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A HE curriculum for teaching and learning ethical issues arising from pervasive communications

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Abstract :*A current field of innovation and change in electronic and computer engineering is the development of pervasive communications, enabled by technologies that allow seamless communication and dynamic configuration of wireless networks and services to adapt to users' preferences and network conditions. Pervasive communications are proliferating steadily throughout society via ubiquitous mobile devices with internet access, personal communications, and tracking abilities. It is thus important to instill an awareness of ethical issues arising from pervasive communications to engineering students, who will impact public welfare through their professional practice. Professional organizations such as the Royal Academy of Engineering in the UK, the European Union research funding, and the Institute of Electrical and Electronics Engineers USA strongly support engineering ethics in their current and future policy activities. Indeed, ethics in the engineering curriculum is becoming one of the criteria universities worldwide must meet to maintain their accreditation. We thus propose the inclusion of a course within the engineering curriculum for those students specialising in communications, at advanced undergraduate or masters level to foster thoughts about their obligations as communications engineers. This paper will review the emerging ethical issues arising from pervasive communications, including issues of privacy, integrity, trust, and intellectual property rights. Current practices, nationally and internationally, will be discussed, and the rationale for introducing the ethics course to the curriculum outlined. Recommendations for the course content will follow, including the aims and objectives, the delivery methods, and assessment tools.*

States are not moral agents, people are, and can impose moral standards on powerful institutions
- Noam Chomsky

1. Introduction

In a world today filled with diverse viewpoints and conflicting perspectives, knowledge of ethical behaviour provides guidance in navigating through difficult dilemmas. Ethics is defined as the rules or standards governing the conduct of the members of a profession and often refers to reflective and theoretical perceptions of right and wrong behaviours for the group (Humphreys, 1999). Ethical foundations provide guidance in transitioning values into action and stem from professionally established codes. Behaviours that are ethically sound seek justice and integrity for the common good and unite individuals from similar disciplines. Morals shape ethics by defining individual values that arise from one's conscience and provide a sense of right and wrong behaviours for each unique person. Morals identify virtues and

values that define an individual's character and lead to proper and appropriate conduct.

As we introduce engineering students to the concept of ethics and a professional code of behaviour it is important to examine what the current ethical issues are in the field and the types of questions that they raise. A current field of innovation and change in engineering is the development of telecommunications and computer technology. The new developments in technology have shaped society in new ways and created a culture of pervasive communication. Through cell phones, the Internet, and other forms of communication people have the ability to be in constant contact with one another.

The examination of ethical issues as they relate to the engineering profession is a new area of discipline, receiving attention only since the late 1970s. In addition to the fundamental components of ethical study, this academic discipline includes the study of conduct, character, ideal service, and relationships between engineering professionals and their organizations who are involved in technological development (Martin, 2004). Because of the significance of ethical issues that occur in industry impacting public welfare and safety, it is necessary to introduce ethical foundations into the engineering curriculum to develop students' awareness of these dilemmas. This paper will discuss the rationale for introducing an ethics module into the engineering curriculum, followed by a review of current practices of ethical instruction in both US and UK higher education institutions. Before making recommendations for the implementation of an ethics module, emerging ethical issues in telecommunications technology are discussed.

2. Rationale of Course

Engineers work to improve the well-being of society through their knowledge of technology, the environment, and resources. Thus, it is critical that students develop an awareness of ethical issues in industry to effectively navigate through conflicts and produce quality work that is beneficial to public welfare (Royal Academy of Engineering, 2007). Studying and discussing ethical issues allows students to develop essential transferable skills including critical thinking, synthesis of ideas, and rhetorical analysis that expand upon the traditional technical focused background of an engineering education. It is important for students to be aware of their professional and individual responsibilities as engineers to positively impact society (Sugihara, 2003).

The Royal Academy of Engineering outlines fundamental principles, as well as respective canons of behaviour, to ensure all practicing engineers are working towards the same ideals of service in a cooperative manner. These fundamental principles also support making the engineering practice one in which professionals and the public have the utmost pride and confidence. Because of the myriad of ethical dilemmas that students will face as engineers in industry, it is necessary for them to enter their chosen field with an awareness of these principles to ensure unified behaviour and the highest levels of professionalism. These fundamental principles for appropriate behaviour include Accuracy and Rigour; Honesty and Integrity; Respect for Life, Law, and the Public Good; and Responsible Leadership: Listening and Informing (Royal Academy of Engineering, 2007).

The inclusion of ethical instruction as part of the engineering curriculum ensures that students meet their obligations to the public as future engineers through their recognition of dilemmas and development of problem-solving skills (Lynch & Kline, 2000). They must be able to utilize analytical and judgment abilities to provide strong

and defensible responses to ethical conflicts. Other critical outcomes of this module include the development of communication, reasoning, deduction, and reflection skills. Students also must deliberate about power and consequences while developing their own ethical codes (Hamilton, 2000).

Undoubtedly, knowledge of ethical responsibilities is not an isolated discipline in an engineering curriculum, but rather a fundamental component to all professional instruction (Bhatt, J., Manion, M., & Fromm, E., 2004). The case of incorporating ethics into the engineering curriculum is unique because it adds to professional training while filling a gap of building critical thinking and communication skills that strictly technical coursework does not always allow the time to cover. According to a survey of engineering professors that were asked to report the types of learning processes they utilized in the classroom, 0% reported using 'conflicting evidence, counterexamples, and alternative solutions' in their instruction method (Donald, 2002). While making a broad generalization from one survey is risky, this survey does present a problematic gap in engineering instruction that in depth work in examining ethical cases would fill.

King and Kitchener (1994) created a cognitive development model known as the Reflective Judgment Model. An essential part of moving through phases of cognitive development is the ability to both identify and sort through 'ill structured problems.' Ill structured problems are situations that do not have one right answer, but multiple paths to reaching a conclusion or solution. Utilizing ethical case studies, which are a prime example of an ill structured problem, in the academic coursework, will aid students in developing new ways of thinking that help them move towards success both in and outside the classroom.

3. Current Practices

Guidelines for teaching ethics in engineering curriculum vary between countries, with no consistent requirements set forth by the respective governing bodies. In the UK, the Institute of Engineering and Technology (IET) sets forth the criteria for academic institutions to achieve accreditation for their engineering programs: 'provide an awareness of the environmental, social, legal, economic and regulatory contexts within which engineers operate'. Thus, the inclusion of ethical instruction in the curriculum is not explicitly stated, nor is a detailed set of criteria provided to establish consistent incorporation of these issues across institutions. Institutions are, however, expected to instill awareness in their engineering graduates in order to professionally prepare them for industry.

The Royal Academy of Engineering sets forth recommendations for teaching ethics through a curriculum map. This curriculum provides guidelines and learning outcomes to be embedded within each academic year and provides a variety of exercises to accomplish this ethical instruction. These guidelines for incorporating ethical instruction into engineering curriculum allow students to obtain progressive, in-depth knowledge and comprehension of ethical conceptions and dilemmas in the engineering industry. The curriculum map suggests a multitude of learning activities, including debates, presentations, and research. Undoubtedly, this variety in learning experiences enhances student engagement and involvement by developing a number of diverse skills and abilities.

Several universities in the UK are currently incorporating, explicitly or as part of standard engineering courses, ethics instruction into their educational programmes. For example, Imperial College in London offers a course entitled 'Controversies and Ethical Dilemmas in Science and Technology' as an elective through the Humanities

programme. This course is not designed and instructed by engineering faculty, but it does offer engineering students the opportunity to analytically examine their work in a context outside of their primarily technical academic work. The course is divided into four main sections of content topics: the history of ethics in technology and society (including technology and warfare), ethics in everyday engineering and research, controversies arising around science and technology, and controversies and dilemmas arising through medicine and biotechnology. The University of Southampton, on the other hand, includes a compulsory module entitled 'Professional Issues' that is to be taken during the first year. This course is taught through the Department of Electronics and Computer Science and covers a variety of topics including ethical behaviour of professional engineers, the role of professional bodies, and the benefits of teamwork. The learning outcomes of the course consist of the development of research, presentation, and project management skills. The topics chosen for these courses demonstrate the wide range of ethical issues that engineers need to consider. While appropriate for initial years of the undergraduate degree due to its broad coverage, a more in-depth and timely approach is necessary to deal with specialised issues as presented in this paper.

In the US, ABET Inc., the national accreditation organization for engineering programmes, specifies outcomes for engineering students to demonstrate upon graduation in order for higher education institutions to maintain accreditation. Since 2000, ABET Inc. requires that engineering graduates demonstrate an 'understanding of professional and ethical responsibility'. Consequently, universities are trying different approaches to ethical instruction. A few universities have made these ethics classes compulsory to graduate while others have designated them as elective courses. Other programs integrate ethics discussions into standard engineering courses to achieve ethical knowledge across the curriculum. Two of the US universities leading the way to require instruction in ethics in the engineering program are Texas A&M University, College Station, and the University of Virginia, Charlottesville. For example, first-year engineering students at the University of Virginia must take a course in the Department of Science, Technology, and Society, which discusses ethical and social issues facing a professional engineer. The main objective of this course is to improve the students' writing and presentation skills (Jones, 2005).

Professional engineering organizations in the US also demonstrate their strong commitment to ethical instruction in educational institutions. IEEE-USA offers lecture materials to instructors and practicing engineers on ethical issues. They have also established an Ethics and Member Conduct Committee to serve as a resource for any constituent in the community facing an ethical dilemma (IEEE, 2005).

Given the variety of engineering programmes provided by institutions across the world, methodology for ethical instruction differs and should be constructed to align with student needs. Undoubtedly ethics instruction provides value to the curriculum in an engineering programme to benefit both the profession and society. The course outlined in this paper expands on the ideas set forth by the Royal Academy and provides detailed information about an in-depth approach devoted to learning ethics and associated skills in order to incorporate them into daily practice. First, we explore the emerging issues associated with pervasive communications in order to better shape our ethics course.

4. Ethical Issues in Pervasive Telecommunication Technology

Pervasive communication technology has many potential valuable uses, as well as a growing list of problematic social and ethical issues. In order to both benefit society

and protect basic human rights, it is necessary for the public in general, and engineers specifically, to become familiar with these issues and the principles of ethics that guide them.

There are many relevant ethical questions that are currently being discussed and as new technologies and devices continue to develop, more questions will be raised. What would our society look like if each individual were required to be implanted with a chip containing their personal information? In what ways can we use new technology to create a safe and secure society yet still protect the privacy rights of individuals? Who is responsible for communicating information about technology and determining what the public should know? With knowledge about developing and using technology comes power; how should this knowledge and power be used? How can a code of engineering ethics aid in creating a safer society?

This review of example cases provides a brief outline of some current issues relating to telecommunications. This is not an exhaustive list, but a sample of the spectrum of questions that may result from recent technological innovations.

5.1. Privacy & Security

As pervasive communication is shaping a new way of life in modern society, a source of ethical significance is the growing tension between providing community and national security versus protecting personal privacy. Privacy can be seen through the lenses of different disciplines, including two particularly relevant to ethics; psychological and legal. In psychology, privacy "represents control over transactions between person(s) and other(s), the ultimate aim of which is to enhance autonomy and/or to minimize vulnerability" (Margulis 2003). This definition leads to many important functions of privacy including opportunities for self evaluation and privacy's contribution to individuality and identity development. Legally privacy is considered in the contexts of an individual's freedom to make decisions and in what terms government officials have the right to search and monitor personal property.

While personal privacy as described above is an important concern, the increasingly globalized world is also facing new challenges in protecting the collective security of communities and countries. Advancements in telecommunications benefit society, but have also aided terrorists in communicating and organizing wide-scale destruction. In some cases, the government or other agencies collect personal information concerning individuals and questionable activities, which may be considered an invasion of personal privacy, but in the end could contribute to the prevention of terrorist acts (Nissenbaum, 2005) In addition to global terrorists, local criminals may also use communication devices to communicate and locate their victims. Online sexual predators approaching teenagers in chat rooms has been a growing problem.

Another example of recent technology that helps to illustrate the tensions between security and privacy are location tracking devices. GPS tracking is navigation systems that can be used in personal cars for assistance with driving and directions, while pinpointing the location of a vehicle for roadside assistance if needed. While this technology provides its users with increased confidence and a sense of security on the road, questions concerning the privacy of the information that is being maintained should also be considered. Third party organizations or companies, for example, government officials, police officers, insurance companies, car companies, and employers, may be interested in obtaining some of the tracking information that a service provider, like On Star, collects (Freeman, 2007). What is the responsibility of On Star in storing and distributing this information? Who has a right to see this

information and under what circumstances? What rights do the customers have in regards to maintaining confidentiality in regards to their driving history?

RFID chips, sometimes referred to as 'contactless chips', also have the ability to track the location of an item or person from very close distances with the additional capabilities of storing information in the format of a tiny chip. The International Civil Aviation Organization endorses and encourages all nations to transition to the use of the e-passports using RFID chips with the aim of creating greater security on airplanes and at entry points. The UK, the US and other nations are currently in the process of making this transition. While this new technology has the potential to increase security it does not come without risks or controversy. The design of the passport, as well as the RFID chip, is essential in securing this personal information. The material of the passport cover should be thick to protect the chip. Recently, a Dutch news-team demonstrated how important the design of these new e-passports is by testing if they could recover information from one. With an antenna and computer software it took the team just two hours to retrieve personal details from a supposedly secure e-passport ("Cracked It!"). Additionally, some concerns have been raised about technology that will enable users to clone RFID chips used in passports (Reid, 2006). Clearly, it is important that engineers be aware of how the information on RFID chips could be misused and ways that they can assist in protecting personal information, e.g., via encryption algorithms.

5.2. Intellectual Property Rights

As information becomes more readily available around the world, a new host of issues concerning intellectual property rights is developing. The concept of intellectual property rights developed as writers and artists wanted to protect their work and their ability to make a profit to live off of their trade. Different cultures view the meaning of "property" in different ways which has led to a variety of laws and policies regarding copyrights and patents. As computer software developed, questions were raised as to how to protect the information and in what ways copyright laws apply to this new form of intellectual property. Today the US court system is finding that due to the nature of computer software programs, copyright laws are not necessarily the best fit. Technology changes at such a rapid pace that the long periods of time that property is protected does not always foster conditions for sharing information to jointly create new technological innovations (DeGeorge, 2006).

The entertainment industry in particular has faced a host of challenges and legal battles concerning piracy of copyrighted work. Countless internet programs allow users to download music, movies, and television shows for free. Some users see this simply as sharing their personal collections on a wide-spread scale, while artists and entertainment companies usually view this as stolen merchandise and a loss of profit. One of the most famous cases regarding this issue is the 'Napster' website, which was shut down as a free music sharing hub in a 2001 law suit. In 2003 it was re-launched as a subscription service and continues to be popular today (Waters, 2005). In the US, the Recording Industry Association of America (RIAA), brought forth over 380 law suits concerning illegal downloading in 2004 (US Illegal Downloads on the Rise, 2004). A big surge in public awareness concerning piracy and illegal downloads has occurred because of these major lawsuits, but piracy websites continue to exist and effect various realms of the entertainment world.

Open source software debates in other areas of technology use still continue today. Computer software giant, Microsoft, has been at the forefront of the computer software development field and also has experienced many legal issues and scrutiny of ethical practices. Currently there are on-going debates about the impact that new

developments in open source software will have on the Microsoft Empire (Silverthorne, 2005). A current legal battle ensues against Microsoft and the open source company Linux, which offers free operating programs similar to Microsoft Windows. Microsoft is claiming that Linux is violating 235 of its patents (Vaughan-Nichols, 2007).

These cases illustrate debates concerning ownership of information with communications technology and the responsibilities of computer and software engineers as they write new software and communication protocols.

5. Course Recommendations

The educational aim of this course is to provide students with an awareness of the prominent issues relating to pervasive communications, as well as the ethical guidelines for daily practice in the engineering industry. In achieving these contextual aims, students will grow cognitively and develop critical thinking skills. The foundation for the course will be based on Perry's (1970) Scheme of Ethical and Intellectual Development. In the first stage of development, known as duality, students view the world in black and white, good and bad perspectives. Prior to exploration of ethical issues in the telecommunications industry, students may view pervasive communications with this dichotomous lens, e.g., as users of the technology, students may view their increasingly ubiquitous nature as beneficial and acceptable within society without considering their ethical implications. The next stage of ethical and intellectual development is known as multiplicity, referring to the stage in which students recognize outside perspectives other than their own and begin to reflect upon these diverse viewpoints. The introduction of the fundamental principles set forth by the Royal Academy of Engineering facilitates students' awareness of these other viewpoints and stimulates them to begin analysis of the connection between these principles and their own moral codes. By studying these ethical principles, students explore perspectives outside of their own and examine how their own beliefs connect with the other professional viewpoints.

Perry's next stage of ethical and intellectual development is known as relativism and describes the awareness of dilemmas and their complexity in reaching a solution. Students recognize that no one right answer exists for conflicts and begin debating their viewpoints using personal values, beliefs, and aspirations. Students will have a variety of mediums to discuss these viewpoints with their peers, including the electronic discussions through a virtual learning environment (VLE), in-class discussions, and the cumulative case presentation. These learning components will facilitate students' transition to the relativism stage by developing their analytical and communication skills through the presentation of ideas and opinions, as well as the provision of sound evidence for proposed solutions. By listening to their peers' perspectives as well as their own, students will be able to identify the complexity of ethical dilemmas and strengthen their own viewpoints through the use of evidence and research to support their beliefs.

5.1. Course delivery

To create a well-rounded academic approach to learning that supports this developmental scheme, the course must have foundations rooted in ethical and moral conceptions while including a practical component that is relevant to everyday engineering practice. Shaping the course around key problems in pervasive communications equips students to be effective learners within industry and identify what concepts they need to know and how to approach new problems to simulate professional practice (Ashwin, 2006). Having students work in groups in problem-based learning also supports cooperation and collaboration with peers while

facilitating interdependent learning. To achieve these objectives, several key delivery methods are recommended, including the use of case studies, electronic discussions, and a seminar instruction format.

Using case studies, such as those discussed in Section 4, will present realistic everyday ethical issues for reflection and connecting fundamental principles learned in the classroom to real-world engineering practice. Thus, the following guidelines (Lynch & Kline, 2000) are suggested for effective application of these case studies to practice: (i) emphasise on the complexity and ambiguity of the technology and its use, as opposed to a clearly outlined conflict of values, (ii) eliminate assumptions by including important information such as workplace culture, practices, rules, and resources.

Electronic discussions provide a forum beyond the classroom for students to discuss ethical codes and how they impact on specific dilemmas and cases. This medium of communication has been shown to be both beneficial and effective because it stimulates debates as students explore ethical issues while providing the opportunity for sharing thoughts and ideas amongst peers (Bhatt et al., 2004). Furthermore, this additional method of engagement deepens participants' involvement in the course material through its student-centred approach to learning (Butcher et al. 2006). Students can be organized into groups through a university's VLE to create an intimate group of peers in which to share ideas and provide constructive feedback. The discussion topics can be posted by either the instructor or the students for reflection and thoughtful written responses. The topics for discussion can include one's personal reflection on a particular fundamental principle set forth by the Royal Academy, or devising a creative solution to a given case. This component of learning in the course supports independent reflection, the communication of ideas within a given community, and the ability to strengthen writing skills through posted responses.

A seminar format with small class sizes is preferred over a lecture model to develop students' communication and reasoning skills, actively engage students and facilitate the transition from being distanced in a large classroom to being involved in a more intimate setting. Furthermore, a seminar format decreases students' dependency on instructors to provide information and increases student's self-management through the inclusion of class discussions, group work, and guest speakers to the classroom. (Baldwin and Williams, 1988).

5.2. Assessment

Assessment in higher education defines what students regard as important, how they allocate their time, and how they view themselves as graduates and future professionals. Over the last 20 years there have been shifts in higher education assessment, creating greater levels of students' ownership and accountability in their learning (Brown et al., 1997). As a result of these shifts, a redistribution of power has occurred between the instructor and students, leading to students' increased confidence levels in their abilities (Fitzpatrick, 2006). Thus, the assessment tools that are recommended for the ethics module to support active learning and engagement include a self-assessment, a written essay midterm, a cumulative case-study analysis and presentation as a group project to enhance collaboration instead of competition.

Incorporating a self-assessment instrument into the course supports the assessment shift from tutor-led to student-led. Undoubtedly, students are likely to initiate learning, direct it, and actively participate in it when they believe their success is a result of their own effort and behaviour, rather than by factors outside of their control (Brown

et al., 1997). Through a self-assessment, students will identify their current learning needs and what they hope to achieve in their professional practice while there is time left in the module for feedback from the instructor (Fitzpatrick, 2006). In addition, the instructor can assess the appropriateness of delivery methods and the progress of learning outcomes being met (Butcher et al., 2006). Upon completion of the self-assessment, the instructors should discuss and provide feedback to the students so that it is a useful activity and students do not regard the activity as meaningless and a waste of time (Brown et al., 1997).

In addition, the essay midterm will assess students' comprehension, evaluative, and application of knowledge skills through written response to assigned questions. The midterm will consist of a combination of short answer questions as well as essays to evaluate the progressive levels of students' understanding from comprehension to synthesis. An example of a short answer question could be to identify one ethical principle discussed in class and list two canons that it describes as guiding ethical behaviour. An essay could comprise a discussion of the impact that chip technology has on privacy because of its ability to store and provide medical information upon implantation.

A case study research and presentation project is a cumulative exercise to take place at the end of the term for students to utilize research, synthesis, and oral presentation skills. This assignment measures students' capacity to analyse and evaluate a real-world situation using ethical principles and concepts as supporting evidence in the dilemma. Students will also be evaluated on their ability to gather, prepare, and structure information in an organized and thoughtful format (Butcher et al., 2006). Through the presentation to the class, students employ and strengthen their ability to orally present an issue, discuss it using their knowledge of ethical conceptions and abstractions, and demonstrate their application of information to a new and challenging context (Butcher et al., 2006).

6. Conclusion

Understanding issues relating to pervasive communication is a timely exercise and at the forefront of understanding the impact of technology on society in the world today. The prominent ethical issues in the engineering profession will continue to evolve, but the core learning skills that derive from exploring them will remain a constant benefit to students and professionals. In order to provide a comprehensive engineering education it is important for universities to evaluate their current practices in teaching ethics and utilize purposeful and in-depth academic work to promote technical, analytical and critical learning. Governing bodies and professional associations in the engineering field including the Royal Academy of Engineering and IEEE are making efforts to move towards all HEIs incorporating ethics into engineering education at various levels. The issues and coursework discussed in this paper, expanded upon the Royal Academy of Engineering guidelines, providing the rationale for and the components of an ethics course in electronic and computer engineering degree programmes.

7. References

Anderson, A.M., & Labay, V. (2006). Ethical considerations and proposed guidelines for the use of radio frequency identification: Especially concerning its use for promoting public safety and national security. Science and Engineering Ethics, 12(2), 265-272.

Ashwin, P. (Ed.) (2006). Changing higher education: The development of learning & teaching. London: Routledge.

Baldwin, J., & Williams, H. (1988). Active Learning: A Trainer's Guide. Oxford: Basil Blackwell Ltd.

Bhatt, J., Manion, M., & Fromm, E. (2004). Engineering ethics and the Drexel University Library: A collaborative teaching partnership. Proc. of the 2004 American Society for Engineering Education Annual Conference & Exposition. Available at: http://eprints.rclis.org/archive/00004419/01/2004-773_Final.pdf.

Black, P., Harrison, C., Lee, C., Marshall, B., & Wiliam, D. (2003). Assessment for Learning: Putting it into Practice. Maidenhead: Open University Press.

Brown, G., Bull, J., & Pendlebury, M. (1997). Assessing student learning in higher education. London: Routledge.

Butcher, C., Davies, C., & Highton, M. (2006). Designing learning: From module outline to effective teaching. London: Routledge.

"Cracked It!" Guardian Unlimited. 17 November 2006.

Davis, M. (1991). Thinking like an engineer: The place of a code of ethics in the practice of a profession. Philosophy & Public Affairs, 20(2), 150-167.

DeGeorge, R. (2006). Information technology, globalization and ethics. Ethics and Information Technology. 8, 29-40.

Donald, J (2002). Learning to think: disciplinary perspectives. San Francisco: Jossey-Bass.

Fitzpatrick, J. (2006). An evaluative case study of the dilemmas experienced in designing a self-assessment strategy for community nursing students. Assessment & Evaluation in Higher Education, 31(1), 37-53.

Freeman, S (2007). How on-star works. Available at: http://auto.howstuffworks.com/onstar.htm.

Glasser, D.J., Goodman, K.W., & Einspruch, N.G. (2006). Chips, tags and scanners: Ethical challenges for radio frequency identification. Ethics and Information Technology. http://www.springerlink.com/content/r645173t11817367/fulltext.pdf

Hamilton, M. (2000). Educating our "selves": The ethics of technology. The Journal of the Midwest Modern Language Association, 33(2), 17-26.

Humphreys, K. K. (1999). What every engineer should know about ethics. New York: NY. Marcel Dekker, Inc.

IEEE (2005). Engineering Ethics. Available at: http://www.ieeeusa.org/careers/ethics.html.

International Telecommunication Union (April 2005). Ubiquitous network societies: The case of Japan. ITU Workshop on ubiquitous network societies. Available at: http://www.itu.int/osg/spu/ni/ubiquitous/Papers/UNSJapanCaseStudy.pdf

Jones, W.D. (2005). Adding ethics to engineering education. IEEE The Institute 06 December 2005.

King, P & Kitchener, K. (1994). Developing reflective judgment. San Francisco, CA: Jossey-Bass.

Lynch, W. T., & Kline, R. (2000). Engineering practice and engineering ethics. Science, Technology, & Human Values, 25(2), 195-225.

Martin, M.W. (2004). Ethics in engineering. McGraw-Hill Professional.
Michael, K., McNamee, A., & Michael, M.G. (2006). The emerging ethics of humancentric GPS tracking and monitoring. Faculty of Informatics-Papers, University of Wollongong. http://ro.uow.edu.au/infopapers/385.

Nissenbaum, H. (2005). Where computer security meets national security. Ethics and Information Technology. 7, 61-73.

Perakslis, C., & Wolk, R. (2006). Social acceptance of RFID as a biometric security method. IEEE Technology and Society Magazine, Fall 2006, 34-42.

Perry, W. (1970). Forms of Ethical and Intellectual Development in the College Years: A Scheme. Jossey-Bass.

Reid, D. (2006). ePassports 'at risk' from cloning. BBC News. Available at: http://news.bbc.co.uk/1/hi/programmes/click_online/6182207.stm.

Royal Academy of Engineering (2007). Statement of ethical principles. Available at: http://www.raeng.org.uk/policy/ethics/pdf/Statement_of_Ethical_Principles.pdf.

Silverthorne, S (2005). Microsoft vs. open source: Who will win? Harvard Business School. Available at: http://hbswk.hbs.edu/item/4834.html.

Sugihara, K. (2003). Developing teaching methods for an engineering ethics curriculum. International Conference on Engineering Education. Available at: http://www.ineer.org/events/icee2003/proceedings/pdf/2655.pdf.

"US Illegal Downloads on the Rise" (2004). BBC News. Available at: http://news.bbc.co.uk/1/hi/entertainment/music/3402349.stm.

Vaughan-Nichols, S. (2007), *Microsoft vs. Open Source: Setting the Battle Lines* Available at: http://www.eweek.com/article2/0,1895,2129973,00.asp.

Waters, D. (2005). Napster boss on life after piracy. BBC News. Available at: http://news.bbc.co.uk/1/hi/entertainment/music/4165868.stm.