to work within", Tutor.

3.23 What is ethics? Need to raise ethical awareness?

The interviewees had been provided with a brief and provisional definition of 'ethical awareness' (see Box 3.1 above). However, it was clear that all three were unfamiliar with the general discourse of ethics although they had a sense that ethical issues were of growing importance and aware that they certainly fell within the professional education remit. There were considerable differences in their understanding of the ethics domain. One emphasized that it was essentially a 'personal' matter, another that it was essentially legal/regulatory and another that it was essentially about professional 'responsibility'. All three have part of the truth, no doubt. Two were encouraging about 'enhancing' ethics provision in engineering and one described himself as 'indifferent'.

The first (perhaps playing devil's advocate) said that the 'student's ethics have nothing to do with me'. I spent some time showing him that ethics could not just be 'personal', since if ethics concerned (among other things) harms to others then issues such as corporate responsibility, corruption, environmental damage, unjustifiable secrecy, email virus dissemination, negligence, child labour and fair trade could hardly be described as 'personal'. There is, however, a legitimate concern that students might go into a company and be judgmental about policy or practices on the basis of 'mere personal opinion', but I explained how the 'ethical awareness' flexispace would have ground rules that would warn against such behaviour and would give clear examples of what counted as an 'ethical issue' for students to acknowledge.

He also thought that there was a danger that 'religion' would be brought into ethical awareness and discussion and this would be a 'can of worms'. I argued that in my experience religion does not come directly into most ethics discussions in the professions, but if it did then as long as tolerance and respect were accepted as ground rules there need not be any difficulty. In any case, the mainstream of major religions are in general agreement about basics such as honesty, integrity, compassion and human dignity, otherwise it would not have been possible to drawn up international declarations and charters, such as those concerning human rights. Because he took this 'personal opinion' view of ethics, he inferred that the clear lines drawn by law were really all that the student needed to know. Thus Health and Safety *would* be his concern as a tutor.

I suggest that, in the last analysis, people are entitled to different views, may have different values, and at the end of the discussion, when they have had the benefit of the discussion, and understand consequences and everything else, they may reach complete or partial agreement. However, they may still disagree, but it is better that they go through that process rather than that they lock horns on the basis of ignorance and misunderstanding each other's views. A person might change their mind during or after the discussion, because of grasping the facts better or because of how they interpret the facts when their values change (if they wish to change them). It is the process that is important.

The question of students going on placements with the MOD or MOD-related companies or work also arose in the discussion with this Tutor. He agreed that

students have a right to decline, or withdraw from, such a placement, if that is their wish.

He also agreed that protection of the privacy of personal (e.g. medical) information in electronic devices was an ethical issue, of which students should be aware. After all, there are also valid grounds for sharing or disclosing information and students have to begin to think about how that's to be done while protecting privacy. Making balanced judgements is a vital professional skill. If a student were working on a project in which this was an issue, the point is not for them to challenge the company but raise it in an appropriate way in an appropriate context as to how we are dealing with this issue? Once raised and there's a response, then the student only needs half a page or less in their report to say the company is aware of the issue and is following x y or z guidelines, or has had such and such a policy meeting. It's a matter of generally and gently raising a wider context for the ongoing work.

One objection made here is that the student reporting back on such a matter could be in breach of any confidentiality agreements they have signed, or maybe even the Official Secrets Act. The reply to this is that students need to understand and evaluate what they are signing. If they do not wish to sign it, then they may decide not to go on that particular placement.

Another interviewee took a broader view: Students ought to be aware of issues like 'the role of the manager in the workplace, and bullying and things like that, and duty of care is part of any employment situation, in both employer and employee directions'.

After discussion, all three agreed (separately) that there was a need to raise the ethical awareness of students, although one took considerable persuasion that it could have anything to do with his role.

> **"…there are many instances where a computing project might make people redundant, might change the way they work, the way in which everyone is managed by the NHS or by the taxation system. Situations in which you are changing peoples lives with a computing system and therefore one ought to be aware of the softer social side as well as the harder legal side", Tutor.**

3.24 Student intake, placements and motivation

Large numbers of students are going on PT placements at the University of Surrey. However, there are two crucial cautions, if the PT Report is to be considered as the vehicle for 'ethical awareness' criteria of assessment. Firstly, it is far from the case that all engineering students go on placements, and the situation is very uneven across the school. Secondly, the PT placement experience varies widely (see below, 3.211). The University may be addressing these issues in the future.

In Computing Science, I was told, about 50-75 students are on placement in each academic year. It is optional, but about 80% do it. 'The overseas students perhaps find less opportunity.' In Electronics, the interviewee said that it was a 'low number' of 31 on placements, which includes postgraduates. He thought this was an unacceptably low percentage of the students who could go on placement, but could not say what percentage it represented. He claimed that it was difficult to ascertain precise numbers. (This puzzled me, since I am accustomed to the mandatory nature of nursing placements in EIHMS, which is highly systematised and supported by an office.) In the opinion of this Tutor the principal causes of the difficulty was that

students have little enthusiasm for taking a year out when they are anxious to qualify and get a job (since student fees are high), and staff have little enthusiasm for the extra workload of managing the placement trainees. Certainly, there were plenty of companies that wanted to take the trainees, he averred. He added that, 'the ones that go on PT all come back and say it was the best thing they ever did. We get them to speak to tell the other students. But still uptake is poor. One difficulty is that some tutors get a lot of tutees, highly motivated, coming to them and others don't'.

In Chemical Engineering, the tutor had 16 students to place that year. He estimated that there were perhaps 70 or so placement students in Civil Engineering and Mechanical Engineering altogether. He was very positive about placements and felt sure that students valued the PT year highly. He thought the students would accept an 'ethical awareness' component in their PT activities.

> **The PT year is "part of the culture. You go out to industry, you work hard, and it's in your interest to work hard. They [students] are motivated by management, by the environment they are in, the people around them, so they are driven by their thirst for a professional reputation", Tutor.**

3.25 Legal Issues

All tutors tended to consider issues of right/wrong either in technical terms (the right tool for the job) or legal terms (regulatory, contractual, etc.). The latter we might call 'legal minimalism' and is the idea that as long as one is not breaking the law one is a 'good professional' (See 3.29 below).

My point is not that we do not need the law in professional practice, but rather that it is not sufficient – we need ethical awareness too. Certainly, legal aspects of practice should not be omitted in professional education, and my intention is to include it in the 'ethical awareness' framework together with wider ethical, social and policy dimensions.

In Computing Science, the Data Protection Act and Computer Misuse Act are emphasized, while the Health and Safety Act is taken for granted as essential by all tutors. As we have seen, the professional Code of Conduct and its disciplinary function is referred to quite often in connection with ethics. My intention is to develop a location on the 'ethical awareness' online facility for summaries of, and links to, the principal legislation and regulations; in the wider setting of an 'ethical inquiry-based' understanding of professional practice. In this way students will learn early on that 'good practice' is much more than 'non-illegal practice' and that 'defensive practice' may be unethical.

In disagreements and disputes, engineering professionals will tend to look to the legal contract first or even exclusively, rather than to the human resolution of the misunderstanding or conflict of interest. It seems to me that 'ethical awareness' would entail looking first to achieving understanding and as a last resort to contract and legal redress. This would certainly reduce conflict and litigation bills, as well as enhance the standing of professions in the public eye.

> **"If every student who goes out into a placement and gets a nice fancy electronic connection to the internet starts downloading pornography we shall be rattling down the steps of the company a few seconds later", Tutor speaking of the Computer Misuse Act.**

3.26 Health & Safety

Health and safety issues are nearly always constructed in the minds of engineering academics as legal or technical issues, but hardly ever as ethical or ethics-related issues. Issues about harms and risks, which could otherwise fall into the ambit of ethics, are usually perceived in terms of safety devices and inspection procedures. In other words, they are assimilated to operational discourse. This reduces the matter of moral responsibility for the welfare of others to compliance, and that does not necessarily require the skills of understanding, negotiating, contextualising, questioning or creativity. Furthermore, it also suggests that a situation of potential serious harm may be ignored if it is not specifically covered by a Health and Safety rule, but is e.g. due to a suspected design fault. Here, what is ethically required (responsibility) is not legally required (compliance).

The Computing tutor thought that he and students could benefit from 'safety training', but at the same time 'All our students go into an *office* environment, so short of sticking their fingers into the mains plug there's remarkably little they could do that's any more damaging than anywhere else'. He was concerned that companies taking placements 'subscribe to the legal requirements'.

The Electronics tutor said, 'I wouldn't have thought health and safety have anything to do with ethics'. We then discussed the responsibility of students in placements who noticed a negligent or dangerous practice or policy (see 3.27 below), and he said he would support the student on legal grounds, but he did not see it as a matter for ethical discussion or exploration. The Chemical Engineering tutor, however, did think it was a matter of moral responsibility for student, tutor and industrial supervisor and that it should be regarded as one for open discussion and understanding, in a constructive spirit.

In my view health and safety is a vital part of professional training but should not be seen as a matter of unthinking compliance in a narrow workplace context, but situated as one aspect in a wider ethical context of balancing the harms and benefits of industry and commerce in society and future generations. This would also have the advantage of making 'Health and Safety' far more interesting for students.

> **"I wouldn't have thought health and safety has anything to do with ethics", Tutor.**

3.27 Raising Concerns

My technique for sliding the conceptual scheme from one of compliance to one of responsibility was to present each tutor with a scenario in which a student in the workplace stumbles upon personal knowledge of a potentially serious harm to the public. This technique was very effective in generating debate and conceptual exploration.

What if a student in placement notices that an inspection of safety-critical apparatus is skipped, for whatever reason, and that the apparatus is not functioning well, for example, corrosion in a critical cooling device? I referred to the explosion at a nuclear plant in Japan some years ago which killed several workers and was due precisely to such a situation. There is plenty here to explore and discuss: whether it

was an oversight, a misunderstanding, neglect or a deliberate decision (e.g. to cut costs); and whether the skipping of the inspection was a breach of regulation, or was not. Here is an opportunity for ethical learning: understanding values, how they are prioritised, differences in interpretation, communication and accountability, how risks and benefits are balanced and so on. In the case of a nursing or medical student who notices, for example, that a sterilising autoclave is not working properly, which may eventually infect and even kill patients, the student clearly has an ethical responsibility and may be held accountable for not acting appropriately. To reach agreement about what is appropriate for a student requires inquiring discussion.

One tutor proposed to seek legal advice from the University before approaching the company in order 'to back the student to the hilt'. Another fell back on the Health and Safety compliance of the company, but added: 'It is an interesting scenario, and this is exactly what you're driving at I suppose, making students aware of their personal responsibility. The message would have to be that anything like that would have to be addressed with the employer. They can't keep quiet'.

When asked if the student should raise it with the (on-site) industrial supervisor, he said 'Yes. The tutor should not even necessarily be involved. The student is working in a company; they have a responsibility which should be well defined by the company. But if the student observes something they think is not right, unsafe, we should encourage them to bring that to the forefront and discuss it and that is, I think, at the heart of what you are trying to achieve'.

Obviously, dramatic issues such as this example occur rarely, but as one tutor observed, they could happen quite frequently 'on a more minor scale' and the ethical values or principles might be the same.

I would add that we do not want our placement students to become nitpicking complainants, but neither we nor socially responsible employers wish them to be ethically blind and unprepared for a complex world of work either.

> **"But I think if we could encourage our students to be aware of ethics and to take a responsible ethical stance on things, take responsibility, then we've done very well. I'm hoping that your initiative will encourage them to do that. Still, there's a distinction between the ethical responsibility of the individual and the ethical position of the organisation. I'm keen to promote the former", Tutor.**

3.28 Environmental issues

The last two sentences of quotation in 3.27 above were intended to warn against allowing or encouraging placement student to challenge the corporate policies of their employer. I concur, but it seems to me perfectly legitimate and in fact helpful for a student to inquire about any relevant corporate responsibility policies (or absence of them), note them and make some constructive remarks about them in their PT Report if they wish to do so.

One tutor expressed a concern that, 'If we place a student with a large oil company and we encourage them to think about ethics and they start thinking about the policies that the company are operating with globally, in the Third World, I think things could backfire. If you have a student's who's impressionable and they start reading the more fanatical websites about the exploitation of the Third World countries, polluting the environment, etc., then we could open a Pandora's Box'.

However, surely the idea is that the student is learning about the 'ethical culture' of the company, not that the company is learning from the student's preconceptions. This will be made clear to the student beforehand. Our intention is to cultivate inquiring, balanced student/professionals. A student is not going into a company to pass negative judgements but to observe and inquire within circumscribed limits. In a particular case the student could raise questions in a positive and constructive way, and then just leave the matter alone, however inadequate or even unethical they personally believe the situation to be. Since there might occasionally be situations in which the student really ought to report (e.g. a dangerous or illegal practice) then that is something they should take back to the industrial supervisor and/or tutor for discussion.

Of course, students are not going into a company to campaign for a cause, but they can ask questions and more often than not the company will have responses to them. They might respond, for example, 'We have a sustainability report'; so the student would report that 'I raised this question and they directed me to their sustainability report which says X, Y and Z'. They don't have to push it any further.

One tutor said, concerning a question about e.g. 'sustainability' measures: 'I imagine the majority of companies will be well-versed in dealing with questions and challenges like that'.

The Computer Science tutor was asked about environmental ethics, for example, toxicity of hardware elements at manufacture and disposal stages. He pointed out that his department 'worries more about software than hardware. You'd probably do better to talk to the electronic engineers to see what they are saying about the hardware side'. He was aware that the IET 'does mention some of those sustainability issues in its remit', and mentioned to students how a computer left switched on 24/7 incurs 'a substantial cost' as well as CO_2 emissions.

> **"However, what I think is the way you present the information to them [students] and encourage them to examine the ethics of the organisation and their particular role needs to be very carefully toned … because, maybe certain students who are idealistic and impressionable could get themselves into trouble by subscribing to the view expressed upon by some of the journals and websites - *Friends of the Earth* type organisations", Tutor.**

3.29 Beyond Legalism?

Deeper consideration of legal minimalism raises the question of how one moves beyond it. Students could, very broadly, be helped to become aware of three major shortcomings.

Firstly, it is entirely negative in the sense that it emphasizes what one should not do for fear of some sanction, but not what one ought (pro-actively) to do in order to be helpful, creative or promote good practice and human flourishing.

Secondly, it fails to recognise that laws themselves rest on ethical notions, require ethical sense to be interpreted and fairly implemented and can also be regarded in certain circumstances as morally and ethically wrong, hence the ongoing need for legal reforms.

Thirdly, it encourages a defensive stance in the professions, as we now see in medical practice to a large extent, especially in the USA. It is generally recognised that a foregrounding by professionals of possible legal or regulatory sanctions may be

to the detriment of good (i.e. ethical) practice. A professional may avoid or transfer (to the future or to another professional group or agency) an otherwise acceptable technical risk, or make an unnecessary intervention, because it reduces the 'legal risk'. In medicine, for example, caesarean sections have increased enormously in relation to natural childbirth not because they are ethically preferable, but because the doctor perceives a possibility of litigation for not having intervened earlier if something goes wrong during a natural delivery. It would be very fruitful to explore this issue in the engineering professions. It would also best be tackled by engendering an awareness of the issue at an early stage in the career of the engineer.

The computing tutor insisted that one had to take as one's point of departure what is legally required and what the professional Code of Conduct demands, and then move on from that. He said:

> '… in the context of their job that legal framework rules their department, and is relevant to them, so it is something they all feel comfortable to subscribe to. Whereas a collection of other questions would be subsidiary and until they become interested and motivated by it they'll probably feel more comfortable to ignore. Finding them something which immediately is apparent to them as soon as they set foot in a computing organisation seems to me to be a very good hook to hang these things on'.

My feeling is that while some legal and regulatory requirements should certainly come in early in the students' learning experience, the same should be said of moral values and ethical awareness, in a free-flowing and questioning manner rather than a serial 'law first' manner.

> **"But it might be that one might be able to come up with a webpage or ULearn page that essentially says 'Well, right, you've signed up to the BCS code of conduct, your company ties you down with respect to these operational activities, <u>but</u> have you thought about this, this and this?'", Tutor.**

3.210 Supervisory system

All three tutors were familiar with the PT procedural system, and thought it provided adequate supervision and communication. All agree that it should be possible to bring some awareness of ethical issues into this system.

Students have an on-site 'industrial supervisor', i.e. a designated employee within the company, often a middle manager (a team leader of departmental manager). They are therefore in a triangular relationship, involving the university-based tutor, who will make occasional visits (usually three a year) and keep in touch with the student by email. An industrial supervisor might have more than one student, as well as several employees, to look after. It depends on the size of the company.

The Computing tutor said, '… obviously we talk to the supervisor about the sort of work the student is doing and the way that integrates into our course to some extent because we like the students to appreciate that relationship'. It seems to me that there might be opportunities for tutors to mention 'ethical awareness' as part of the student learning, if the tutors are suitably briefed and informed.

In the case of the computing PT students the BCS provides a schema of six-monthly plans which can be mapped onto their designated job roles. The students are '…certainly advised that they need to keep a personal diary which they can use to contribute to their final report at the end of the year'.

There could be scope for negotiation with the accrediting bodies to incorporate 'ethical awareness' in the criteria embedded in the plan that PT students follow.

The Chemical Engineering tutor explained that the PT Report is about 3,000 words long. There are also 'Progress Reports', which are three interim reports which coincide with the visits of the tutor, and those are 2 or 3 pages, perhaps with diagrams or graphs, describing their activities. The student's industrial supervisor makes a report which is quite a large component: 37.5%. The students make an oral presentation to the company and the visiting tutor on the last visit. In some other schools of the University the students make their presentation after they return to the Level 3 programme.

3.211 The placement experience

The interviews revealed that the placement experience can vary quite widely, perhaps too widely. While some students are fully involved in a team working on a project, with constant supervision and feedback, others (at the other end of the scale) may be doing little more than putting data into a database, with little interaction or feedback. Some are working in very large companies and others in SMEs.

What this means is that there will be as much variety in considering 'ethical issues' in the students' placement year as there is in the other parameters of their experience. One has to take account of this diversity, allowing for considerable flexibility in expectations of evidence of ethical awareness. It means that any online framework provided for students must be broad, mainly process-based, and not too rigid in content. It will have to be made clear that some questions and content will be appropriate in one PT placement, partially appropriate in another and wholly irrelevant in another.

For example, in Computing, '… many PT students are developing software, involved in teams typically, and they either work on little projects by themselves or on projects with other people. They build web-based systems, build databases, write procedural software … mostly by themselves, testing and evaluating it as they go, documenting it. Many of them might be involved in supporting existing systems, so, fielding requests for help, fielding log reports, etc. Other ones might be involved in organisational type activities in which they are in some way managing part of the process although that might well be more on the support side so it might instigated by their users. Some of them do project management work'.

Not only does the diversity in the PT experience have to be allowed for, but the diversity in the content, concerns and objectives of the different engineering disciplines (chemical, mechanical, civil, etc.) would have to be allowed for. This, I believe, is why a process-oriented, rather than content-based, one is vital for the success of the 'ethical awareness' provision.

> **Most of them [PT students' tasks] are technical, in terms of 'Will write web-pages', 'Will de-bug output', 'Will document results' and so on. But clearly there are some ethical issues relating even to just those, in relation to correctness, Data Protection Act, and so on.**

3.212 Is the PT year the best place for ethics?

The tutors were asked to consider whether the PT year was the best place to locate an 'ethical awareness' requirement. Two other options arose in discussions with various parties, including the tutors. It could be made available throughout the UG programme; or it might fit better in the third year, when students would have more time and freedom to reflect on the previous year's experience. There was also the matter of catering for students who do not do the PT year at all. The conclusion I have veered towards (see Conclusion of this section) is that, on balance, it would be best to place the ethical awareness framework in an online facility for student 'Key Skills' development, where it could be available at any point in the UG programme, and that a simple reference in the PT year Handbook to this facility would encourage at least some of the students to embrace it briefly in the PT Report.

On this question the tutors were mainly preoccupied with the students' perspective on the burden of work and motivation. These are related to the matter of assessment (see 3.213). My overall impression was that while all of them thought ethics should come in somewhere in the curriculum for engineering students, there was doubt about how it would work in the placement year. One tutor said, 'We would have to find a framework that students would be prepared to put an effort into, especially if it is not directly assessed … It would certainly be possible to slot one or two extra pieces in so long as we do it in a sufficiently user-friendly way, that the students don't feel that this is just another burden on their time'.

Another was concerned about whether the online 'ethics material' would 'mesh' with what students are actually doing in their PT year. He asked, 'Is it possible to ask some open-ended questions such that there's a particular section of the report in which they consider ethical issues faced in their particular placement. We'd have to be careful that didn't conflict with any company policy or cause any difficulties with their supervisors. That might be a way to go with this. My concern is that it would be a detached concept separate from their main agenda and would be seen as another piece of university coursework, another hoop to jump through'.

The same tutor became more convinced as the discussion proceeded, suggesting it might be workable for students to have 'a small section – say, half-page to a page – which discusses ethical challenges, issues that relate to the placement: the operation of the company and your [student's] own specific role within the company, whether a food or pharmaceutical company…. That might be difficult but …",

> **"…I think they would accept it [ethical awareness in the PT year] if it's not too onerous, and it's good for them to consider these things. Personally I would encourage them to think about their ethical position", Tutor.**

3.213 Assessment

At the moment the PT year is assessed but does not carry award-bearing credits. That is, the progress reports and end-of-year report that students write are evaluated and marked in so far as students are given feedback on specific points of their performance in the placement and their write-ups, but they are not given marks which count in their grade of degree. The only concrete outcome of their PT year is an

‘Associateship of the University of Surrey’ (AUS), which is a recognition that they have indeed satisfactorily completed their work experience. This has some value in so far as employers look favourably on it when considering students for employment, and it may be taken into account in schemes for ‘Chartered status’ in some professions. (The ‘AUS’ recognition is currently being reconsidered by the University of Surrey, and may not continue in its current form.) Two tutors pointed out that in any case students who did take the PT year generally did better in the Year 3 exams.

While one tutor, as we saw above (3.24) thought that students were not very motivated to take the PT year and perform well in it, the other two thought that they were. The latter two emphasized that students were not motivated to undertake an academic or professional activity ‘just because’ it carried marks towards the final qualification. There were other factors, such as wanting to learn on the job and have a real feel for the profession, wanting to be in a position to impress prospective employers in the future, wanting to have the possibility of returning to the placement employer on completion of the degree, as well as professional pride and reputation (see 3.24 above).

One tutor thought that if there were to be formal (award-bearing) assessment in the PT then ‘we would have to increase the rigour of the assessments we make in that year quite considerably. And we don’t want that to dominate various aspects of the year. It would involve more work on our behalf, on the students’ behalf and on the employers’ behalf. And I’m not sure that the benefits are really there’.

Another tutor played with the idea that students should perhaps have ‘hard’ criteria for ‘ethical awareness’ in the PT Report, but was not entirely sure. He said, ‘Students like prescriptive information, so if you say “include a section on this and you’ll be marked on it”, they feel comfortable because they’ve got the boundaries, they’ve got a framework for their report, and off they go and they generate a section’. Although he appeared to favour marks for ‘ethical awareness’, he did not mean that such marks should *count* towards the grade of degree. He emphasized that it would not be fair to make such marks count:

‘We feel very strongly about this, that it would be unfair on the student for their performance at level P to count, or have any weighting towards their final mark for the degree because of the difficulty of getting objective marking from supervisors and also visiting tutors for that matter. What happens during the student placement is to a certain extent out of our control, and there are these external factors which we feel it would be unfair on the student to let this affect them … you send a student off to a company and everyone agrees on a plan of action and what students should be doing and then suddenly the company gets sold or the boss moves away or ...so circumstances are out of our control’.

The Royal Academy of Engineering’s ‘Curriculum Map’ (see above 2.2) suggests that assessment of ethics in relation to modules could be done variously, through the addition of an ethical element to the technical assignments, marks for ethical audit of student projects, and peer review of group debates. These are all excellent ideas. However, it also proposes that ‘Placement assessment could include an ethics review report [*sic*] of the host organisation, given appropriate debriefing of the host’. As we have seen in m Report, this could present considerable difficulties, and empirical research is needed into students’ and employers’ experiences in the wide variety of engineering student placements.

In any event, regarding ‘ethical awareness’ in the placement year, the upshot of the foregoing discussion is, so far, as follows (and see Table 3.213):

- If the University were to decide that the PT Year is given award-bearing assessment, then that might be an opportunity to decide whether 'ethical awareness' could also specifically carry some marks that count towards the degree grade.
- A less radical change is that 'ethical awareness' carry a few marks for some section of the PT Report, even though (taking the existing system for granted) it does not count towards the degree grade.
- Even less radical is that the Report carries no specific marks for an identifiably 'ethical' component, but the Tutors recommend that students take account of anything of ethical relevance as a sign of their general professional understanding.

Table 3.213 Location of 'ethical awareness' provision

Curriculum location	Advantages	Disadvantages	Assessment
Part 1 (Year 1)	Early intro to ethics creates basic mindset	Large classes, insufficient tutors and lecturers.	Formative or summative?
Professional Training Year	Everyday engagement with ethical reality of 'lived' practice; early induction in real ethical practice; moderate incentive.	Diversity of actual PT experience; too much reliance on Tutors; sensitivity to employers	Formative?
Part 3 (Year 3)	Time and freedom to reflect with more 'distance' and little constraint; high (external) incentive; 'safe' for employers.	Year 3 already overloaded and stressful? Too late in learning experience; could be rather abstract.	Formative or summative?
Universal availability	Flexibility; contributes to general culture of learning & teaching	Could be ignored; no external incentive (but self-incentive?)	Formative assessment?

3.214 Online provision

None of the tutors had any objection to using ULearn as a vehicle for making 'ethical awareness' available to students. There was some doubt as to whether students would actually use it. However, where there is already some departmental online provision, the 'ethical awareness' could either be added directly to it or connected to it via a link.

In Computing Science students are already directed to publicly available web-pages created by the department itself. Unsurprisingly, the University has a number of web-pages devoted to various aspects of the PT Year. For example, the School of Electronic and Electrical Engineering (SEPS) (Soon to be part of Faculty of Engineering and Physical Sciences) has a page on the 'SEPS Professional Training Year' (www.eps.surrey.ac.uk/placement) with information on jobs and specific information for the departments of Computing, Electronic Engineering, Mathematics & Statistics, and Physics.

However, none of these are suitable for carrying educational material, although it might be appropriate to carry links to educational pages, such as those I envisage for 'ethical awareness'.

At the moment at least one tutor refers students to the website of the relevant professional institution, and I would have to be careful to ensure that any ULearn provision I design would link to and build on these, without duplication. Thus there would be no point in uploading Codes of Conduct when the Institutions already carry these on their websites, but I could provide links.

In any case, the real merit of a ULearn 'ethical awareness' website would be its interactive features, facilitating a process approach in ethical dialogue, inquiry and debate.

The location of such a website has to be given careful thought. As I have said, it might be that it would sit well with other students' general 'Key Skills' development utilities.

> **'I'm sure that [*online 'ethical awareness framework'*] would be very useful , especially as you would I suspect coming at that form the 'softer side', whereas we in our courses tend to talk about the hard legal type issues. But the two together might be quite nice. Certainly if we were to pull together everything that we thought students needed to know..', Tutor.**

3.215 Integrate or add on?

While one tutor had suggested the possibility of a separate 'ethical awareness' section in the PT Report, the general trend of their thinking was that ethics should be integrated across modules, and the learning experience, rather than something provided separately or as a casual add-on here and there. The reason for this did not appear to be that they thought ethics too valuable or too exciting to merely add on. It was rather that students would ignore it unless it came up wherever relevant. One said, 'If you don't integrate it then, frankly, the problem is that students will just switch off on this "dull, boring module" that they don't quite see the relevance of; especially if you present it too early in the course'.

I found the tutors rather ambivalent about the whole question of ethics in the curriculum; on the one hand they sensed that it was important and should be present (and not just because the Institutions wanted it) and, on the other hand, feared that it would be something that students would be reluctant to accept. I feel sure this is due to lack of knowledge of ethics (next section): they just weren't sure what it is. It's a good thing, but what is it? In this regard ethics seems to be in the same category as Zen meditation, electoral reform and nanotechnology.

Another tutor, when asked if this ethics provision was worthwhile, said he was 'indifferent' and when pressed he added: '…but I don't have a good feel for what it entails or what the implications are, and I am happy for you to change my perceptions'. When I explained the excitement generated by ethical discussion in class, and the excellent student evaluations I had received in ethics classes in a number of different disciplines, he began to change his mind.

The same tutor thought it could be quickly put in place 'top down', but such a strategy would not win over the tutors, adding: 'The trouble is you've got to educate people from the bottom up and get the framework in place from the top down'. I entirely agreed with him.

"I don't have a good feel for what it [ethics] entails or what the implications are, and I am happy for you to change my perceptions", Tutor.

3.216 Staff prepared for ethics?

After my interviews there was no doubt in my mind what the main task, of several important tasks, would be in introducing a workable 'ethical awareness' provision of some kind into the UG engineering programmes: educating the educators. If the tutors are to be primarily involved in delivering this dimension of professional education then they would have to have a basic understanding of the value, discourse, content and process of 'ethical awareness'. Their scientific and technical training has, on the whole, not prepared them for this.

One tutor gave the impression that what he and other tutors knew about ethics mainly, or perhaps entirely, came through the accreditation requirements of the Institutions. Since ethics is 'something they [Institutions] are very keen on' the tutors and other academic staff are concerned about complying, especially when another round of re-validation arrives.

I tried to paint a much broader picture by asking the question, 'why is ethics coming to the fore these days?' and partially answering it myself: Isn't it partly because the general public is asking a lot of questions about whether science and technology are taking us in the right direction? There is widespread scepticism, and in some cases even public protest, about technological developments, such as to GMOs, mobile phones and electromagnetic fields, genetic engineering, scientific fraud, suspicion about the motives of pharmaceutical companies, the nuclear energy option, global warming, chemicals in the environment, and so on, and that is why as professionals we have to be ready to engage with the public about the issues. With this, they all agreed.

If there were the time and managerial/administrative support for it, the tutors would cooperate with the ongoing development of a ULearn site on 'ethical awareness', and even a Faculty-wide workshop (or series) for tutors and other academics. One tutor replied, 'That sounds great, but maybe that opens up something wider: it's a continuous maintenance thing, it's not a one-off... And it raises a wider issue with PT, and that is that Tutors [need to be better trained] for doing the job'.

'The longer this conversation [about 'ethical awareness'] goes on the more I am seeing 'Ah! I see what you mean'. But it's taking quite a long discussion in order to establish this', Tutor.

3.3 Interim Conclusions

Here is a summary of conclusions and findings, based on the interviews with the tutors and reflection on what they had to say. Ethical awareness' provision:

- Must be integrated, not added on.

- Must be flexible to take account of diversity of academic discipline and actual work experience.
- Must be process-oriented (inquiry-led) not content-based.
- Must clarify overlaps and differences between personal morality, professional ethics, regulation and law.
- Must build on what the professional Institutions already provide under the rubric of 'ethics'.
- Must be grounded on a foundational ethics programme (workshops) for tutors and other relevant academics.
- Must take account of legitimate sensitivities of employers (providing some simple 'ground rules' for students).
- Is probably best anchored in an online interactive website that is directly accessible, and providing other basic skills for students.
- Requires that further thought be given to assessment, but award-bearing marks are probably not necessary for developing 'ethical awareness'.
- Preferably self-motivated (self-incentivised) by students, not just external (award-bearing marks).

4 External Evaluations and Other Comments

I obtained evaluations and reflections from a number of independent external specialists. Each had first read at least my reflective report on the interviews with PT Tutors (section 3).

4.1 Prof. Richard Bowen (Engineering)

Professor W. Richard Bowen, FREng, is in the Centre for Complex Fluids Processing, School of Engineering, University of Wales Swansea. He is also a member of the Royal Academy of Engineering's 'Teaching Engineering Ethics Group'.

Here are some personal *reflections from Professor Bowen, having read my reflective report on the tutor interviews:*

[The tutors'] views fall within expectations, especially the emphasis on the technical and legal. You are right to identify a need to educate the educators. You do not write about how the tutors were selected. A useful strategy for your work could be to identify those academics who are most interested in engineering ethics so that you can work with them to promote a wider engagement. It is likely that there are thoughtful individuals who are sympathetic to your goals in each Department. (Maybe you have already done this.)

There have been some interesting studies in business ethics on levels of moral reasoning based on Kohlberg's theory. These suggest that reasoning at his levels 3 and 4 is the most usual amongst US business managers ("good-boy orientation", "authority and social-order maintaining orientation"). There appears to be a tendency for those in technical roles to have slightly lower levels of reasoning than those in pure management roles. Overall this is not very encouraging. I do not know of any such studies for engineers.

Another factor which is apparent in business ethics is “bracketing” – a tendency for individuals to suppress their personal ethical responsibility while at work. This suggests that a way to increase professional ethical awareness would be to encourage people to view their lives as an ethical whole rather than a series of roles.

One factor you do not mention in the section of the report that you sent is that some companies now have written Codes of Conduct that they take very seriously and which can set really aspirational ethical expectations. These can additionally include clear statements that they do not serve as a substitute for individual responsibility. They can seek to promote ethical coherence by suggesting questions in cases of doubt such as, “What would others think about this action – your manager, colleagues or family?”. Such Codes can be supported by confidential and independent procedures for raising concerns (independent of the line management or even of the company).

However, other companies do not aim for such high standards. I recently had some discussions with the Chief Executive of a major international engineering company who took the view that he would work on any project that was not specifically illegal as “someone else would do the job anyway”. I came to the conclusion that he had no concept of personal responsibility for his professional activities.

[T]he opening paragraph of the RAE’s ‘Statement of Ethical Principles’ [states]: ‘Professional Engineers work to enhance the welfare, health and safety of all whilst paying due regard to the environment and the sustainability of resources. They have made personal and professional commitments to enhance the wellbeing of society through the exploitation of knowledge and the management of creative teams’. This seems to me to be a very strong statement of the ethical nature of engineering – it aims to help others. I note in particular the use of the words “of all”. So, ethics is not something that should simply be integrated into engineering, it should be an integral part of engineering.

Unfortunately, this is often not the case. The modern development of engineering has been imbalanced, giving too great an emphasis to technical wizardry and forgetting the priority of people. This imbalance is also an important justification for the type of development that you are proposing at Surrey.

In my view, ethics needs to be an integral part of engineering courses from the very start, beginning with the presentation of the subject to potential students. This is starting to happen.

[I]n teaching ethics at university I would suggest that it is important to give a balanced account of the overall goals of engineering as well as considering “quandaries” (dilemmas). In my view there is too much emphasis on the latter at present. In this context, the convention of [philosopher Paul] Ricoeur in regarding the designation “ethics” as referring to the aims of a life that could be described as good and regarding the designation “morality” as referring to the rules or norms that provide specific articulations of these aims is helpful. You mention placements in your report. Along these lines I would suggest that important questions to students following such placements should include questions such as:

- How did the company contribute to the welfare of others?
- Did the company have any negative effects on such wellbeing?
- Did the company ethos engender respect for others, including colleagues, customers and society generally?

Even better, students could be asked to consider benefits to the wellbeing of society in choosing their placements.

I note that you intend to develop a web site to teach ethics. The web is certainly a good means of placing information. However, I would suggest that it is even more important to discuss ethics directly and personally with the students. Engineering students already spend plenty of time engaging with technology, and ethics is about people.

4.2 Dr Natasha McCarthy (Royal Academy of Engineering)

Dr Natasha McCarthy is Policy Advisor at The Royal Academy of Engineering.

Dr McCarthy points out that these are her 'personal comments based on the work I have done with the TEEG group [Teaching Engineering Ethics Group] at the Academy'.

I can only really comment on the conclusions of this [interviews] section. Of course, they are conclusions reached on the basis of your interviews, so I can't disagree with them as legitimate conclusions on the basis of those discussions, but I would like to point out things that I think that are missing, and where I would disagree with the conclusions that were drawn. In the main I agree with the conclusions that you draw – particularly the need to teach the tutors. The very idea that tutors might need support in teaching ethics shows that an ability to deal with the issues does not simply come with experience, so it would be wrong to assume that tutors are automatically able to teach the subject.

Integration: I fully agree with the idea that it is better to integrate ethics in the curriculum (as you will know, this is the suggestion from the Teaching Engineering Ethics Group's 'curriculum map'). On the one hand, stand alone ethics modules would be unlikely to attract students, and if they were made mandatory students might see them as a distraction from the 'real' subjects. On the other, the reason for teaching engineering ethics to students is because ethical issues do arise in the working life of the practising engineer, and they arise *within* a project, not separate from the processes of design, management etc. Students need to be prepared for recognising potential ethical problems that threaten to arise in a particular project, for thinking through the aspects of that problem, for finding the best solution and for justifying that solution. These problems might arise at the design stage of a project, in the course of managing a large project, or after a project has ostensibly finished. So, within each module that covers a topic with potential ethical issues, there could be one tutorial or lecture that brings out the ethical issues – whether those be the social impact of a construction project; privacy issues in a database design; designing-in safety and balancing cost versus safety; the impact of a system on its users, and so on.

Teaching ethics through discussion: However, I would say that the best way to carry this out would be slightly more interactive than suggested by your conclusions (at least as I understand them). I am concerned about the ideas of study into ethics being 'self-motivated' and being implemented by using web-based learning tools. I think that students get a lot out of discussions with other students when it comes to ethics, as it opens their eyes to opposing points of view. It could make them more aware of what issues might create ethical dilemmas: one person might see something

as ethically questionable which another accepts, but hearing why it is found ethically questionable can make students sensitive to ethical issues that they might otherwise not foresee.

Also, the Teaching Engineering Ethics Group has long argued that studying case studies of ethical dilemmas in engineering and how they have been dealt with helps students. Students could indeed study these independently, but often they get more out of it if they can discuss the case studies in groups and hear each others' opinions. Even more effective can be role plays where the students act out the process of negotiating a tricky ethical problem.

Dealing with real ethical issues: I think studying ethics in groups with other students is also valuable in that it helps to build a student's confidence in voicing their opinion on ethical matters. I was concerned about the suggestion of incorporating ethics into the degree only in the placement year, because one of the main reasons for adding ethics to the curriculum is to allow students to develop their thinking in this area before they face real problems with practical ramifications. In addition, with no experience of dealing with such issues students may feel unprepared and nervous about addressing an ethical issue that arises in the workplace. I think discussing ethical issues should indeed form part of the student's report on their placement experience, but this should not be the first time that they have dealt with the issue.

Ethical audits: Another possible area where ethics can be incorporated into the curriculum is in the context of the final year project. In a couple of meetings on engineering ethics that I have been to it has been suggested that final year projects could include 'ethics audits', where the student has to identify any ethical impacts of their project (e.g., impacts on environment, communities, employees etc), and how they might deal with those to prevent problems. This seems like a good suggestion as it will prepare the student for dealing with ethical issues in practical situations (rather than in the abstract) and seems quite straightforward to assess (have they missed any obvious issues, do they have reasonable suggestions for dealing with them and can they justify their solutions?)

4.3 Prof. Charles Engel (Education)

Professor Charles Engel is currently at the Centre for Higher Education Studies, School of Lifelong Education & International Development, Institute of Education, University of London.

I met with him in London to share thoughts on my project and his own project on education for sustainable development in engineering. The following are my own notes on salient points made by Prof. Engel.

It was suggested that my study needs to be greatly extended if my inferences and conclusions are to be generalisable. A research-based study, with a greater sample and an objective method which puts aside my own views would carry much more weight in carrying such a project outside the University of Surrey. It was appreciated that my study was more of an inhouse feasibility study in which I was also gauging the Tutors reactions to my proposals and arguments for change.

As a feasibility study I would have to pay closer attention to the three aspects of any such study, which are:

1) The *acceptability* of the proposal to those who will have to implement it and will be affected by its consequences - staff and students.
2) *Effectiveness* of the proposal if implemented, even if it only has the modest aim of raising 'ethical awareness'.
3) *Efficiency* of the proposal if implemented, in terms of costs-benefit, use of resources and facilities, effort of those involved - how sustainable would it be in long run?

There is a need for a clearer idea of whom is being addressed by this Report and to what end. If the Tutors are important to delivery, then they will need to be encouraged. It is agreed, however, that the Report could be valuable for university policy-makers at managerial and professorial level. In any case, it is unlikely that the Tutors would even have the time to read a Report of this length and, furthermore, they might not be in a position to 'take ownership' of it. They might see it as a case of 'special pleading'.

Prof. Engel was cautious about tutors being the right people to help to drive through this change. He thought ethics was a specialist discipline and that the 'expertise' involved meant that there should be a professor in engineering ethics who could lead and drive curriculum changes.

'Ethics' may not be understood at first. It would be best to place ethics in the wider context of professional development and responsibility. Engineering as a whole needs to be socially contextualised for students. The argument should be promoted that employers and international competition favours engineering students with a wider contextualised education, in which students learn to be creative and take a lead. Engineering is still based on lectures and an 'information-transmission' style of education and this has to change. Prof. Engel favours a Problem-Based Learning approach, and is sympathetic to EBL but fears that it allows an 'anything goes' tendency.

It was inferred that ethics in the context of the placement year would be hampered by severe out-datedness and deficiencies in the current arrangement. Taking medical training as the model, it was argued that placement ideally needs re-situating and systematising in the context of a complete overhaul of professional training of engineers. This would begin with Year 1, in which there would be a properly administered system by which all engineering students would go on several short placements to different industries, be part of projects, and learn by problem-solving. Government would have to provide strong incentives for industry to support this training system, and the professional Institutions would have to build this in as an accreditation requirement. Engineering ethics could have an effective place in such a system.

4.4 Ms Helen Booth (Healthcare)

Ms Helen Booth, is Senior Tutor and SCEPTrE Fellow, Faculty of Health and Medical Sciences, University of Surrey, and Chair of the Professional Council, College of Operating Department Practitioners (www.codp.org.uk).

While Ms Booth is not external to the University she is external to the engineering professions and working in an area (healthcare) in which both ethics and PT placement have a long history from which engineering education may learn a great deal.

In respect of placements I have the following comments. There does not seem to be a great emphasis on the placement year regarding the integration of theory and practice. It seems to be an add-on, not essential, other than from the view point of future employment. Ethical awareness should be taught in year 2 (with workshops of scenarios) for exploring in the placement year with the supervisor. Other skills would also require how to behave professionally with respect of their role and how to understand the industry in the wider global concept. This would require some rehearsal time and space to explore the impact of technology and scientific advancement could/would have on the individual and society (conflict of interests could also be explored here). However, this would require placement supervisors being competent to facilitate their learning also.

Are placements audited as reliable learning environments or is it all centred on whether they meet all Health and Safety measures? A learning outcome for the dissertation could require the work to have a learning outcome/ section/ chapter/ discussion on the global issues within the industry, which no doubt would raise an ethical dimension.

Your findings also make me question the equity of experience that students gain if they do not do the practice placement year?

I recommend that placements are integrated into programme outcomes; Year 2 and final year sessions on ethical awareness related to the area of the industry (engineering) – via workshop one session to develop the learning in year 2 and in the final year to explore through discussion around the experience; tutors/ lecturers need to have sessions to help them explore with students the world of professional preparation within a lot of the areas you have already discussed in your report

The introduction of a more flexible approach to the practice year maybe required especially if finance is an issue. Possibly placements need to be only for 6 months (mandatory) with objectives that include an ethical dimension.

5 Proposed 'Ethical Awareness Framework'

The full framework I am designing in the light of this feasibility study will appear online within the University's web facilities. This section of the Report is meant to give a broad outline of its approach, process and content. The online framework will be a pilot, and it will continue to develop in dialogue with students, placement tutors, industrial supervisors, academic staff, SCEPTrE colleagues and other interested parties inside and outside the University.

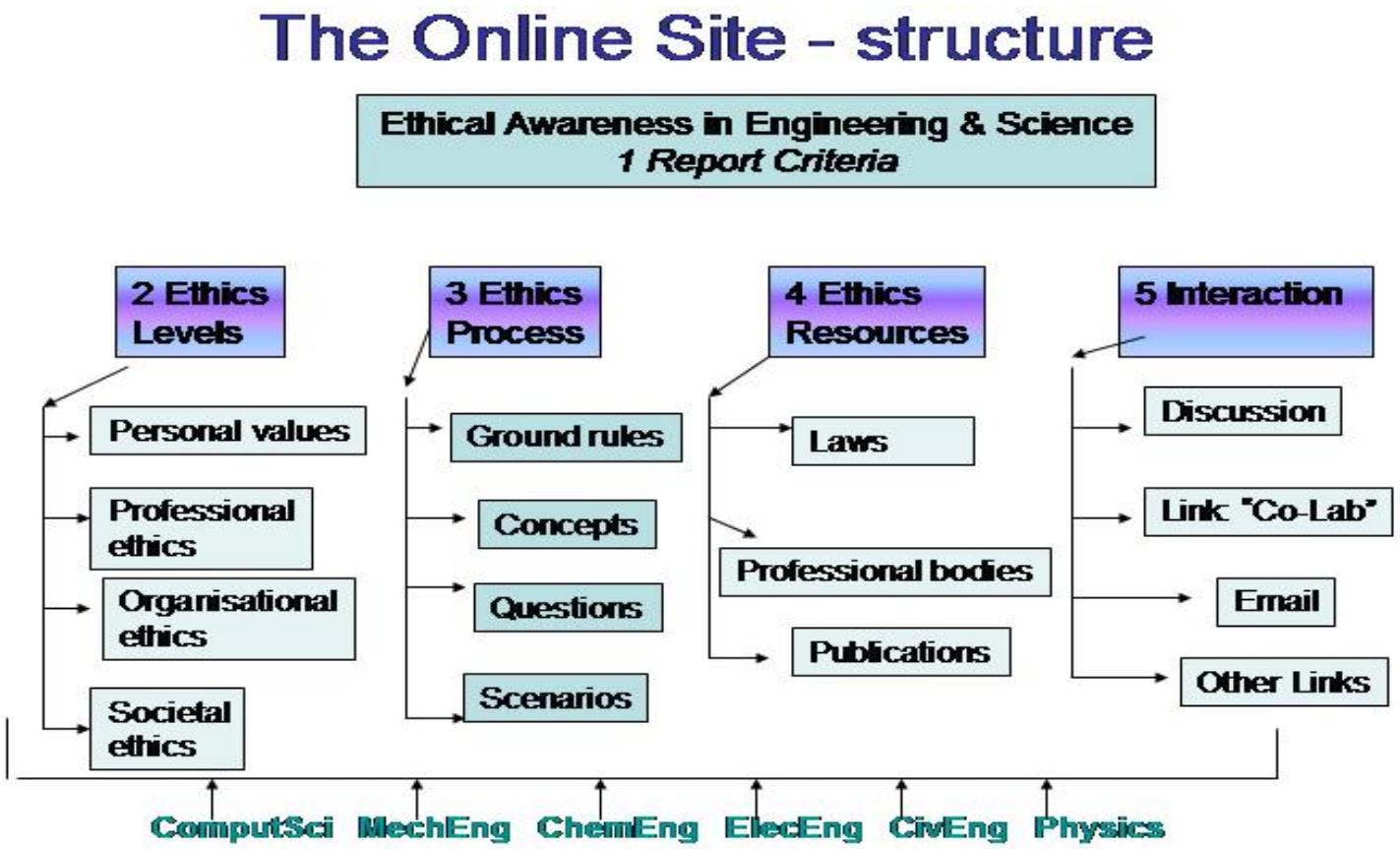
5.1 The Online Site and Ethics Framework

The University's online site for the 'Ethical Awareness' flexispace is shown in Diagram 2 below. The content of site and its subdivisions will be fleshed out in detail during the implementation phase of the project, beginning 1st August 2007, beyond the Fellowship period. (An indicative content of the 'Ethical Awareness' flexispace is given in 5.2 below). The aim is to keep the site clear and simple, with minimal substantive content, and improve it through an iterative process with students, tutors and other staff. It will be minimal in content, since its aim is principally to trigger a *process* of ethical inquiry, rather than provide lectures or knowledge for 'transmission'. It will be the *anchor* of the flexispace.

5.2 Indicative Content of the 'Ethical Awareness' flexispace

Report criteria: Brief account of what counts as evidence of 'ethical awareness' in the PT Report.
Ethics Levels: Brief explanation of how ethical issues often split into four levels of personal values, professional ethics, organisational ethics and social ethics; and how the lower level is often constrained by the higher level (e.g. conscientious objection, whistleblowing), or higher level mobilised by lower level (e.g. leadership, team solidarity); with case examples.
Personal values: Values that an individual holds (or does not hold) regardless of their formal role, and which may be embedded in their family, cultural, religious, spiritual and experiential background, e.g. the value of 'hard work'. Inner harmony or dilemmas.
Professional ethics: Values and principles which custom and tradition attach to a specific profession and which may (or may not) be embodied in a code of conduct and/or code of good practice e.g. confidentiality for the client. Inner harmony or conflicts and dilemmas.
Organisational ethics: Values of a corporate entity, in this context usually the employing organisation, which may be implicit in the organisational culture or embodied in a mission statement, statement of company values, corporate responsibility statement, or the like, e.g. 'customer care'. Inner harmony or conflicts and dilemmas e.g. between management, professionals and workers.
Societal ethics: Values of a society (cultural, national, regional, global) as they emerge or are prescribed e.g. 'human rights'. Inner harmony or conflicts.
Resources: Any leads which students can follow up in inquiring into the ethical dimensions of the scenarios and incidents they encounter, including website, blogs, bulletin boards, news, journals, magazines, books, libraries, organisations.
Laws: Links to the national, regional and international laws and regulations of most relevance e.g. Data Protection Act, Computer Misuse Act, Health & Safety Act, chemicals legislation, Human Rights and the like. A very brief bullet-pointed list of main aspects of some laws will be provided.
Professional Bodies: A list of the principal professional (and accrediting) Institutions (see 2.3 above), linking to codes, advice etc., with brief description of any salient features.
Publications: Brief list of journal papers, professional magazine articles and books relevant to each profession.

Diagram 2: Online structure for 'Ethical Awareness' Flexispace



Interaction: Opportunities for students to interact with each other, with PT Tutors and/or the 'Ethical Awareness' coordinators; by means of an online Discussion area, Co-Lab, and email (below). The 'Discussion' area will be specifically for students to share ideas and questions with the Tutors and/or 'Ethical Awareness' coordinators; while 'Co-Lab' is a student-managed and student-led discussion area by which students can share ideas and questions with each other, and provided here as a link only; and an area of email links to other relevant contacts. There will also be a page of any other links to sites which may be useful, either generally or specifically.
Ethics Process: Students will first read the Ground Rules, then grasp some basic ethics concepts, then look at some trigger questions, and then examine some online scenarios/case studies (at the four different levels outlined above) to understand the kind of situation that is relevant to 'ethical awareness', and then 'interrogate' their own workplace situations in the light of questions that arise for them (see 5.3).
Ground Rules: Students will be provided with a minimal set of 'good practice' rules for considering the ethical dimensions of a workplace situation or incident. These include "don'ts" such as 'Do not adopt a judgemental or campaigning stance' and "do's" such as 'Always first discuss the situation with your industrial supervisor' and 'respect commercial confidentiality'.
Ethics Concepts / Definitions: Short definitions of basic concepts each with an illustration. For example, privacy of person, confidentiality of information, informed consent, conflict of interest, ethical dilemma, balanced judgement (between dogmatic extremes), honesty, loyalty, discrimination.
Trigger questions (for EBL): Here are some examples. Which of the following would you described as an ethically balanced judgement and why? Is there a conflict of interest in any of the following, and if so, why? Is there a dilemma between 'the right thing' at different levels in the following cases, and if so, why?
Scenarios: Some sample scenarios or case studies relevant to each engineering/science profession, designed to illustrate main ethical concepts and promote inquiry. Here are some samples. (1) If your workplace experimented on laboratory rats in a manner that appeared to cause unnecessary pain what would you do or not do, and why? (2) If you regularly witnessed a colleague at your workplace omitting important but unfavourable information to clients what would you do or not do, and why? (3) If an inferior chemical ingredient was systematically and 'secretly' substituted in a process at your workplace, what would you do or not do, and why? (4) If a middle manager in a chemical plant signs off safety sheet for whole week in advance on grounds it saves time and money, what would you do or not do, and why?

Small group discussion, role-play, audit and other learning vehicles may be deployed in connection with the online facility. All of the above are to be developed in detail in my intended next stage (iterative implementation).

5.3 The Teaching-Learning Process

Provisionally, it is envisaged that the teaching-learning process of the flexispace will have phases such as:

Phase 1 (Initiation): Initial provision of critical tools and sample scenarios and questions for the development of inquiring abilities; in an open manner leaving choice to the learner.

Phase 2 (Experiential reflection): Learners' reflective attitude and responsiveness to work-based experiences (usually PT placement year) develop and is given shape largely/partly on basis of phase 1.
Phase 3 (Dynamic responsiveness): Readiness of tutors and online staff to respond to student reflections and create a dynamic space for exchange, exploration and provisional solution/ resolution/consensus/agree-to-disagree outcomes
Phase 4 (Creative Criticality): Self-conscious recognition and articulation by learners and teachers that a shift to 'creative critical inquirers' is (or is not, or is partly) occurring in the learners
Phase 5 (Formative Assessment): Assessment of ethical awareness would not be discrete and formal, but would be 'formative' i.e. incorporated in a modification or enhancement of the general criteria of assessment of the student Report issuing from the work placement experience.

Staff would need to be consulted and, where necessary, assisted in developing their ability to evaluate EBL-enhanced ethical awareness. Unfamiliar or novel criteria may emerge. Interventions by means of appropriate 'Staff Development' initiatives may be indicated.

The delivery/communication of the ethics flexispace would be through a mix of 'direct human' and 'digital interface' contact, depending on appropriateness of level, task, resources etc. The details of administration, timetabling, fit with other elements of the students' course, resourcing, etc. will be developed through the feasibility study and the consultation/interaction with students, colleagues, administrators, CLD, and others.

6 Conclusion

This study indicates, so far, that an e-learning anchored 'flexispace' provision of 'ethical awareness' for engineering undergraduates is feasible if certain conditions are met. I shall now summarise my outcomes regarding the feasibility of an 'Ethical Awareness' flexispace, the recommendations that follow and the further work that needs to be done.

6.1 Summary of Outcomes on Feasibility

Taking advice from Prof Engel (see 4.5), I shall now briefly re-examine the findings in the light of the three criteria of acceptability, effectiveness and efficiency.

Acceptability

The idea of ethics teaching for engineering UG students, including the PT Year, is not only wholly acceptable to the professional bodies – from the EC and RAE to the individual engineering Institutions – but is required, encouraged and promoted. It is not unlikely that ethics will be built into the accreditation requirements of some or all Institutions at some time in the not too distant future.

The idea is wholly acceptable to the Dean of the Faculty and other key managers and professors, albeit with provisos about implementation.

The PT Tutors appear to lie in an uncertain position. They are not against it, but some may be indifferent, and some are moderately in favour. The general impression is that they are not clear about what 'ethics' is, what its importance is,

whether they could themselves deliver any of it, how it would fit into the curriculum and how it would impact on resourcing. These perfectly reasonable questions were partially answered to their satisfaction. However, they have to be answered more definitively. I think the flexispace delivery, I have proposed, is an experimental way of doing so. Staff development workshops would be helpful too.

Effectiveness

This flexi-space could be offered effectively either though ULearn, with the support of Tutors, or through the 'Key Skills Online' provision of the University teaching and learning team. Either way, PT tutors should be offered opportunities to enhance their own skills in engineering ethics. ULearn delivery would have the disadvantage that the engineering ethics development would be denied to those students whose Tutors are unable or unwilling to take it on. PDP 'Key Skills' provision would make the flexispace available to all of them, on demand, and any PT Tutors who do wish to avail themselves of it (now or in the future) would be able to do so.

My own experience in teaching ethics to professionals for 20 years is that, delivered through engagement with actually practice (using EBL, problem-based approaches, etc.), it is effective in changing the mindsets of professionals in the direction of contextualising, inquiry and creativity skills. For example, several articles in the academic peer-reviewed international journal, *Nursing Ethics*, of which I am co-founder and Assistant Editor, indicate such effectiveness.

Efficiency

The use of an online University facility as an 'anchor' to deliver the flexispace would also be very efficient. PT Tutors are persuaded that the 'Ethical Awareness' flexispace proposed, would create minimal (and therefore manageable) demands on resources and time and would not require any major curriculum changes. Such a facility would also make for easy interaction between students in inquiring into ethical issues.

6.2 Further Work & Recommendations

This project is a *feasibility* study, and as such does not necessarily involve implementation. However, I have made a start on implementation with a ULearn-based Framework, to be tested with PT Tutors and students. Next stages may be outlined as follows.

1) I will need to continue my engagement with current stakeholders: PT tutoring staff in the University, learning and teaching staff in the University, internal and external academics in engineering, ethics and other relevant disciplines ethics, professional and regulatory bodies. I already have a scheduled meeting with the Chief Executive of the Engineering Council, Andrew Ramsay, in August 2007.
2) I shall have to gain opinions and advice from SCEPTrE, and the managerial, professorial and 'Teaching & Learning Development' staff to whom this Report is addressed.
3) I shall re-engage with PT Tutors,
    a) Preparing a brief outline of findings, suggestions and questions for the PT Tutors (this Report is not intended for them) to explore further with me, and

b) Creating as pilot ULearn (or similar) interactive website for students, to test the 'Ethical Awareness' Framework proposed.

c) Generating a workshop, (or series of workshops) at SCEPTrE in 'teaching ethics to engineering students'.

4) I shall have to extend exploratory discussions and 'testing' with two critical stakeholder groups, not covered by this small feasibility study:

a) Students

b) Employers

5) I shall begin to explore ramifications of what I have learned for the whole UG Engineering curriculum (before and after the PT year) and for PG and even post-doctoral education.

6) I shall develop publications in order to:

a) Disseminate my findings

b) Create novel teaching materials for students.

7 References & Bibliography

Below is a list of works relevant to ethics in engineering, some of which were referred to in this study and in compiling this reflective Report. I have separated out the publications of the Royal Academy of Engineering and Engineering Council because of their special relevance.

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Appendix 1:

ENGINEERING COUNCIL UK
GUIDELINES FOR INSTITUTION CODES OF CONDUCT

The Code of Professional Conduct of each Nominated Engineering Institution should place a personal obligation on its members to act with integrity, in the public interest, and to exercise all reasonable professional skill and care to:

1. Prevent avoidable danger to health or safety.
2. Prevent avoidable adverse impact on the environment.
3. A Maintain their competence.
   B Undertake only professional tasks for which they are competent.
   C Disclose relevant limitations of competence.
4. A Accept appropriate responsibility for work carried out under their supervision.
   B Treat all persons fairly, without bias, and with respect.
   C Encourage others to advance their learning and competence.
5. A Avoid where possible real or perceived conflict of interest.
   B Advise affected parties when such conflicts arise.
6. Observe the proper duties of confidentiality owed to appropriate parties.
7. Reject bribery.
8. Assess relevant risks and liability, and if appropriate hold professional indemnity insurance.
9. Notify the Institution if convicted of a criminal offence or upon becoming bankrupt or disqualified as a Company Director.
10. Notify the Institution of any significant violation of the Institution's Code of Conduct by another member.

Appendix 2:

Royal Academy of Engineering

STATEMENT OF ETHICAL PRINCIPLES

The Royal Academy of Engineering, in collaboration with Engineering Council (UK) and a number of the leading professional engineering institutions, has created a Statement of Ethical Principles to which it believes all professional engineers and related bodies should subscribe.

Professional Engineers work to enhance the welfare, health and safety of all whilst paying due regard to the environment and the sustainability of resources. They have made personal and professional commitments to enhance the wellbeing of society through the exploitation of knowledge and the management of creative teams.

This Statement of Ethical Principles sets a standard to which members of the engineering profession should aspire in their working habits and relationships. The Statement is fully compatible with the principles in the UK Government Chief Scientific Adviser's Universal Ethical Code for Scientists, with an emphasis on matters of particular relevance to engineers. The values on which it is based should apply in every situation in which professional engineers exercise their judgement.

There are four fundamental principles that should guide an engineer in achieving the high ideals of professional life. These express the beliefs and values of the profession and are amplified below.

Accuracy and Rigour
Professional Engineers have a duty to ensure that they acquire and use wisely and faithfully the knowledge that is relevant to the engineering skills needed in their work in the service of others. They should:
• always act with care and competence
• perform services only in areas of current competence.
• keep their knowledge and skills up to date and assist the development of engineering knowledge and skills in others.
• not knowingly mislead or allow others to be misled about engineering matters.
• present and review engineering evidence, theory and interpretation honestly, accurately and without bias.
• identify and evaluate and, where possible, quantify risks.

Honesty and Integrity
Professional Engineers should adopt the highest standards of professional conduct, openness, fairness and honesty. They should:
• be alert to the ways in which their work might affect others and duly respect the rights and reputations of other parties.
• avoid deceptive acts, take steps to prevent corrupt practices or professional misconduct, and declare conflicts of interest.
• reject bribery or improper influence.
• act for each employer or client in a reliable and trustworthy manner.

Respect for Life, Law and the Public Good
Professional Engineers should give due weight to all relevant law, facts and published guidance, and the wider public interest. They should:
• ensure that all work is lawful and justified.
• minimise and justify any adverse effect on society or on the natural environment for their own and succeeding generations.
• take due account of the limited availability of natural and human resources.
• hold paramount the health and safety of others.
• act honourably, responsibly and lawfully and uphold the reputation, standing and dignity of the profession.

Responsible Leadership: Listening and Informing
Professional Engineers should aspire to high standards of leadership in the exploitation and management of technology.
They hold a privileged and trusted position in society, and are expected to demonstrate that they are seeking to serve wider society and to be sensitive to public concerns. They should:
• be aware of the issues that engineering and technology raise for society, and listen to the aspirations and concerns of others.
• actively promote public awareness and understanding of the impact and benefits of engineering achievements.
• be objective and truthful in any statement made in their professional capacity.

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