DOCTORAL THESIS

Education in ethical values: a pedagogical proposal for the training of ICT professionals

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EDUCATION IN ETHICAL VALUES: A PEDAGOGICAL PROPOSAL FOR THE TRAINING OF ICT PROFESSIONALS

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WE CERTIFY THAT WE HAVE READ THIS THESIS AND THAT IN OUR OPINION IT IS FULLY ADEQUATE, IN SCOPE AND IN QUALITY, AS A DISSERTATION FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

Bellaterra, July 2012

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This is dedicated to Inma Ortuño Ortín. Much loved friend, colleague and teacher. She was the inspiration for my academic career. Without her encouragement, advice and, above all, her confidence in me, I wouldn't have arrived at this point of my professional life. Eternal thanks, Inma, for your great help. Your memory will always be unforgettable.

Abstract

This study investigates the training in ethical values of ICT professionals with a view to highlighting an educative framework from which to carry out the learning process within engineering schools. This educative framework is explored through the following central points:

- What is the role of ethics within the context of ICT.
- What moral implications professional ethics has.
- What are the essential educative requirements that ICT professionals need to develop an appropriate ethical profile.

Consequently, the study's principal contributions are twofold. On one hand, identifying moral involved with technology and how these shape the daily practical exercise in the scope of ICT professionals. On the other hand, providing the students of engineering schools with professional ethics by means of a set of methodological and pedagogical resources, in order to train students to work in accord with the relevant social values on which suitable ethics instruction is based.

The research approaches employed in this study are three: the hermeneutic approach, the discursive ethics and the virtue ethics, applied within the field of professional ethics. These methods seek to elicit and represent the different perspectives and experiences of the students when facing ethical dilemmas. Thus, this

research work approaches jointly the corresponding set of learning tools that allow students to raise their awareness regarding the ethical issues related to their moral construction, at the same time as they develop the technical expertise typical of an engineering degree.

So this proposal provides a framework that consists of a set of educational resources based on learning tools that allow the deliberation of ethical issues, and the fulfilment of a training process aimed at the experiential improvement of the student of engineering.

The study's findings culminate in the following remarks:

- The necessity of emphasizing that ethical behaviour is always appropriate in the exercise of a social profession such as engineering, not only when things goes wrong.
- The incorporation of an ethical dimension that allows us to analyse the actions, outcomes and responsibilities with regard to the existing relationship between technology and the engineering profession taking into account the social context in which it is deployed.
- The search for an ethics with typical features implemented through appropriate methods, learning tools, and technological resources. All of this with the aim of achieving good practice which strengthens ethical sensitivity among the students of engineering.

Based on the preceding results, teaching staff and the student body of engineering degrees, where ICT technologies have an prominent and leading role, should be able to evaluate how they approach ethical professional training and learning, if they aim to promote a profession of quality and of clear social connectivity, based on a full awareness of the ethics within the current ICT professional world.

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Contents

Introduction

The current doctoral thesis arises from a desire to show that engineering degree is more than a set of basic technical subjects. What is more, neither the technical training nor the technical-scientific, by themselves, nowadays constitute a satisfactory curriculum for this kind of degree.

Many years ago, having got through my computer science engineering degree and being a teacher of Computer Sciences engineering degree at the Universitat Autònoma de Barcelona (UAB), I noticed that I and my students, our future engineers, needed to broaden the meaning of the engineer's professional life. Now, one thing is very clear to me, as teachers of technical degrees, we prepare our students exclusively for technical work because technology is, today, the main subject in every engineering degree, but this fact worries me because, in taking this position we put ourselves at a distance from how things really are in the professional world. Our students need to develop many competences and attitudes which are not technical because after graduation, they will work, mainly, for people and among people. Thus, the results of their work will, sooner or later, have an effect on people. Furthermore, it is necessary to incorporate other subjects in order to extend the engineer's approach with regard to the social context, ethical, legal and professional issues in the exercise of their duties as an engineer. These kind of subjects will help the students to understand how and why their work with technology can affect the life of other people (Dreyfus, 2001). So,

it is important not only to me, but for key figures, professionals and institutions experienced in this field of knowledge, which will be discussed in the second part of this work, that after studying such subjects, the students should be more aware of their responsibility in the exercise of their profession or, at least, they be able to admit the existence of the two faces of their profession, the technological one and, above all, the social involvement of their professional activity. This social involvement is not a mere knowledge of what is "good", it requires a commitment to social welfare and sustainable development in order to achieve a virtuous praxis of the profession (Aristotle).

Taking into account the fact that the engineer's professional environment is, more and more, an environment designed and developed on a basis of technology and is, consequently, dependent on it, the presence of computer systems is usual in every sphere of our life, as much private as public. We can even consider ourselves, in historical terms, to be living through a new revolution, the technical-scientific one (Echevarría, 2003; Agazzi, 1996; Riera, 1994). According to Mitcham a broader framework is presented, which allows us to analyse technology and engineering from different points of view such as: the historical, the philosophical, the sociological and the epistemological. However, as well as this, together with the advantages that technology carries other unexpected, undesirable and, in many cases, unknown effects are derived from it too. This ambivalence drives us towards a deep reflection about, firstly, our limits in relation to what we can achieve through technology and, secondly, what our limits should be in relation to those things which, whilst possibly being feasible, we shouldn't attempt (Jonas, 1995; Weizenbaum, 1976).

Due to these factors, within the educational framework, it is inevitable that we become concerned about the higher education of the future experts that will contribute to the design, development and exploitation of software and hardware components

and devices typical to computer science and telecommunication engineering degrees. Thus, such training cannot ignore the complex social context in which they are acting. Additionally, we cannot forget that their actions have a bearing on the people's interests and rights. In this sense, a great responsibility appears among all specialists and, in particular, among engineers.

In view of the transformative power of engineering practice (and the rest of technological activity) it is essential to bear the "contingency principle" in mind. The reason is that, in case of accident, the financial costs could be very severe and people might suffer great injury, which could be, if the worst comes to the worst, irreversible. So it is an error to believe that the students of engineering degrees are naturally able to act appropriately when facing cases related to the exercise of the ethical side of their profession. Quite the opposite, it is from the universities that it is necessary to incorporate an all-round educational system in order to develop an ethical sensitivity throughout the academic training. We aspire to ethical sensitivity producing a personal change in order to promote a flourishing personal development. Only in this way, will our students become aware of the different ethical aspects and moral dilemmas involved in their profession.

My final concern to explain is that, in general, the current syllabuses still seem to demonstrate little interest in incorporating subjects which could contribute to the move towards such a direction. The reasons are several and complex, such as ignorance of, or a lack of interest in, subjects belonging to the field of humanities. From this concern, this work aspires to contribute to the stimulus of initiatives and experiences that different universities and institutions can carry out in order to renew the curriculum. Additionally, as a teacher of engineering degrees, I feel the need to show the necessity for a generous and open attitude when training our future engineers. This great responsibility is ours.

1. Research aim

The adaptation adoption of the European Space of Higher Education (ESHE) involves a rethink within the educational system. This adoption is favouring an intense debate on the need for reform in the training methods applied during university education. Therefore, and in accordance with Bolonya's guidelines, we have the challenge of facing a change in the approach to the learning process.

One of the outstanding aspects of this learning model is the training by competences, a fact that forges a tighter link between theory and practical issues. This educational model takes all its firmness and prominence from this connection. Thus, this educational approach by *professional competences* has been consolidated into a very attractive alternative, seeking to provide a learning process that harmonise the needs of the people, companies and of society as a whole.

In sum, professional competences are a very good tool to unite the academic and the professional world: "The competences represent a dynamic combination of attributes, in relation to *knowledge, skills, attitudes and responsibilities*, that describe the results of the learning of an educational program or what the students are able to show at the end of an educational process" (Project Tuning[1]).

So, taking into account the definition of competence as an important and typical feature of the new educational paradigm, together with the introduction of Information and Communication Technologies (ICT) within the educational system, we can say that this thesis was born with the intention to

1. *The Project Tuning* is the project of greatest impact that the European universities have launched in order to answer to the Statement of Bolonya and to the Communiqué of Prague. It consists of elaborating some proposals of quality that can be of reference (in the aims, the process, the results, the approach and the capacity to answer to the current demands) for the whole of universities degrees.

study, in depth, one set of competences defined by the ESHE. The area of knowledge under study is called "the ethical and professional commitment" applied to technical degrees, specifically, engineering ones.

Some experiences that have been carried out in face to face environments and at universities of our country are going to be taken as a starting point of our study. These are a very serious and carefully thought out experiences and the team of teachers were and are eager to engage with them, showing a great deal of interest in this area of knowledge. All the invested efforts and the current ones tend towards the same direction as the new global guidelines of the ESHE.

It is important to emphasize that the transmission of these kinds of contents and their training is not a trivial process. It implies not only the teaching of ethical issues from a theoretical and practical point of view (which it is not as easy as it looks) but also the methodology, strategies, mechanisms, tools and technological resources needed to carry out the process as a whole. What is more, another important fact to keep in mind throughout the process is the way that we understand applied ethics as a subject to be taught based, overall, on the praxis of the contents. All of these methodological issues are developed in the course of the Third part of this work.

The global goal of this work is to look for the academic, pedagogical and scientific basis in order to implement, properly, this kind of subject within new technical degrees. Up to now, we have been able to notice the existing lack of formalism and precision when defining the requirements typical of this discipline. Therefore, it is important for us to provide validity, consolidation, and clarification and, as a whole, a solid structure which lends these kind of subjects the viability and importance such content deserves within technical degrees and within a world where human values and needs are in constant change.

2. Research goals and contributions

Ethics takes its place in science and technology, contributing, substantially, towards giving them sense in human life. Both domains, science and technology, are recognized as key forms of human activity, and stand alongside the arts and social sciences as fundamental to human achievement and expression. In relation to this work, technological practices, knowledge and outcomes can provide mechanisms for science to gain a better view of its defined world, and in fact can provide serious challenges to the defining of that world. Thus, the development of technological artefacts which extend and, very often, change the perception and behavioural capabilities of human beings, make available new relationships with the world in which we are living. For instance, these new relationships reflected in the intersection between technology and human being can be found in the first part of this work. In this light, ethics will help us to develop sensitivities and imagination, not formal knowledge and, at the same time, it will create a framework that allows us to improve basic social and environmental skills to turn future engineers into committed professionals, with the willingness to involve themselves, with social awareness, in their profession.

So far the ethics applied to engineering has been particularly directed at explaining or advising how to prevent some damaging situations and how these situations can be avoided, taking into account the engineer's responsibility and its appropriate management. However, this management goes beyond the fact of knowing technological regulations as established by various agencies and institutions. It is necessary to emphasize that ethical behaviour is always desirable in the exercise of a social profession such as engineering, and not only when things goes wrong. For this reason, we need to incorporate an ethical dimension that allows us to analyse the actions, the outcomes and the responsibilities with regard to the relationship established between technology

and the engineer's profession, taking into account the social context where it is deployed. The combination of both parties, technical regulation and serious ethical reflection, should improve the decision-making within the profession. In this way, engineers will have more confidence and security, in other words, they will feel more autonomous when integrating ethics into the daily practice of their profession.

Therefore, next I am going to present the aims I hope to achieve in this work, focused particularly on the training of contents belonging to the knowledge area "the ethical and professional commitment" as applied to technical degrees.

Regarding the definition of these contents and learning process, our task lies in:

- Exploring the meaning and importance of ethics within the engineering profession.
- Showing the students the rights and the professional duties of the engineer through the deontological codes. These codes will set the standard for the minimum attitudes and desirable behaviours acting as guidelines for future engineers, even though its isolated and exclusive use is not enough to achieve the ethical training that we pursue.
- Expounding the values embedded in the daily practice of technology (engineer's workplace) within the technical-scientific environment, taking into account the social repercussions of their actions in the exercise of their profession.
- Showing how to teach to identify these values and how to manage them in relation to technical-scientific, environmental, economic, political, corporate and, above all, social surroundings.
- Studying the axiology and the possibilities, limitations and requirements, (such as pedagogical and methodological issues) that these values demand within a technical-scientific context.

- Providing resources, tools and strategies to enable students to find suitable answers to the moral questions related to technological development and its social consequences in order to become aware when facing engineering ethical issues.
- Establishing strong links between the ethical discussions achieved in the classroom and the ethical issues of the real world. In this way, students will be able to believe in this kind of content and will see that these are a part of their training as future engineers.
- Designing the academic, pedagogical and scientific base typical of a university discipline in order to properly implement this kind of subject within new technical degrees.
- Providing this knowledge area with formal validity with the purpose of promoting an integral and transverse training for the student.
- Giving a representative sample of technological resources belonging to Internet and ICT technologies framework with which the ethical conversational practices can be combined for leveraging the effectiveness of the ethical training and to offer new ways or formats of learning (i.e.: desktop video conferencing, streaming video, live chats, video conferences and web based technologies) to complement traditional learning resources (i.e.: magisterial lectures and e-mail or text based communications).

In relation to the students' learning process and the content they need to acquire, our purpose is:

- To show the students that this kind of content demands willingness and commitment, maturity and reflection when learning and, in the future, in the exercise of their profession.
- To prove to the students of engineering that their profession has an strong social component and therefore they

are required to answer with technical and ethical quality (human lives are at stake).
- To provide the students with sufficient ability in order to develop the skills necessary to grasp the problematic elements existing in the exercise of their profession as engineers, taking into account the public threats (environmental and personal) and the apparent, but perhaps not immediately noticeable, risks.

These study attempts, through making desirable recommendations, to show what the responsible exercise of engineering entails as a clearly defined subject. Thus, we should show an ethics with its typical features and we should find the appropriate methods and resources needed to carry out its learning process, all of this with the aim of achieving good practice together the ethical sensitivity we aspire to produce among students of engineering. Concretely, the study's principal contribution is to provide an appropriate applied ethics which the educational engineer profile requires. This ethics should be as follows:

- Applied to the professional context. Abstract and formal when it is required.
- Practical, meaning based on the study of real or realistic cases. Theoretical when it is required.
- Pragmatic, so it has to be oriented to the development of abilities in order to determine and assess, ethically, the different alternatives that occur in complex situations.
- Rational and reasonable. It always has to consider the means (rational) and the ends (reasonable) in an integrated way. In no case doctrinaire.
- Attentive to social, cultural and technological changes and needs with a critical eye. In no case dogmatic.

The ethics that we promote should be understood as praxis. A praxis whose meaning is *to do well what we do* (Ricoeur, 1989; Aristotle) in order to obtain a result of quality within the exercise, in our case, of the engineering profession.

The model for the values of the student of engineering is set up from the conception of an appropriate technology in the profession, which is expressed from different points of view: intellectual, technical, ethical, aesthetic and ideological for this professional. It is necessary to look for the interaction and the integrity of all these factors to achieve the exercise of good practical training. Thus, the ethical dimension of the engineering profession underlines the responsibility that the professional takes on with his context (natural or social). At this point, we will have to highlight human dignity as a supreme value to respect in order to cultivate respect for the profession. This respect is closely tied to a proper understanding of the reality in which we live and a great commitment to it.

3. Previous experiences

In general, ethical dilemmas are seen as simply another class of "problem" that can be tackled by the typical engineering rational-scientific procedures. However, this is not the approach that many of our country's universities follow. Our main goal, together with these other institutions, is to get engineers to think in non-engineering ways, to have them grapple with issues that cannot be simply quantified. All the experiences which we are going to expound on in this section, agree with promoting engineering education reform. They call for greater emphasis on professional and ethical responsibility in the engineering curriculum. Or, in other words, it is thought that ethics across the curriculum has the potential advantage for helping students understand that ethical and societal considerations are integral parts of engineering and not simply add-on material.

After several years of meetings with colleagues belonging to other universities and talking about how to integrate ethics content into engineering degrees, we have realized that they are the starting point of our study. Their experiences have allowed us to expose the process of the current research work. So, let us cite those schemes carried out in engineering programs, by face to face universities, which have given us this opportunity:

Universitat Autònoma de Barcelona (UAB). At this university we find the subject called "Ètica per a l'enginyeria" (3 ECTS) in the third year. This subject is an obligatory course and belongs to the Computer Science Engineering Bolonya degree. The teacher who has led the introduction of ethical issues is Josep M. Basart. The subject is about the ethical aspects inherent to the exercise of the profession in order to show the students what ethically responsible conduct in their professional environment is. From the view point of applied ethics it is a very practical course, based on activities such as debates, case study, role playing, movies, etc. The subject demands a very active involvement of the students by means of exposition and reasoning for their view point, practising their capacity for argumentation and discussion and also their communicative skills.

Universitat Politècnica de Catalunya (UPC). At this university we find the subjects called "Tecnologia i societat" (3 LRU credits) and "Technoethics" (3 LRU credits). These subjects are optional courses and belong to the old syllabus of Telecommunication Engineering degree. The teachers who have led the introduction of ethical issues are Climent Nadeu, José B. Mariño and Mireia Farrús. The first subject is the macro-ethics area of technology and society, while the second focuses on the micro-ethics area of professional responsibility. Both courses are based on active participation of students in the classroom, mainly through the use of debates about cases of ethical conflict, where opposed

viewpoints have to be argued. Movies and documentary films are also used to foster discussion and case study methodology is largely used.

Despite these types of non-technical courses being a stimulating challenge for students (and teachers) and that such courses help them to reflect about the social and environmental aspects of technology in order to become more aware of their mutual interactions and, as a final goal, to comprehend the important involvement of ethics in the daily engineering practice, these subjects have disappeared from new engineering degrees. These subjects are not currently present within the new programs, missing an opportunity that is already rarely found in the other courses which are nearly all technical. In such cases, the new degrees seem to be taking a step backwards when the complexity of technology and its ability to transform nature and society is continuously increasing and, consequently, the engineer's responsibility is becoming more and more apparent.

Facultat d'Informàtica de Barcelona (FIB). At this faculty, belonging to UPC university, we find the subject called "Aspectes Socials i Mediambientals de la Informàtica" (6 ECTS). This subject is an optional course and belongs to the Computer Science Engineering Bolonya degree. The teacher who has led the introduction of ethical issues is Miquel Barceló. The subject is about different ethical aspects such as codes of ethics, laws, software piracy, hacking, science, technology and society. It is a very practical course based on activities such as debates, case study, making reports, presentations, etc. Here, again, the subject demands very active involvement from the students through the interaction between them when building a well-constructed reasoning about the ethical case under discussion.

Institut Químic de Sarrià (IQS). At this faculty of the Universitat Ramon Llull (URL) we find two subjects. On one hand, we

have "Ètica Professional" (5 ECTS) in the fourth year. This subject is an obligatory course and is part of the Industrial Technology Engineering Bolonya degree. On the other hand, we have "Ètica" (5 ECTS) in the third year. This subject is also an obligatory course and part of the Chemical Engineering Bolonya degree. The teacher who has led the introduction of the ethical issues is Albert Florensa. The subjects are based on the analysis of the relationship between sciences, technique, man and society. Afterwards, a general introduction to the ethics is made in order to discuss ethical practical matters bound to the engineering profession. Both courses also involve the active participation of students in the classroom. From a well informed script the students have to deal with the particular ethical issue expressed. Movies, documentary films and reports are also used to foster discussion about cases related to professional ethics.

Deustuko Unibersitatea (DU). This Basque recognized institution has an international reputation for its excellent education in the field of ethics. An expert team of teachers leads the training in ethics within the different syllabuses. They have varied lines of research with regard to ethics such as "Ética aplicada a la realidad social", "Ética social y política", "Ética en las organizaciones" and "Cooperativismo y economía social y solidaria". They are involved with diverse networks of for the discussion of ethics and other organizations (i.e., UNIJES), furthermore, they work with South American universities (México, Colombia, Perú, Chile, etc.). Additionally, each member of the team is involved in activities related to the university programs such as: training in postgraduate courses and others, publications in journals, communications in congresses, projects' leadership and so on. This university has a large curriculum in ethical education and its evidence is proved through its own centre of ethics "Centro de Ética aplicada" of Deustuko Unibersitatea (DU) at the web site www.etica.deusto.es.

As a specific example, at this university we find the subject called "Desafíos éticos en el mundo global" (6 ECTS) in the second year of study. This subject is an optional course within the Telematics Engineering Bolonya degree and an obligatory course within the Computer Sciences Engineering Bolonya degree. The teacher who leads the subject is Jaime Cuenca. The subject is focussed on providing tools that help students when facing critical situations of the psychosocial environment in order to act effectively. Other abilities developed through this subject are: reflection on the concept of the engineering professional, on his sense and social end; knowing the rights and duties of the engineering professional by means of codes of conduct; being able to incorporate ethical criteria into the analysis and resolution of real cases related to decision making in ethical dilemmas; identifying responsibility as a guiding principle of the professional ethics of engineering; collaborating actively in the achievement of common aims with other people and so on.

It is interesting to mention the teaching profile of those who lead all of these real proposals on ethical training. The majority of them come from a background of technical instruction, but some have additional studies in humanities, an exceptional fact (or not so much in recent times) taking into account the extreme technological nature of engineering careers. However, the main common denominator is their great interest and willingness to teach ethics within engineering syllabus. All of them think that it is worth devoting a meaningful portion of the learning time of students to the social and human aspects of their instruction as engineers in order to announce the *ethos* associated with their profession which, very often, seems to be almost missing in their awareness. The whole idea is to expand the engineer's approach to their daily engineering practice towards being a responsible professional with the society, the ecosystem and the environment in which they live.

We hope that these combined efforts will continue unabated with respect to the development of both curricular content and learning methods. However, despite our commitment to close collaboration and to working together in this direction, there are still some systemic difficulties that are likely to impede the effectiveness of ethics education within engineering degrees. Even so, this joint action is not prepared to abandon this educational engagement with professional ethics and social responsibility and we believe that one way to address these difficulties at the undergraduate level is through a change in the nature of degree engineering education to include a component on ethical and societal concerns.

4. Overview of the thesis

This work is divided into three parts: "Ethics in technology", "The essential premise", and "Professional ethics: inside the learning process".

The first part of the work consists of the first two chapters, the first of which introduces the concept of technology and its treatment, not from a technical point of view, but from an ethical one, together with all the consequences that derive from this approach. For instance, how human beings and technologies are always bound together in a dynamic relationship. As a consequence of this, we show how technology shapes and determines the professional world, concretely, the engineer's professional profile being closely bound with technology and society. In Chapter 2 the role of technology in the professional world is made concrete by means of the codes of ethics and its importance within Corporate Social Responsibility (CSR) when confronting what is called the Risk Society.

The second part of the work encompasses Chapters 3 and 4. In Chapter 3 the literature in the field is surveyed, in order to

understand where such research has led us thus far and what this might mean with respect to the research goals pursued in this current project. This is organized in terms of key figures (philosophers, historians, engineers, humanists, etc.); disciplines which frame our study (deontological ethics, dialogical or discursive ethics, hermeneutic perspective, heuristic analysis, etc.); institutions or agencies (IEEE, ACM, TUNING, WFEO, UNESCO, engineers associations, etc.) and codes of ethics (ACM, NSPE, FENAI, ABET, etc.); a catalogue of ethical experiences from different universities is presented in order to highlight the importance of the role that ethics is acquiring in the educational world; and, finally, a set of personal interviews with some managers of local corporations and some representatives of professional associations are presented in order to grasp the perception of the different ethical experiences from a managerial point of view and from the engineers' associations in contrast with the ethical goals that the academic part pursues. Chapter 4 is dedicated to analyzing the engineer's responsibility, taking into account the historical evolution of ethics, rights and CSR focused on engineering ethics. Achieving a comparison between these neighbouring spheres we will obtain a clearer understanding of where we are and towards where we should go as a professional. In that way we will discover what aspects could be useful to introduce or modify in the current treatment of the engineering ethics profile. Finally, we show that the education and the training from technical schools and universities have an important influence and responsibility when implementing methodologies, strategies, mechanisms and tools to get a complete moral development of our future engineers.

The third part of the work consists of Chapters 5 and 6. These two chapters introduce the methodological and pedagogical aspects of the learning process when teaching applied ethics in the technical schools and universities. Chapter 5, first of all, is focused on the meaning of applied ethics in engineering schools

and how to achieve the learning process of these kinds of subjects within a deep-rooted technological tradition. Also, in this chapter hermeneutic perspective and dialogical ethics are showed as being very suitable approaches within the learning process of applied ethics. Finally, case analyses and literature are presented as supportive learning tools when deliberating on moral issues. Chapter 6 emphasizes the language and the communication resources required when training ethical issues. Our proposal here is to show how learning resources such as dialogue, moral reasoning and, non judgemental language, work and, how they are an outstanding part of the ethical communication of the ethical contents. Lastly, we present the importance of the introduction of the ICT technologies when training ethical contents and how these technologies shape the learning process through web based tools when giving support to our theoretical communication framework in order to develop the appropriate ethical communicative competences.

Finally, Epilogue shows some reflections supported by the principal thoughts and ideas of the research work in order to form it. These reflections are presented in response to the goals of the current project and they are the final result of the whole research process. We also indicate some topics for further research.

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FIRST PART

ETHICS IN TECHNOLOGY

CHAPTER 1

Embedded values in technology

Technology influences society, but society also influences the development of technology. In order to explore the nature of this interaction and to understand how social and value issues enter into the development of technology, we have based our study on the field of Computer Ethics (CE) which will help us to fill the vacuum between the intertwined paths of: technological matters, legal needs and moral social issues. From this starting point, we present the professional engineering curriculum focussed on the ethical commitment to society and environment. Attention also has to be paid to the educational framework as a means of spreading social responsibility and the inherent public dimension of engineering professionals. Additionally, it is necessary to take into account the moral role that technology plays in influencing 'ways of doing' with regard to the engineering profession, the environment and all living creatures and particularly when shaping the actions of engineering professionals. Finally, we show ways of shaping the profile of the Information and Communication Technology (ICT) professional in order to improve the educational training of our future engineers by providing the appropriate support to the professional practices for the benefit of the welfare of mankind.

The contents of this chapter are based on some sections that emanate from the paper: J. Basart and M. Serra, "A frame for ethical evaluation of (information) technologies", *Proceedings of the 8th International Conference of Computer Ethics: Philosophical Enquiry*, 2009, Ionian Academy, Ionian University, Corfu (Greece).

1. Why ethics in technology?

According to Carl Mitcham "[…] traditionally, ethics has focused on interpersonal behaviour, on how human beings should act toward one another, because this was the area manifesting the most substantive freedom of choice". However, as a result of technological development, concretely, ICT, a new discipline in a continuous state of innovation, the traditional moral theories (utilitarian, deontological, etc.) have been applied in new ways. For instance, this discipline, intimately involved with technology, forces the professionals of this field to take into account new relationships with human beings and non-human world such as animals, nature and even artefacts. This discipline has undergone significant change, but such change has not been matched with a development in ethical thinking in the field (Gotterbarn, 2001). So, the ethical challenge for the ICT professionals is imposed because they have to cope with this new and complex net of relationships.

The significance of ethics for ICT professionals is recognised by the professionals themselves, employers, academics and students. For this reason, the analysis of the ethical issues becomes necessary through the field of Computer Ethics (CE) where an enlarged and complex range of ethical issues are handled. In CE, another active participant, technology, appears, playing an important role and, in some ways, affecting the society in which it is embedded and, consequently, affecting the culture that produces it. So, in that case, the ethical question is placed in the context of the enormous develop-

ment and use of ICT, in its advanced form of computing, impacting on our culture and causing unexpected changes in it within a short period of time. In other words, and according to Luciano Floridi "[...] CE, a new branch of applied ethics that investigates the transformations brought about by ICT's and their implications for the future of human life and society, for the evolution of moral values and rights, and for the evaluation of agents' behaviors". CE can be included in a broader subject, namely Information Technologies Ethics (ITE), or even in a Global Information Ethics (Bynum and Moor, 2000: 275), in which the word *technology* indicates that computers belong to a very sophisticated field. Thus, the broadest area would be Technology Ethics (TE). Undoubtedly, many books and articles have recently been published about TE (Goujon and Dubreuil, 2001); in fact, this is the case even when we restrict ourselves to ITE, a good proof of its present importance is shown in (Tavani, 2008). Now, although we all could easily agree on what the word *ethics* means in these contexts, the same is not true when the word *technology* is considered. This is especially noticeable when technology is approached, not from a technical point of view, but from an ethical one.

Computers as the core of technology have a greater impact and full implications on key areas of our life such as the workplace. So, as society becomes more dependent on computers, we also become more easily influenced by them creating a whole new range of doubts, questions, reflections, new ways of looking at the ethical issues that emerge from this apparent dependence and, as a boomerang effect, unforeseen ethical dilemmas appear for computer professionals and users. Because of this CE as a branch of Technology Ethics (TE) heads many topics, ranging through computer crime, privacy, security, professional codes, etc. All these issues relate to judgements on the role of technology in our society and to the specific difficulties (the ethical choices to be made) in mastering complex technologies involved in the exercise of certain professions such as engineering.

2. Professional curriculum

When the terms technology and daily life (personal and professional) are juxtaposed, one, as an engineer, should wonder if ICT can change the quality and the shape of people's lives, so affecting their social values. In that case, as a ICT professional, we will have to be attentive with regard to what we do when exercising the profession and the consequences that our actions involve, ensuring that social well being, the common good, is not at risk. For this reason, it is advisable to rely on norms of behaviour to guide ICT professionals in their ethical practice.

Responding to the recommendations of the most prestigious international institutions, it is necessary to keep in mind the IEEE (Institute of Electrical and Electronics Engineers) and the ACM (Association for Computing Machinery). These two institutions published an important report about a set of curricula for diverse engineering degrees.

The document pertaining to Computer Engineering (*http://www.eng.auburn.edu/ece/CCCE/CCCE-FinalReport-2004Dec12.pdf*) contains two paragraphs, specifically, in the Chapter 2, focused on the profession and its close relationship with ethics:

> 2.3.2: "Professionalism and ethics are critical elements, since the focus of engineering where design and development makes social context paramount to studies in the field. Computer engineering students must learn to integrate theory, professional practice, and social constructs in their engineering careers. It is incumbent upon all computer engineers to uphold the tenets of their profession and to adhere to the codes of professional practice. The public expects engineers to follow prescribed rules of professional practice and to not engage in activities that would tarnish their image gold that of their practising colleagues."

> 6.1: "Professionalism and ethics should be the cornerstone of year curriculum in computer engineering. The focus on design and

> development makes social context paramount to one's studies in the field. Professionalism should be a constant theme that pervades the entire curriculum. Computer engineering students must learn to integrate theory, professional practice, and social constructs in their engineering careers. Computing professionalism should be a major emphasis of the curriculum."

The importance of the social, ethical, and professional context in computing was at last officially recognized in the long-awaited 1998 report of the IEEE and the ACM institutions that set the project *Joint IEEE Computer Society/ACM Task Force* in motion, to review the curriculum related to Computer Engineering, Computer Science, Software Engineering, Information Technology and Information Systems. The report argues that undergraduate programs should "prepare students to understand the field of computing both as an academic discipline and as a profession within the context of a larger society". A key goal, it says, should also be to "expose students to the ethical and societal issues that are associated with the computing field". What is more, it says, students need to develop "the ability to ask serious questions about the social impact on computing". In 2001 and 2002 respectively, the works related to Computer Science and Information Systems were completed.

Thus, starting from this serious and formal reference we are going to define a general framework for our study of the teaching of computer ethics.

2.1. The Computer Ethics (CE) curriculum

The corresponding document to the Computer Ethics (CE) curriculum (final report published in 2004) is composed of 18 fields: Algorithms and Complexity, Computer Architecture and Organization, Computer Systems Engineering, Circuits and Signals, Database Systems, Digital Logic, Digital Signal Processing, Electronics, Embedded Systems, Human-

Computer Interaction, Computer Networks, Operating Systems, Programming Fundamentals, Social and Professional Issues, Software Engineering, VLSI Design and Fabrication, Discrete Structures and Probability & Statistics. In these fields the subjects to take into account are present, whether they are seen as essential or complementary, within the preparation of the CE curriculum on the part of every technical school or faculty. It should be noted that the 18 fields meet the subjects considered specifics within the CE curriculum.

Non technical subjects are included in the field called *Social and Professional Issues*. Next we are going to deal with this and show the defined units.

2.2. The professional and social units of the CE curriculum

Engineering professionals should be aware of their social responsibility and the inherent public dimension of their work in order to accept the consequences of their professional activity. In the case of Computer Science degrees, this situation is intensifying owing to the use of digital technologies. Thus, it becomes necessary to take into account the diverse ethical, legal, politics, economic issues that interweave with the ICT technologies.

Within the CE curriculum 10 units are defined with a clear social and/or professional profile. The first 9 units are considered as essentials (*core*), whereas the last one is presented as optional or complementary (*elective*):

1. History and overview
2. Public policy
3. Methods and tools of analysis
4. Professional and ethical responsibilities
5. Risks and liabilities
6. Intellectual property
7. Privacy and civil liberties

8. Computer crime
9. Economic issues in computing
10. Philosophical frameworks

These units should be the scaffolding when defining subjects corresponding to a certain syllabus. At the same time, it is noticeable that, except for the third unit, all are clearly related to the field under study. Concerning the unit called *Methods and tools of analysis*, the items to develop are: a) formulation and assessment of ethical arguments, b) identification and assessment of ethical choices, c) understanding of the social context with regard to design and d) identification of premises and values.

The ethics applied to the world of the technology and, in particular, to computing, have been present for several years within international forums, international associations, books, periodicals, congresses and seminars. Suffice to say that the code of ethics and the professional conduct code of the IEEE and ACM institutions, respectively, appeared early in the 90's (IEEE code of ethics: http://www.ieee.org/about/whatis/code.html; ACM code of ethics: http://www.acm.org/constitution/code.htm).

For this reason, it is advisable to incorporate non-technical practices and contents into all technical degrees involved with the organization, analysis or transmission of information. It is important to emphasize that these non technical contents have been identified within the main international curriculum by the most prestigious international associations.

It is our principal wish to break down barriers in the area of computing trying to correct the current educational conditions where the non technical subjects are perceived as a simple complement, amusing and demanding no effort. This often means that students consider the non technical subjects as being unimportant in their training. For them, these contents are considered an isolated portion of knowledge, distracting from the typical

obligations of the *really* important subjects; these are perhaps best instanced as the technical.

3. Moral dimension of technology

Technology is a concept, a general label used to refer to a large number of quite different technologies. The point is that, in our world, we do not interact with abstract technology, but with particular technologies in particular contexts. The interrelationships with these technologies are established between them and between them and us, weaving a set of actions that affect, in some way, the world. According to (Arnold and Pearce, 2008) "[...] some of these actions are performed at the direct command of humans, while others are autonomous in that they prompted by triggers internal to the technology. Some actions are optional for the operator; others are mandated by the technology, or perhaps by other technical systems to which the system in question is answerable. Other human actions require the participation of technologies. Technologies thereby respond to action, intervene with their own acts, make requests for action, receive requests for action, make demands on others, and receive demands from others [...]". Therefore, we can say that the technology acts to shape human affairs.

From this previous approach, computer ethics should not just study ethical issues in the use of computer technology, but also in the technology itself. In other words, many new ethical issues emerge throughout its designing process. Some of the most recent works about ethics in technology (Arnold and Pearce, 2008; Verbeek, 2006) take into account how morality is present ("materialized") in each technology, and how technologies moralize their surroundings. These works apply some concepts and ideas developed by M. Akrich, B. Latour and C. Venn (Akrich, 1992; Latour, 1992, 1994, 1999; Latour and Venn, 2002); for

instance, the "script" concept. The script describes the many roles that technology can play in every context. Each technology brings a script inside itself with all the instructions (actions) to be followed by the actors involved in it. It means, "Technologies are able to evoke certain kinds of behavior" (Verbeek, 2006). Therefore, scripts are a means technology uses to influence human beings' behavior. It could be useful for the engineers or the technicians to have a script present throughout the design process of a technological artifact in order to materialize, a priori, the values within it. In this way, the engineer or the technician will feel involved in the whole of the design process, uncovering the implicit values of its design and, at the same time, carrying out a constant assessment in order to limit possible damage to human values.

Taking the line that technologies act by themselves, one can say that they are not just tools and means at our service, they negotiate with us what is going to be and how it will be done. Like human beings, they are responsible actors mediating in human affairs. For this reason, regarding technology as any other actor becomes necessary because it is not only a set of means used to do specific tasks but is also another active participant in a social and cognitive context. Technology and human beings cannot be moved away from each other, both entities shape a unit thanks to the aligned relationship established among them (Basart, 2008). Consequently, ethical criticism of technologies should not be limited neither to the accurate design of technologies nor to the proper use of them. A more complex approach is required.

On one hand and, in particular, designers can anticipate how users will interact with a given technology. One way to carry out this anticipation is by using the ability to see another's situation as if it were one's own. With the help of the designer's *moral imagination* (Coeckelbergh, 2006) it is quite possible to predict many implications and consequences in this complex relation-

ship. While working on a design, technicians and engineers are adding prescriptions, therefore, they are delegating responsibility to technology. Thus, when technology needs to be morally evaluated, a responsibility in the designers' work appears. This responsibility should prevent possible harm to human values from the very beginning of the design process (Brey, 2000). So, increasing the moral imagination can help engineers to: discern the moral relevance of design problems, create new design options and envisage the potential results of their designs in order to carry out this prevention (Coeckelbergh, 2006). The new perception where technology plays a mediating role in the actions of users impregnates the designer's work with a revised moral dimension. "The fact that technologies always mediate human actions charges designers with the responsibility to anticipate these mediating roles" (Verbeek, 2006). In short, designers play an important role in the coming about of technological mediations, but not the only role, "Users, with their interpretations and specific forms of appropriation, also have a part to play" (Verbeek, 2009). The mediating role of technology depends on the user's perception and interpretation, too. "The mediating role of technologies is not only the result of the activities of designers, who inscribe scripts or delegate responsibilities, but also depends on users, who interpret and appropriate technologies, and on the technologies themselves, which can evoke emergent forms of mediation" (Verbeek, 2009). The technological mediation shows that technology shapes human actions making possible new practices and experiences on the basis of which moral decisions are made, so in accordance with Verbeek "every technological artefact that is used will mediate human actions, and every act of design therefore helps to constitute specific human practices".

On the other hand, if we adapt the Actor-Network Theory (ANT) approach (Latour, 1992; Latour and Venn, 2002) where things, in our case technology, and human beings are treated at the same level, we can see that "Humans and artifacts exist not

in themselves but through the relations with others, humans and things alike". In their relationship, they act on each other in order to create meaning within the network. "Artifacts alter meaning in a network; they help create new or different values" (Alison, 2005, 2008). The reasoning of the ANT consists of, above all, outlining the connections among heterogeneous elements, meaning, the description of networks. Likewise, morality is distributed through the network consisting of human and non human things.

It is important to become aware of the presence of technology and its influence over all of us and all living creatures because it determines our existence. It affects the way of living and the way that we mix with others and our environment; causing and modifying beliefs, tastes and opinions; transforming our attitudes and behaviors; introducing new habits and ways of doing; opening and closing practical possibilities for taking part in the world, and so on. In short, it is not only the existence and the wide variety of artifacts that we have access to, but also, the introduction of new ways of organizing ourselves, mixing with others and acting; in fact, the strengthening of other ways of living.

In this light, from an ethical perspective, different projects were developed in the past in order to show that the relationship between individuals and technology, as previously mentioned, existed and exists in many ways.

3.1. Some precedents for the mediating role of technology

The first systematic works in this field date back, at least, to the eighties (Kling, 1980). In his "Declaration of Empowerment" address to users in human-computer interaction, Shneiderman proposed (Shneiderman, 1990) to elaborate on the Social Impact Statement "[...] at the start of every human-computer interaction project".

The framework proposed by Bologna (Bologna, 1991) focuses on some areas of ethical and legal concern, mainly from an instru-

mental approach to computers (software applications, hardware, infrastructures...). In this sense his study goes very deep, but also the dynamic relationship between human beings, environment, and technology is missed.

Huff and Martin (Huff and Martin, 1995) presented the Project ImpactCS "[...] for integrating social impact and ethics into the computer science curriculum". This project recognizes that from the perspective of computer science, every ethical issue about a technology is located at a particular level of social analysis. The framework provided the sort of comprehensive, conceptual overview that the field of computer science had been lacking until then. This framework considers nine ethical issues present in seven levels of social analysis (individuals, groups, organizations, cultures, institutions, nations and global). It takes into account the fact that the analysis of any ethical issue needs to go in parallel with both social and technical analysis. The framework distinguishes two kinds of responsibilities: professional responsibility and individual responsibility. In some situations, it is quite easy to make such a distinction, but this is not always the case. In fact, which responsibility is paramount when complex ethical dilemmas arise in the engineering practice? What should be decided when contradictions appear? For this reason, in our proposal there is no clear-cut separation between a person as individual and the same person as a professional.

Currently, the context of the professional responsibility is full of uncertainty and dilemmas affecting, directly, the relationship with the customer, stakeholders and colleagues, teamwork, the quality of the performance at work, and, most importantly, the engineer as a person and the rebound onto society and the environment. It means, historically, professional responsibility has been concerned almost exclusively with a good technical praxis and professional harmony, tainted by recommendations and jurisprudence. Even so, the new changes and needs of the ICT society demand to taking a new turn, from the formal to the

essential, from an ethics worried about how to exercise the engineering profession to an ethics concerned mainly with the ends and professional goals with regard to the people and environment. So, the engineer, as part of a professional collective, needs to be held by the ties of a similar responsibility based on a set of values shared by all in order to give a responsible answer to the society from two dimensions, the technical and the moral, when exercising their profession. Additionally, this public, juridical and social responsibility of the engineer's professional activity governs their conduct in reporting to the customers, stakeholders, colleagues, society and environment for their actions and their consequences. The warder of this public responsibility is the state and its law, based on, substantially, democracy, the personal conscience of its members and a common, civil and compulsory ethics through watching over social cohabitation and move forward through the ages. In this last concept we find what is called the minimalist ethics (Walzer, 2008). This ethics gives the duties that every one of us have with regard to the rest of the society. Furthermore, minimalist ethics is the ethics shared by every engineer and, as a result, professional ethics has to head in the direction of a common area for everyone, the individual and the professional.

In this light, the professional praxis and the social responsibility of the engineering profession should aspire not only to comply with the regulations currently in force, but it should aspire to be the guide for the professional ethos finding inspiration in excellence, pursuing the job well done, beyond the legal minimum, future contracts and goals in the short and medium term. Thus, our main task as educators within engineering degrees is to promote among the students a sense of responsibility, regaining the view of teamwork with the same purpose and will. At this point, it is important to highlight the *service* that an engineer has to provide to society in order to come up with his recognition for the work done and the quality reached. In other words, the

workplace of the engineering professional demands involvement with and commitment to the rest of their colleagues because their combined efforts will benefit the quality of the service addressed to the most important customer, society.

Gotterbarn and Rogerson (Gotterbarn and Rogerson, 2005) presented a Software Development Impact Statement that "[...] improves and expands risk perception" and "[...] should reduce the dangers of a narrow focus on quantitative risks" in software development. This work considers that "[...] any software project goes through three distinct phases: an initial phase where the feasibility of the project is examined; a requirements phase that lays out the overall structure and function of the project; and a detailed phase that lays out the plans for building the software. Each of these phases has its peculiar risks." It is necessary to include in the evaluation "[...] social, professional, and ethical risks that lead to software failure and extends the range of stakeholders considered in risk analysis". They argue that in a process of software development, it is necessary to make an actors' list identifying all the stakeholders implied in the project because limiting the consideration of them to developers and clients can be a cause of failure. Another type of failure arises when developers limit the scope of software risk analysis to technical and economical issues. Therefore, a complete software development process requires the identification of all relevant stakeholders and their roles and enlarging risk analysis to include social, political, and ethical issues.

Another interesting and daring example is the work *Eternally Yours* (van Hinte, 1997; Verbeek, 2006) focused on developing ways to create product longevity in order to attach the users to the product (in our case it could be applied to technology) inviting people to use them as long as possible. *Eternally Yours* is looking for what product features are able to provoke a bond with their users, in others words, seeking an appropriate design. Again, we encounter a good example of anticipating mediation by imagi-

nation. For *Eternally Yours* the products' psychological life span is a very important element, that is why the design process is the main concern and the key to the problem is "How can the psychological lifetime of products be prolonged?", in order to keep the engagement alive between users and products. According to this work "It is an engaging product that asks for attention and involvement in its functioning, much like a campfire". The functioning of a product is dependant on people's involvement and in this way they are mediating the behavior of the users. Additionally, the products of *Eternally Yours* have a consistent component, environmental ethics, "They seduce their users to cherish them rather than throwing them away prematurely".

Lastly, another way to enhance the mediating role of technology-in-design is the Constructive Technology Assessment method (CTA; Schot, 1992; Rip, Misa and Schot, 1995). In this work CTA establishes a link between the context of use and the context of design in a practical way involving all relevant stakeholders (users, managers, suppliers, etc.) in the design process of technologies. The assessment of a technology is made during its development and not after it has been developed, allowing the modification of the original design if it does not work as expected. For this reason, "Participants in the CTA process should be invited not only to integrate assessments of users in product specifications but also to anticipate possible mediating roles of the technology-in-design". It is a way of mitigating possible human damage because the method is constantly trying to anticipate the user's actions and, consequently, possible adverse effects.

3.2. A new framework to assess the ethical quality of technology

Technology is an intentional human activity that the modern industry has incorporated to the market. This technology is promoted by strategic decisions made from different kind of institutions (private or public) such as enterprises, investors, universities

and research and development centers. It is evident that behind the technology there are involved interests and these interests are not only epistemic, but they respond to diverse internal and external pressures (economic, politics, commercial, military, etc.).

Additionally, technology is not simply the computer, for example, but large-scale computer networks linked through telecommunications systems; it is able to control and command systems; it is data banks; the know-how and the software to manipulate them, and the power implicit in controlling them and so on. Technology holds a lot of power, exercised by people over people or things, in view of obtaining the desired goal and, as a result of this exercise, diverse benefits and damages are derived. This means that technology as an *instrument of power* (Barbour, 1993) is not neutral. It is always an instrument of ambiguous power (versatile) that can generate diverse consequences depending on the context in which it is deployed. Moreover, it is accepted that technological development is in the hands of big enterprises and private institutions. Nevertheless, political power and other mechanisms of social pressure should act as an important counterpoint in order to hold back interests and leanings. Starting from these assumptions in order to change goals and reduce the harmful effects of technologies, we are first of all required to reconsider the priorities with the purpose of modifying our attitudes and behaviors according to the context. In this sense, this perspective calls for the effort to analyze every technology in great depth within its own circumstances, avoiding deep-seated topics, slogans and prejudgments.

Taking into account the qualifications mentioned in the previous paragraph we can say that the technologies are not morally neutral. Technology is not an exclusively technical productive activity. This fact means that technologies must be socially questioned from many sides. In the next section we concretise the criticism of every technology, by formulating a set of questions in order to assess the moral dimension of technology because its

incorporation, as a new social actor, into our everyday life has modified, in many ways, the social paradigm.

In our study it is essential to bear in mind how human beings and technologies are always bound together in a dynamic relationship. Technologies never exist alone, but as a more or less ambiguous opportunity to open new possibilities often unknown to us at the beginning. They act both actively and passively: actively, by imposing their requirements and restrictions, and passively, when used for attaining certain human purposes. Having this point of view in mind, it is possible to assess the ethical quality of a particular technology by considering to what extent this technology is in accordance with an established list of relevant ethical factors. The list is fixed in the sense that it does not change from technology to technology, but it is also open and may be revised according to improvements in our ability to adjust our ethical assessments. The result of such an evaluation shows what conditions are imposed, what values promoted, and what purposes are sought from the technology under scrutiny; in short, what its script is. The current list of eleven ethical factors is as follows:

(1) Does it answer or help to answer an existing demand?

(2) Does it make understanding and cooperation easier among people trying to manage a problem?

(3) Does it point towards the characteristics and demands of its users? Is it flexible, easy to adapt to changes in its environment and to new requirements?

(4) Does it promote users' autonomy?

(5) In what ways does it increase the welfare of its users?

(6) Does it respect valuable social practices and universal human rights?

(7) Does it keep working under human control?

(8) Can it be integrated with other well-founded technologies? Is it easy to update and maintain?

(9) Is it constrained by a heavy demand for resources when it is manufactured or used?

(10) What are the undesired effects on people or the environment?

(11) To what degree is it recyclable and/or reusable?

It is necessary to specify that here the autonomy considered in factor (4) is that showed by Shneiderman (Shneiderman, 1990) "[...] users want to be empowered by technology to be able to apply their knowledge and experience to make judgements that lead to improved job performance and greater personal satisfaction". From an ethical perspective, this is always a central issue in the relationship between individuals and technology.

It is important to emphasize that any answer to these questions would be a determinant one, but the setting of them is a first approximation made in order to know what the moral impact of the technology under scrutiny is. It is a way to find out what the valuable elements are and what are the reprehensible or undesirable elements embedded within the analysed technology. However, the process is not finished at this point. It has to be completed through new questions or through a detailed analysis of the answers received and the implications associated with them.

Now it is possible to illustrate how the analysis of these previous questions inside the ICT environment shows many of the key ethical points to be considered in these technologies. For instance, the exploration could proceed as follows:

(1) Is this technology necessary or is it just another model or version of something already existing? Is it just business in its cycle of production and consumption? Does it contribute towards solving a real social necessity? Novelties seem to be indispensable in the market; "New!" appears to be the best advertising, but newer is not necessarily synonymous with better.

(2) Does this technology facilitate and enhance communication among people? From an ethical analysis, communication is not just transmission of information. In a communication environment, quality (what and how it is said) is often more important than quantity (how many bits are sent).

(3) To what extent does the design of these systems and devices take into account the physical and psychological structure of human beings? Do people adapt to the machine rather than the reverse?

(4) Does this technology produce an empowerment of the user in regard to working with, communicating or managing information?

(5) Are there clear benefits for people, or are we talking of benefits for systems and machines? The latter does not always imply the former.

(6) To what extent are trust, privacy, reliability and security protected?

(7) The high level of automation that computers have introduced should not be an excuse to elude accountability and responsibility. Nevertheless, this is possible only when there is someone making a final decision whenever it is necessary.

(8) IT opens a vast and as yet unexplored horizon of new possibilities. However, its success often depends on its capacity to operate well with other digital technologies. The procedures to maintain and to update these technologies are not just technical possibilities that can be more or less fulfilled. The ethical claim is that these procedures must exist and have to be as effective as possible.

(9) Again, consumption of resources is not just an economic matter, but also an ethical one. This is because today, more than ever, we all share a world of scarce resources where saving (rational and reasonable spending) is not optional.

(10) Disposal of electronic waste damages the environment, while the accumulation of radiation emissions from electronic

products may be potentially dangerous in the long term. In addition, an important point to analyse is how information transmission devices have an effect on human communication and human relation patterns.

Finally, (11) Recycling is also necessary to reduce the huge economical and ecological impact of IT as much as possible. As an example, restricting ourselves to domestic goods, we can find personal computers, laptops, cellular phones, TV sets, video cameras, video games, digital players and so on.

By proceeding in this way, we believe that ethical evaluations would be fairer, more realistic and systematic because the questions are always the same for each technology, whatever its particular characteristics are. As we have said throughout this passage, the achievement of some kind of script during the design process would be useful in prescribing how to act when using technology. In this sense, the set of ethical questions presented here could work as a script. Simultaneously, this set of questions could help us to contextualize our way of life with regard to our close relationship with technology, thinking about what is wrong, what we should improve, who we are affecting, and, what is more, what kind of person we wish to be in order to improve our daily personal and professional practices (and their implications) in order to achieve a good quality of life, in short, to live well in our societies (Aristotle).

At a later stage, extensive works have been developed in order to range over the whole field of technological assessment. These new studies (Wright, 2011) follows the same approach as we have set out above, a set of questions aimed at uncovering ethical issues related to ICT, even though it could be applied in a wider context.

This ethical framework is based on the insight that the whole of technological assessment is value laden, from the internal and external participants of a technological project (i.e.: users, managers, customers, stakeholders, researchers, experts, etc.) to the

different processes that constitute the technological project (i.e.: decision-making, policy-making, designing, development, etc.). It is not sufficient to simply analyse the ethical consequences of a technology, but the ethical issues of the whole assessment process must also be considered.

Technologies may challenge moral or cultural values and beliefs, and their implementation may also have significant impact on people other than the direct consumer of the technology, meaning the user or customer. For this reason, in contrast to Wright's framework, our set of ethical factors have a twofold address, to concrete technology and also to ICT technologies, in order to grasp the essential significance of the ethical involvement between human beings and technology at many different levels (domestic technology, information technology, telecommunications, industrial technology, etc.).

Additionally, the ethical framework presented by Wright is structured around key ethical questions rather than philosophical theories, applicable to different cultures (contexts). In accordance with Wright the new proposal is "[…] a framework for an ethical assessment which can be performed in regard to any policy, service, project or programme involving information technology". The ethical evaluations carried out through this framework not only consider ICT as one of the main actors, but also the stakeholders and the context within which they are involved in the technological project. Therefore it is necessary to take into account the nature of the situation, the context where a technology is deployed to enable an understanding of the ethical issues woven through the social values of that particular moment.

What is more, as we argue throughout the present research work, the new framework proposed is based on the idea that "The ethical impact assessment is needed of new and emerging technologies because technologies are not neutral, nor value free" (Wright, 2011). Technologies, through their configuration and use, are the reflection of the values of their designers, policy-

makers, developers, project managers, users, etc. and, nowadays, of their stakeholders as well. The latter, through this kind of consultation, can register and comment at any stage during the assessment process. They can nominate alternative courses of actions, drafting of scopes and guidelines, suggest safeguards and redefine some aspects of design to minimise ethical risks before a technology, service or programme is launched.

It is important to emphasize that the information gathered from the set of questions is a first approximation in order to know what the moral impact of the technology under scrutiny is. As we have said, the process is not finished only by answering all the questions, there is yet more work to do and the significance of the ethical factors will be detailed more fully through new questions or through a detailed analysis of the answers received and the implications associated with them. In comparison with Wright, his framework also needs to be added to with additional information but only from the stakeholders that are directly related to ICT technologies, and not with the remaining existing technologies. For him, a way to engage with the stakeholders is to proactively provide information, responding to their complaints and implementing good practices when undertaking the ethical impact assessment.

From our point of view, a fact to emphasis is that Wright, on many occasions, uses debate as a communicative ethical tool, for instance, among the stakeholders. In comparison with our idea of ethical tools, we prefer to talk about dialogue instead of debate. Dialogue, as we will see in Chapter 5 assumes that the participants in the course of deliberation already have some interest in and insight into the matter at hand. It also presupposes that the participants can elaborate their interest and knowledge through an exchange of perspectives. Dialogue requires openness towards the views of others. These summarized features should be the central elements in reaching an understanding by mutual consent with the stakeholders.

In the light of this diversity, the definition of an appropriate framework for an ethical assessment, such as Wright proposes, by means of the identification of the relevant ethical issues within the whole structure of a technological project is required. In accordance with him further research on technology assessment should seek to make explicit the social, ethical, and political values embedded in a given innovation (and its context) and reinforced through its use. Such research might, for instance, examine the extent to which an innovation exacerbates dependence on technological expertise, supports user autonomy, or fosters social inequalities. Finally, it could also explore how the use of certain technologies reinforces or undermines institutional values (i.e.: efficiency, accountability and responsiveness).

4. Shaping the profile of the ICT professional

Computer Ethics has eventually gained influence within the field of engineering on both the profession and the experiences of teaching. On one hand, computer systems, as a core of technology, have provided diverse advantages and opportunities that have repercussions on the life quality of people. On the other hand, computers have brought about problems arising from hardware and software malfunctions and from misuse by human beings, causing a set of vulnerabilities and crimes related to privacy, security, fraud, harassment and so on. Consequently, as educators, we have to realize that our engineering students have not the awareness of social trends, global problems, or organizational issues to adequately tackle and cope with them in the manner a more experienced person would. Hence we are responsible for shaping their training in order to more closely aid students' career goals by focusing on the ethical dilemmas they will face in their future everyday professional lives. For this reason educational training of the ICT professionals should be

examined in order to be able to face the social concerns that technology involves.

4.1. Addressing the ethical issues of the ICT professional: virtue ethics

Most moral dilemmas in engineering are analyzed from a consequential point of view but this framework has its limitations. In this framework it is not always clear how to judge which consequences are best and neither does it take into account the importance of the emotional element of the human experience. Therefore the introduction of the virtue ethics (Aristotle) framework which focuses on the character of the moral agent rather than the rightness of an action, can help us to address the ethical dilemmas raised during the exercise of the engineering profession. In considering the new relationships, needs, motivation and emotional sensitivities unique to the ICT society, virtue ethics provides a practical ethical analysis when facing difficulties. Simultaneously, virtue ethics does not differentiate between the individual and the professional. It looks for the coherence between the self and the professional based on the nature of the character of the moral agent in order to make moral decisions with care and consistency. We don't consider it wise to strip the decision making process of affect or attitude and focus on rationality alone. Human beings have an ability to reason that is complemented by emotional reaction. These reactions are an integral part of how we perceive the world but also influence our judgments. Virtue ethics recognizes this important component of our moral experience. It explores how moral agents can learn by habitual practice to develop good characteristics that will enable us to 'be' better.

For this reason, we think that virtue ethics approach can contribute to the maturity of future engineers in order to create professionals that care "[...] about the good of the community as well as him/herself" (Grodzinsky, 1999). Therefore, it is in my self-interest, not only as a person, but also as a competent professional, to

firstly, understand the social responsibilities attached to my work as an engineer and to secondly, take care of them. Furthermore, from the approach of virtue ethics this moral consistency among different spheres of a life has a twofold benefit, personal and public. On the one hand, to act with consistency provides sense (meaning) to one's life. This sense is most valuable because it does not become established by something external to the individual (as is the case with duty in deontological ethics or calculation in utilitarian ethics), it comes from inside oneself. On the other hand, consistency is an essential quality for any one asking for trust.

In this light, a virtue ethics approach will help us to reinforce the quality of the practices introduced by mediating technologies (in no case on the actions resulting from specific design) and their implications for the kind of life we are living. In such an approach, it is not primarily the impact of mediation on the behavior of human beings which is important, but mainly the ways in which mediating technologies help to shape specific ways of dealing with things. In accordance with Aristotle, there are two kinds of reasoning, the theoretical one, which generates knowledge and beliefs about the world, and the practical one, which generates choices and actions. Thus excellent practical reasoning is the kind that leads to virtuous actions. Using theoretical and practical reasoning makes human beings ethically responsible for what they do and what they become. In this sense, the power deployed by technology should be supervised by the responsibility and accountability that our engineering professionals possess because the development of technology should only contribute to the quality of life in society.

4.2. Professional character: a virtue portrait of the ICT professional

A way to recognize professional responsibility is through the codes of ethics by means of their contribution to the defense of the values mentioned before such as coherence, consistency,

responsibility and accountability. Codes of ethics should materialize all desirable elements in order to shape the profession in ways at least socially benign and, ideally, socially beneficial. An engineer as an individual and professional should accept responsibility because her association with others who share knowledge and skills become a social reference; in short, society puts its trust in them. So, when working in groups designing technology to be used by others, they are always dealing with social interactions. In sum, knowledge and practice of these responsibilities is essential to ethical thought and behavior by computers professionals. However, codes of ethics, by themselves, are not enough to guarantee the moral practices that we pursue. Virtue of ethics should pervade the engineers' collective in order to assure a set of people of good character. However, what does good character mean within the engineering profession? Aristotle believed that virtue lay in the middle of two contrary vices and described it as "the mean by reference two vices: the one of excess and the other of deficiency". Courage, for example, lies between foolhardiness and cowardice.

There is no comprehensive list of virtues, even though we can quote, as an example of them, the cardinal virtues expounded by ancient Greek philosophers (Socrates, Plato, and Aristotle) that is to say courage, prudence, temperance, and justice. Transferring this idea onto the engineers profile implies knowing what aspects of this professional should be enhanced through the virtue ethics in order to be applicable to the engineer practitioner in the engineering context (Harris, 2008). According to Harris a virtue portrait of the good engineer should cover:

- *Technical excellences*
  These are virtues associated with technical training, such as the understanding of mathematics and physics, engineering sciences, design, construction and operation. What is more, here we can include being "sensitive to risk", the

impact of an engineering work that was not expected; "tight coupling" and "complex interaction", the correction of a serious problem with little time to do so and the interaction between diverse tasks that can result in sudden and unanticipated outcomes, provoking fatal incidents. In that case engineers should have the experience and judgment enough to determine what precautions and contingency plans have to be applied when faced with them.

- *Non-technical excellences: techno-social sensitivity*
  Human beings and technologies are always bound together in a dynamic relationship as we reviewed in section 3 of this present chapter called "Moral dimension of technology". Technologies affect the society where they are embedded and consequently impact on the social culture causing unexpected changes in it. Technologies never exist alone, acting both actively and passively. Actively, by imposing their requirements and restrictions and passively, when used for attaining certain human purposes. Engineers should be aware of social considerations when designing technology before developing and deploying it.
- *Non-technical excellences: respect for nature*
  It is important that engineers become aware that the presence of technology has influence over all of us, affecting the way of living and the way that we mix with others, non human beings (the animal kingdom) and the environment (the ecosystem).
- *Non-technical excellences: commitment to the public good*
  Engineering professionals should be aware of their social responsibility and the inherent public dimension of their work. In this line we find the concept of "good works" developed by Michael Pritchard, associated with the laudable engineer's behaviour, highlighting their dedication in ensuring that the social welfare, the common good, is present in their daily professional activity.

As teachers of applied ethics, within the engineering field, we are looking for engineers who do not just possess the preceding character traits, making her a person morally good, admirable, who acts and feels well, rightly, as she should, but also has the capacity to know when and how to exhibit these character traits. Thus the virtuous engineer should use rationality, practical wisdom (Aristotle), to decide how to be. It is by reasoning that a person determines how to act in ways appropriate to a given circumstance. In this way, a person will possess virtues and exercise them with practical wisdom in order to make good choices in acting well.

When engineering students start studying applied ethics they hope they will learn immediately the right and only answers to difficult moral dilemmas but, quickly discover, to their disappointment, that there are none. Instead, there are many different ways of approaching difficult moral dilemmas, which help to tease out justification for a particular course of action. Our position is not to suggest that virtue ethics is an ethical framework that is superior to or replaces those of consquentialism and deontological trends. We do propose that it deeply enhances our approach to moral dilemmas. We think that if the engineering students develop secure foundations, by habitually practicing the previous virtuous characteristics then a desire to fulfill their duties and obligations as a engineering professionals will follow naturally because the consequences of living a virtuous life are likely to be good as such behavior contributes to the dynamic process of human flourishing (Aristotle). As Thomas Aquinas said: "Virtue is that which makes its possessor good, and his work likewise".

As a closing remarks and following the line that we started in this section, from one hand, "The combination of normative and virtue ethics moves the industry in the direction of a more integrative model of computer ethics and sends the message that the 'ethical' ICT professional is an extension of the ethical self and is valued by the profession" (Grodzinsky, 1999). For this rea-

son, education plays a very important part when teaching human good, common good and core values in order to provide support to codes of ethics and to give sense to them through the good professional practices making moral decisions.

On the other hand, being a good engineer will be determined by three important components that will constitute the essence of the engineer profile: the virtue ethics that dissolves the existing gap between the person and the professional, achieving an integrated self, the minimalist ethics which allows us to reach a consensus in order to respect the plurality and the codes of ethics which define those minimalist ethics.

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CHAPTER 2

Professional and social issues of the ICT field

The growth of ethics within the professional field of engineering is centred on the use and application of codes within professional practice. In this chapter we will show that this, while necessary, is not sufficient in the engineering context when dealing with ethical dilemmas and making the relevant decisions.

At present, the development of formalized ethical standards should take into account matters such as: firstly, the new framework of the engineering profession, meaning, the context of the enormous development and global use of Information and Communication technology (ICT) where engineers put into practice their ethical judgments. Secondly, the current professional, as that person who has the responsibility to seek "[…] humane solutions to human questions in computers technology field" (Weizenbaum, 1972), keeping in mind all the new surroundings brought about by the ICT society, is forced to develop new skills and abilities in order to face new social changes and needs when exercising his profession. So having a quick look at the present social scene in which technology plays a very important role with regard to human life, a thorough knowledge of the professional role is required. This reflection demands that global professional

features of the engineering are included explicitly within the codes of ethics. Nowadays, it would be a mistake to believe that obediently following the current codes will satisfy all moral situations because its isolated use cannot be comprehensive enough to address all of these, when we know full well that we are living through constant social and technological change. For this reason, in this chapter we also expound that codes should be a starting point in the process of the ethical practice of engineering profession when making decisions but with the expansion of their meaning (Stohl, Stohl and Popova, 2009).

In this line, we present an implementation of a set of ethical factors concerned with the ethical issues of professional codes (for instance, ACM, IEEE and NSPE) based on a detailed inquiry in order to more precisely delineate which ethical issues could be covered by the codes and which ethical issues are possibly missed by them. By means of this inquiry we should be able to say that something more is needed in addition to the professional codes as well as detecting their weak points.

Finally, codes of ethics, corporate social responsibility (CSR) and the risk society are interwoven in order to show their interdependencies and their influence on ICT professionals and social affairs.

The contents of this chapter are based on the following papers:

- J.M. Basart and M. Serra, "A frame for ethical evaluation of (information) technologies", *Proceedings of the 8th International Conference of Computer Ethics: Philosophical Enquiry*, 2009, Ionian Academy, Ionian University, Corfu (Greece).
- J.M. Basart and M. Serra, "Engineering Ethics Beyond Engineer's Ethics", *Science and Engineering Ethics Journal*, 2011. ISSN: 1353-3452, DOI: 10.1007/s11948-011-9293-z, Springer.

1. Codes of ethics

1.1. Maturation of the codes of ethics

On the beginning of the adoption of professional codes, the American Institute of Consulting (AICE) in 1909, the first engineering society in the United States and the forerunner of the current American Council of Engineering Companies (ACEC), adopted two of the most commonly referenced codes of engineering ethics, published by the Institute of Electrical and Electronics Engineers (IEEE) and the National Society of Professional Engineers (NSPE). In this first attempt, these were focused on issues of how to conduct business but there was a lack of recognition of responsibility towards public health, safety and welfare (Davis, 2001). A shift was made towards engineering codes emphasizing protection of the public when some well known institutions such as the Accreditation Board for Engineering and Technology (ABET) and the old Engineer's Council for Professional Development (ECPD), endorsed the idea that engineers have a responsibility to the public in addition to their client (Harris, Davis, Pritchard and Rabins, 1996). This shift was the first step towards a balance between business interests and the interests of the public. Now all major engineering codes pertaining to the Association for Computing Machinery (ACM), the IEEE and the NSPE have similar goals. Presently, with regard to new developments and the needs of the ICT society, a new trend in engineering codes is required in order to cover issues such as sustainable design and the protection of the environment (Stohl, Stohl and Popova, 2009).

Ethical codes have taken onboard the importance of ethical issues in engineering practice. A clear example has been the institution as ABET with its Criteria 2000 (EC 2000) (Shuman, Besterfield-Sacre and McGourty, 2005) including ethics in the

professional curriculum, as professionals' skills. In this sense, ABET would contend that ethical codes are the professional mechanism through which the characteristics of a profession are reflected, in particular, (ABET, 2007) states in its Criterion 3.f that graduates of engineering degrees have to demonstrate "An understanding of professional and ethical responsibility". So the ethics of codes as a means to re-establish the moral order, within the professional field, seem to be helpful with relation to ICT ethical issues but they are not enough to guarantee the moral practices of a collective of professionals. Such a collective is composed of people who share common practices and common goals together with the values with which they identify and that they defend in their professional exercise in the service of society. However, the objections generated by these codes are diverse. In the first instance, some say that they are excessively detailed, turning them into strict edicts with no opportunity of change (Gotterbarn, 2001). Others say (Grodzinsky, 2000; Spinello, 2001; Haws, 2001) that certain concrete applications and disciplinary rules are missing, so making them internally inconsistent and insufficiently comprehensive. Finally, they appear an appropriate means to improve professional behavior but experience indicates that they really have little influence on it (Cronan and Douglas, 2006). According to (Bilbao, Fuertes and Guibert, 2006) professional codes tend to underline the deontological dimension of the profession ahead of the ethical one because they concentrate their efforts, almost exclusively, on establishing duties. This perspective is essentially poor for the collective of the professionals, because it identifies professional ethics as concrete rules, naming the professional an ethical person if they merely do their duty. Therefore the complexity of the problems posed by ICT in the workplace demands something more to sustain the meaning of the use of ethical codes.

Commonly, codes are presented as a set of specific regulatory principles that can be demanded of all members of the profes-

sion. These duties are gathered together in different sections (Bilbao, Fuertes and Guibert, 2006) as follows:

- The duties towards professional competence and its correlative responsibility. In general terms, to define what is a good professional, delimiting the sphere of activity, establishing the conditions of access and rejecting infiltration.
- The duties towards professionals. The regularization of the relationships among the professionals that belong to the same sphere of activity. The duties towards the professional community, the corporate solidarity, the means of access and the means of expulsion.
- The duties towards the customers with regard to the rendered services and the rights generated (privacy, security, confidentiality, etc.).
- The duties towards society, enhancing the professional contribution to the common good.

As we already know, professional codes include the principles, the values and the goals that professional associations defend in the exercise of the profession represented. In this sense, the codes establish a reference framework and express an unavoidable commitment of service for the institution and its members in the face of society. Nevertheless, we think that the engineering profession covers something more than its professionals and the fulfillment of their duties. In this light, codes of ethics are not able to reflect some of the ethical questions that are at stake when engineers make decisions in their workplace. Therefore, codes of ethics need to be updated in order to enforce sanctions, to talk in terms, not only of individuals but also in terms of the whole organization or community and to take into account all the elements of a conflict situation (human beings, living creatures and environment). In accordance with (O'dwyer and Madden, 2006) professional ethics has to take into account all the participants that belong to

the organization in which the engineer is integrated when resolving a conflict. This means we cannot ascribe the responsibility for concrete actions to only one person. We have to keep in mind that the responsibility has to be seen as a whole as consisting of people, the rights, interests, needs and duties existing among them and extending in all possible directions. This is the process that puts professional and personal responsibility into the context of the social responsibility of the organization.

Finally, we persevere in the proposal of the virtue ethics as a possible path to follow, meaning, as the method that can shape professionals' behavior and attitude in order to achieve a collective populated by persons of good character and with the same interest, focused on the well-being of society through their trustworthiness and honest actions (Grodzinsky, 2000). In other words, the complementarity of acting from a higher level of care for the customer (virtue ethics) and conforming to the development of standards for the engineering profession (duties), is required for a complete configuration of an engineer's profile. Codes of ethics are the appropriate place to reflect on this discourse, being not only imperatives expressing measurable obligations of the professional and customers' rights, but also statements of aspiration and virtuous goals for the professional (Gotterbarn, 2001).

1.2. Moral aspects through the codes of ethics

At this point, an implementation could be useful to reflect the need to do something more. This implementation is based on the eleven ethical factors presented in Chapter 1, section 3. It is the development of the model that we propose in order to know what the moral consideration within the professional world through the codes of ethics is. It is a way to find out what the valuable elements are, which are in some cases missed and what the reprehensible elements embedded within are. Additionally,

through these eleven ethical factors, it is possible to illustrate how the analysis of the set of questions with regard to the new changes and needs of the ICT context shows many of the key ethical points to consider within the new approach for the engineering professional world.

Therefore, due to the importance of the codes of ethics in the engineering profession (Lynch and Kline, 2000), and being aware of the need to frame the basic values, ethical principles and standards through them, it is very fitting to show how our eleven ethical factors are in accordance with the spirit of some of the main codes of engineering ethics. In the following section, three well-known codes of engineering ethics will be reviewed: Association for Computing Machinery (ACM), Institute of Electrical and Electronics Engineers (IEEE), and National Society of Professional Engineers (NSPE).

The relevant statements of these codes with regard to our proposal are the following:

ACM

1 Contribute to society and human well-being.

1.4 Be fair and take action not to discriminate.

2.1 Strive to achieve the highest quality, effectiveness and dignity in both the process and products of professional work.

2.7 Improve public understanding of computing and its consequences.

3.5 Articulate and support policies that protect the dignity of users and others affected by a computing system.

IEEE

1 To accept responsibility in making decisions consistent with the safety, health and welfare of the public, and to disclose promptly factors that might endanger the public or the environment.

5 To improve the understanding of technology, its appropriate application, and practical consequences.

8 To treat fairly all persons regardless of such factors as race, religion, gender, disability, age, or nation origin.

NSPE

I.1 Hold paramount the safety, health, and welfare of the public.

III.2.a Engineers are encouraged to participate in civic affairs [...]

III.2.b Engineers shall not complete, sign, or seal plans and/or specifications that are not in conformity with applicable engineering standards.

III.2.d Engineers are encouraged to adhere to the principles of sustainable development in order to protect the environment for future generations.

The following table summarizes the results of the comparisons:

	ACM	IEEE	NSPE
(1) Does it answer or help to answer an existing demand?	2.1	*	III.2.b
(2) Does it make understanding and cooperation easier among people trying to manage a problem?	*	*	*
(3) Does it point towards the characteristics and demands of its users? Is it flexible, easy to adapt to changes in its environment and to new requirements?	2.1	*	III.2.a
(4) Does it promote user's autonomy?	3.5	*	*
(5) In what ways does it increase the welfare of its users?	1	1	I.1
(6) Does it respect valuable social practices and universal human rights?	1.4	8	III.2.a
(7) Does it keep working under human control?	2.7	*	*
(8) Can it be integrated with other well-founded technologies? Is it easy to update and maintain?	2.1	*	III.2.b
(9) Is it constrained by heavy demand of resources when it is manufactured or used?	*	*	III.2.d
(10) What are the undesired effects on people or the environment?	2.1	5	III.2.d
(11) To what degree is it recyclable and/or reusable?	*	*	*

An asterisk means that there is no obvious correspondence between the ethical factor and the concerns shown in the professional code.

It is significant that two of the eleven ethical factors (numbers (2) and (11)) receive no support from any of the three ethical codes. Moreover, three of the factors (numbers (4), (7) and (9)) receive some support from just one of the codes. We consider that this does not reflect badly on the frame, quite the contrary. In addition, it shows an important characteristic of many professional codes. Both assertions are closely related and need to be justified.

To begin with, it is convenient to distribute these five ethical factors into two groups. The first group contains numbers (9) and (11), both of them pointing to environmental concerns. The second group contains the other three factors: numbers (2), (4) and (7). These are related to ~~let~~ us say—~~u~~ser advantage concerns. On the one hand, until recently, environmental concerns had not been introduced into professional codes. This was considered, and still is, to be a huge social and political problem that lies outside of the ethical professional context. However, as the NSPE code recognizes in III.2.d, there is also a clear responsibility in the work of engineers, both to the environment and to the future generations. Many professional decisions, practices, and attitudes have an influence on the problems of waste, squandering of resources, and pollution/contamination. We can notice that the codes of ethics defend and promote, overall, personal qualities; next, personal relationships and, finally, the relationship with the natural environment. Probably, in the near future, many professional codes will include this concern as being among the most relevant.

On the other hand, with regard to people, professional codes in engineering are directed towards the aim of not hurting anyone. Of course, this is a paramount concern, but is a negative one. It is also very important to think from a positive viewpoint, how to benefit people through the professional activity. This new commitment means that perhaps professional ethics deserves a still more serious consideration.

2. Global features of the field of ICT

More and more contemporary choices in technology raise ethical issues and, simultaneously, the enhancement of the quality of ethical decision-making seems to be a target that should not be missed. Then there is a need to permanently elaborate on and discuss emerging new problems and new issues in order to discern the ethical attitude and behavior necessary to adopt for the resolution of the new ethical dilemmas that ICT causes for society and, although the discipline has undergone significant change, such change has not been matched with a development in ethical thinking in the field (Gotterbarn, 2001). Thus intense ethical practice, new normative rules and policies, and a set of frameworks to understand the new emergent issues are required and it seems to be an interesting challenge for ICT professionals because ICT is in continuous state of innovation.

2.1. Towards a new generation of codes of ethics

Ethical responsiveness in the ICT environment demands a new range of abilities. A critical element in developing these abilities is the provision of mechanisms (i.e. codes of ethics, ethical problem solving heuristics, humanist readings and grounding in theoretical ethics) and tools (i.e. instruction methods as discussion, case studies, Socratic dialog, role-playing and working groups with divergent thinking) for practitioners who face ethical dilemmas in the course of their studies and also at their work as engineers. In our opinion, a response to the development of these abilities could be the introduction of codes of ethics but in combination with other approaches. So it is that, from one hand, a new generation of codes of ethics is required in order to guide engineers when making ethical decisions in an ever-changing professional realm. This updated version of the codes of ethics has to take into account the global issues (environment, econo-

my, markets, capitals, etc.) with reference to the new social ICT context. For this reason and in accordance with (Stohl, Stohl and Popova, 2009) the emphasis of the importance of communication using multiple channels to raise professionals' awareness and disseminate organizational values is required from a global point of view. This means, "A fundamental indicator of the impact of globalization on corporate values is its influence on specific and intentional organizational communication practices". In this light, the meaning of the codes of ethics spreads to taking into account global issues like the interdependencies associated with globalization dynamics such as environmental issues. Thus, "[...] organizations must accommodate to the complexities of operating within a multicultural communicative, legal, moral, and social context where boundaries between domestic and international organizing are progressively more blurred".

On the other hand, it is important to not forget to provide formal training in ethics in order to balance the natural tendency toward a homogeneous and uniform way of thinking among students and also professionals. Without this ethical training the abilities required within the engineering profession will focus on ever-smaller aspects of a single technological problem. Awareness of ethical behavior requires an open way of thinking, considering options and inputs beyond the technological realm of engineering. A shared and specific vernacular, in which ethical conflicts and solutions are couched, is needed, although this question is not our main goal here.

Therefore, to provide an accurate reading of organization's ethical climate, it could be useful to expand survey questions to include information about the ethical issues that concern the employees of an organization and include the stakeholders. For instance, the implementation of the set of ethical factors presented in the previous section 1.2 could be a way, for the professionals, to gather data on technological developments and their global affect on professional, societal and environmental issues. In that way the gap

between the theoretical concepts articulated in the organization's codes of ethics and the values that are at stake in the exercise of the profession in the real life could be smaller. At this point, education should be the key in shaping the organization's ethical culture pointing this awareness out to the future engineers in order to incorporate additional assumptions needed in the new generations of codes of ethics through a constant and reasoned deliberation.

It has been argued (Stohl, Stohl and Popova, 2009) that, at least inside the Western tradition, it is possible to identify three stages or generations (Chapter 4, section 2) in the historical evolution of ethics, rights, and corporate social responsibility (CSR). At this point our interest is focused on the third generations of ethics and CSR. These two issues, the third generation of ethics and CSR, are closely related with the new generation of codes and on a par with technological development, which is especially tied up with the new ICT. From this point of view we have to adapt to the current period of globalisation and the shape it is taking, in other words, we have to adapt to the requirements of new technologies. Therefore, from a professional perspective, the new generation of codes of ethics should be the tool to apply during the adaptation process. Within these new codes, the new demands of the new social paradigm are going to be reflected including greater consideration of global issues in order to provide the professionals with the means to manage the societal global complexities and challenges. From a social approach, the new generation of the codes of ethics and its implementation through the professionals could be the way to put a brake on the contribution to the development of the so called "risk society" (Beck, 1992). This is not an especially dangerous society but rather one in which we are far from being conscious of the effects of the technological systems we have introduced into contemporary societies. Thus, engineering's ethics has to take into account this characterization of society as an indispensable model when formulating its guiding principles.

2.2. Codes of ethics within Corporate Social Responsibility (CSR)

According to (Goujon and Dubreuil, 2001) within the present configuration of the world, where globalization seems to be a multifaceted phenomenon, a call for ethical reflection is required in order to be conscious of our choices as well as their consequences because "An action performed in one part of the world will have consequences far away in another part". Thus engineers have to face this phenomenon when carrying out their personal commitment materialized through the new codes of ethics and these, at the same time, should be an important part of the CSR. In this way, engineers who have special possibilities to influence the direction of technological development and, simultaneously, on social and environmental issues are in the position to confront the risk society.

First of all, to talk about CSR should not be to talk about behavioral corporate indicators published in a business magazine in order to present an irreproachable corporative image in a cosmetic way, but from (Cortina, 2009) the point of view that it should be to talk about the responsibility as part of the professionals' character, the professionals' habits. In others words, a set of predispositions that the professional builds, day in day out, through choices, in order to shape a good professional character. Indeed, keeping in mind the question under study, developing the character is an important enough investment that organizations and institutions should carry it out independently on their professionals. As regards the professionals' activity as engineers, they find themselves involved not only in a set of concrete values, but in the ethos of the organization in its entirety, because their activity is developed, principally, within the framework of institutions of managerial nature. For this reason professional ethics should deal with CSR as unavoidable context.

CSR generally refers to three fields of organizational responsibility which are based on ethical values, respect for the society

and protection for the environment. Thus, beyond making profits, companies are responsible for the totality of their impact on people and the planet. However, the ethical dimension and the moral values associated with CSR have still not been completely developed within the present business world. In accordance with (Arrieta and de la Cruz, 2005) this is an essential and necessary element for CSR to analyze and to explore because the existence of an intrinsic association between ethics and responsibility is clear. This means the social and collective dimension of responsibility has an inevitable moral constituent. There is no voluntary choice without responsibility (Aristotle) and attention to the consequences that emanate from the action and critical reflection on its causes and reasons are the pillars of this responsibility. From our view point, the application of this responsibility to the corporate world has its roots in the decision-making undergone when exercising, in our case, the engineering profession. CSR is a tool that complements the decision-making process of the professional sector.

With the intention of improving our understanding of the meaning of CSR it is necessary to determine the three features that configure its conceptualization (Arrieta and de la Cruz, 2005). These features are as follows:

- *The global nature of CSR*
  Its application affects all the elements that constitute the managerial policy such as: life-long learning; equal opportunities; sustainable development; protection of human rights and so on. All of these have to be managed by an organization that wants to be socially responsible. CSR has a transverse nature that pervades all managerial labor. Its practice involves a set of organized, reflected and proactive actions. Additionally, CSR is a social and political question, meaning that CSR is a demand that society makes of the corporation, so it is a demand that not only concerns the organization, but also an ever-changing society.

- *Social demand*
  Managerial actions bring about consequences within the social environment and these go beyond the internal limits of the corporation. For this reason a socially responsible organization should adopt the measures and mechanisms necessary to assume responsibility for its social impact and in the same way contribute to the social development of the communities in which the corporation operates. In other words, this responsibility entails the great opportunity for innovation, differentiation and legitimation that the corporations have.
- *The stakeholders model*
  Certainly, CSR appears as an important part of the ICT society where new needs and complex networks of relationships and mutual interdependencies between people, professionals, and institutions are made. Today in our interrelated world CSR lies not only in economic benefit, but also in the social impact of professional activity and in its contribution to and collaboration with social, cultural and environmental development. For this reason CSR requires a pluralistic approach, providing benefits to all the stakeholders. According to (Arrieta and de la Cruz, 2005) from this organizational framework of the stakeholders, the corporation has to include within a unitarian politics of management the demands and contributions from the different parties that interact with it. Additionally, the creation of value for all the interested parties is required to fulfill the social commitment of the company. Thus, if all the interested parties are a part of the corporation, the obtained profits will benefit all of them because the stakeholders, as an integral part of the corporation, are seen not only as means in the service of it, but also as participants in: innovation processes, new investment opportunities, confidence creation, managerial culture based on shared

values, decisions making, etc. Finally, the fact that the corporation and stakeholders have a common project means that the corporate government shares its goals and consults with the concerned parties and carries out its actions with independence, honesty and transparency.

As a final remark, when engaged with CSR, a minimum regulation of professional activity is necessary through an inter-subjective frame to configure a moral patrimony integrated within the culture of the corporation (Bilbao, Fuertes and Guibert, 2006). Moral regulation will be expressed by means of the deontological or ethical codes typical of the professional collectives that belong to a corporation; the organizational council, the ethics committee, the ethical awareness of the employees through courses, etc. In short, any corporate responsibility (financial, political, legal, ethical, technological, cultural and environmental) is a social one and, consequently, the organization has to take into account all its main figures, in this case, the stakeholders. Accordingly (Kaptein and Schwartz, 2008): "A business code is a distinct and formal document containing a set of prescriptions developed by and for a company to guide present and future behavior on multiple issues of at least its managers and employees toward one another, the company, external stakeholders and/or society in general". This means, codes of ethics should have a considerable impact within the organization if they are sufficiently familiar to the whole of their members (internal and external) and the way to strengthen their role it is through CSR.

2.3. The risk society: the context of CSR

The impact of the engineer's acts stresses the fact that engineering can involve significant risk for the collective wellbeing or for the health and safety of people and for the environment. So the exercise of the engineering profession involves understand-

ing "[…] the ethical dimension of his technical actions; based on the 'anticipation' of the foreseeable consequences of his actions" (Goujon and Dubreuil, 2001). In this sense, engineers are responsible for providing the technical information concerning the risks and dangers that a process, product or system can have for society. In this light, this social context is the place where the engineering profession is developed and exerts influence and, simultaneously, is modified by the new needs of the society. For this reason, the professional ethics that we pursue is obliged to acknowledge the features of this context (the risk society) in order to know how it should work, taking into account the harmful and devastating effects on the society, when formulating its guiding criterion. One current way to characterize the global society which is, narrowly, related with technology is through the "risk society" (Beck, 1992). This is the present social reality and one of the most typical features of it is the risk.

In accordance with Beck, the risk is a situation in which we are in a constant relationship with threats and dangers that are brought about by the very process of modernization of the society we are living in. At present we are interested in the ways that this risk comes out within the society. On one hand, we have damage to the planet such as the pollution and the contamination, and endangered species. On the other hand, we have the prediction and control of the future consequences of human actions and the diverse undesirable consequences of radicalized modernity. Paradoxically, owing to the unexpected effects of this modernity the dimension of the future is not under control and at this point technological development has an special leading role, meaning, technology has created its advantages and, at the same time, its own risks to the detriment of the safety of society.

In this line we find out an outstanding figure, Jacques Ellul. From what he says in his work *Le Bluff technologique* (1988) the effects of technical progress on contemporary society are unfore-

seeable. This work is focused on the question of prediction of technical progress and he distinguished between: the lack of foresight, the relative unforeseeable and the absolute unforeseeable. From the view point of the risk, the matter under study, the relative unforeseeable is the base for the development of risk management. The relative unforeseeable is "The result of an event from which it is not possible, reasonably, to anticipate, as much the existence as the date". In other words, there is an uncertainty embedded within the technical progress and there are two paths to take in order to face it: to be always lying in wait with expensive measures (economical, politics, human resources, etc.), or living with the possibility of accident and disorder, accepting that the probability of its occurring is small or that the consequences will be minor. The risk society has to confront this technological uncertainty because techno-scientific development evolves so fast, beyond the predictions of the experts and professionals.

From this last point and according with (Bilbao, Fuertes and Guibert, 2006) the role of the professional of the technology, in our case, the engineer, should incorporate in his professional profile the virtue of *prudence*, practical wisdom when making decisions in the workplace. Through prudence, as a way to achieve the welfare of humankind, the professional is able to anticipate, weigh up and assume the consequences of the actions raised in its deliberation process. In other words, the management of risk within the engineering profession has its own requirements and one of these should be to have the appropriate prudence when the deliberation concerns precisely these important decisions for which the result is not clear and is even indeterminate (Aristotle). Additionally, because risk is a part of the exercise of the engineering profession and, consequently, of societal cohabitation, it is necessary to exert an effective control on the decisions made, at least from the self-control of the professional community through, for instance, deontological codes.

So, engineers, as decisions makers, are responsible for the consequences derived from their actions because responsibility always has a direct relationship with the effects produced by actions. Therefore, the engineer, as a member of a community of professionals that belongs to a corporation has his own responsibility and consequently it is legitimate to look to CSR for the whole of these actions and responsibilities versus society. One starting point for the implementation of these professional responsibilities (actions) to benefit the social reality and contribute to its development should be CSR through its deontological codes in order to confront the technological disorders caused in the different spheres (social, environmental, politics, etc.) of the risk society. These disorders have major consequences for people and the natural environment, and they therefore involve ethics, at present, a global ethic.

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SECOND PART

THE ESSENTIAL PREMISE

CHAPTER 3

The background to the research work

In this chapter the literature in the field is surveyed in order to understand where such research has led us thus far and what this might mean with respect to the research goals pursued in this work. It is organized in terms of key figures (philosophers, historians, engineers, physicist, humanists, etc.) and the disciplines associated with them, through which we frame our study. Also, several organizations and associations are mentioned in order to know how their influences through ethical codes, rules, policies, practices, syllabus, etc. have determined the character of the engineering profession from the professional approach and the educational one.

Additionally, we want to enhance the importance that the ethical issues are acquiring within the technical syllabus of engineering schools. To carry out this goal a catalogue of universities together with their technical degrees and the corresponding subjects which are related to the teaching of ethics are presented. In this way we will show the present tendency for this kind of content in the educational institutions. The list is composed of national, European and American virtual and face to face universities. We think that from the teaching position we should make an issue of

this because, as in all professional education, preparation for the broader responsibilities (i.e.: social and environmental) that engineering activity involves is an essential part of preparing students to function as effective and responsible engineers.

Finally, a set of personal interviews with some managers of local corporations and some representatives of professional associations are presented. Finally, an opinion poll is presented and carried out through a questionnaire in order to find out, in broad brushstrokes, the perception of the different ethical experiences from a managerial point of view and from the engineers' associations in contrast with the ethical goals that the academic part pursues. The main goal of these consultations is to test whether the ethical aspects within the organisations' culture are deep-rooted and corporately accepted. The conclusion of this test is able to suggest to us that some kind of action from the academic world is required to achieve the desired objectives. The final results confirm that an effort to raise corporations' awareness about the presence of the ethical issues, as an important part of the corporative culture, is required.

The contents of this chapter are based on the paper: M. Serra, and J.M. Basart, "A Dialogical Approach when Learning Engineering Ethics in a Virtual Education Frame", The "Backwards, forwards and sideways" changes of ICT, Proceedings of the Ethicomp 2010, Universitat Rovira i Virgili, Tarragona (Catalonia).

1. Key figures and frameworks

In this section a set of distinguished figures (humanists, historians, philosophers, physics, engineers, mathematicians, etc.) and some aspects of their disciplines or lines of thought will be expounded in order to offer reliability to the foundations of the work and will be applied throughout all the current study. By

means of these key figures' ideas we will establish criterion and an approach for the subject under study for a more comprehensive analysis of ethical issues in the engineering field, simultaneously, methodological aspects will be supported. Certainly, this list of thinkers is expanded in the course of the whole research work and more very well-known authors are added and referenced in order to develop, formally, all the concepts, ideas and argumentations required in this study.

1.1. Carl Mitcham

He is closely bound to the American school of cultural critics. For this reason, Mitcham introduces himself in the humanist tradition interested in the analysis of diverse aspects of technology (epistemological, philosophical, ethical, etc.). He pays attention to the possible impacts of technology on society and the need to assess and control techno-scientific development. Mitcham has created a philosophy of technology that claims the presence of the humanities in order to recover the human and social values, in the face of the dehumanization, very often, caused by technological development.

This "making more human" of technology inevitably develops through the raising of the professionals' awareness of its consequences when they developing, applying and using it. According to (Mitcham, 1994), it is necessary to provide our future engineers with the sensitivity towards the person, in other words, the value of the person as an unique and unrepeatable individual. In this sense, the common denominator of engineering activity, from any perspective, is the person. From one hand, engineering is developed through professional teams of people. On the other hand, because the professional activity of the engineer is not just limited to his relationship with a customer or user, but it has very significant social repercussions such as economic, political, and environmental and so on. This social link lies in the idea of plac-

ing technology in the service of mankind and not the other way round. This means it is not just a question of creating needs from what technology offers to us, but using the available technology to solve the difficulties and the great needs that our society suffers.

The book "Thinking through Technology. The path between Engineering and Philosophy" is one of his ambitious works, where Mitcham starts a critical analysis of technology from two differentiated perspectives: the engineering approach, which assumes the centrality role of technology in human life, and the humanities approach, which is concerned with its moral and cultural boundaries. These two traditions are bridged by the ethical issues that emerge from the relationship between technology and society, a fact of central importance in our study.

Mitcham looks at technology as it is experienced in everyday life and the idea that human beings acquire throughout their lives an awareness of the existing relationship between technology and society. In this line, it is very important for us to understand the meaning of the technology with regard to: its goals as a material object (from kitchenware to computers), its methods and knowledge (theories, rules, intuitive "know-how", etc.), its activity (design, construction, etc.), its relationships with other areas of human activity (ethics, science, art, etc.) and its use and consequences. By means of these multiple aspects, the ethical factors applied to the technology are more understandable. For instance, a set of ethical factors presented in the Chapter 1, section 3 follows this way. They help us to contextualize, from a different point of view, our way of life in regard to our close relationship with technology.

1.2. Ian Barbour

Ian Barbour, American theologian and scientist, defends a technological contextualist position towards technology. This

refers to those who hold the position that technology is neither inherently good nor evil but rather an ambiguous instrument of social power whose consequences depend on its social context. He believes that as social constructions, technologies are seldom, if ever neutral because particular values and purposes, as well as social goals and institutional interests, are already embedded in their design. In accordance with (Barbour, 1993) there are choices with regards to how the technologies are designed as well as deployed, meaning that the various choices available to designers and users should be explored and scrutinized.

The contextualism promoted by Barbour allows for a two-way interaction between technology and society as we say on numerous occasions throughout of this research work. It does not perceive technology only as an actor upon culture, nor does it single out for scrutiny the cultural forces acting upon technology. Barbour also contends that contextualists give prominence to questions of social justice when evaluating technology because they interpret it as both a product and an instrument of social power.

Transferring contextualism to our study when investigating the attitudes toward technology, it is clear to us that we should reject notions that posit the interaction between humans and technology as merely "use," as opposed to a mutually constituting relationship. We are most interested in how humans negotiate their relationship with technology in their everyday lives and in an everyday context. This is not to say that technology has not altered our notions of the self or of subjectivity. It has, and in significant ways. However, we do not believe that the use of any particular technology guarantees or predetermines any particular use or outcome. Therefore, we are interested in empirical research that is supported by technological contextualism, particularly as it pertains to education and, concretely, technical degrees.

Consequently, what we are saying here it is that the contextualism tries to establish, as a new point of reference of the ethics, the

system of values of a collectivity within a specific environment, never abstract. The engineer as individual belongs to a concrete professional community and as a professional of this community she should know how to cohabit with this contextual determining factor. For this reason, a moral sensitivity should exist among the future professionals of the engineering when facing moral dilemmas in their daily professional task.

1.3. John Dewey

John Dewey was the most important North American philosopher and educator of the first half of the XX century. The common theme underlying Dewey's philosophy was his belief that a democratic society of informed and engaged inquirers was the best means of promoting human interests.

Dewey conceived democracy as an active process of social planning and collective action in all spheres of common life. Democracy is also a source of moral values that may guide the establishment and evolution of social institutions that promote human flourishing. However, unlike other moral frameworks (e.g., religious traditions or political ideologies) democracy as a way of life is neither absolutist nor relativistic, because its norms and procedures are fallible and experimental. It is a consciously collaborative process in which individuals consult with each other to identify and address their common problems. From Dewey, within a fully democratic society, people would treat each other with respect and would demonstrate a willingness to revise their views while maintaining a commitment to cooperative action and experimental inquiry (Dewey, 1938).

Dewey sees experience as physical action and the consequences of that action combined with the judgment of these consequences. He rejects the dualism that often emerges between the actions that a person takes and the way that this person thinks about these actions. In his view, actions and consequences can-

not be separated; there is no way of thinking about things outside of the actual action and actual concrete situation in which an individual is engaged. For him the meaning of things is established through the consequences, based on judgments a posteriori and avoiding prejudgments which represent a kind of intolerance towards a person, group, attitude, habit or belief and which limit our willingness to a social understanding. Thus, this consistency is a very eloquent value to take into account when engineers analyze cases and make decisions about ethical dilemmas, constrained by the circumstances of a situation, because it reflects the capacity of the real compatibility between what we say and what we do as individual. For this reason, the learning process of ethical issues is possible if we keep in mind this consistency in order to assess, in an appropriate way, the acquisition of them.

Additionally, according to Dewey, in a social democratic environment self-interest should not be opposed to social interests because there is neither a community without people nor a person outside society. On one hand, to act with consistency provides sense (meaning) to one's life. This sense is most valuable because it does not become established by something external to the individual, it comes from inside oneself. On the other hand, consistency is an essential quality in any one demanding trust and, in our case, the engineering profession has a duty to the people through this confidence.

As a final remark, Dewey attempted to show the important links between education and politics. Dewy believed that an active learning would help people to develop the ability and motivation to think critically (Dewey, 1933) about the world around them. Dewey also argued that the development of critical thought would also help to protect society from the dangers of dictatorship, but in the analogy of the current technological development and its societal repercussions, this critical thinking should help engineers to confront the risk society mentioned in the Chapter 2, section 2. Dewey outlined his views on how edu-

cation could improve society, arguing that the task of education is to encourage individuals to develop their full potential as human beings. In this way students would not just gain knowledge, but would also develop skills, habits and attitudes necessary for them to solve a wide variety of problems. This is an outstanding fact for our students when making decisions in the daily exercise of the engineering profession. As educators, we have the responsibility to promote critical thinking among our students when facing moral dilemmas in their everyday professional life to the benefit of social interests.

1.4. Joseph Weizenbaum

Joseph Weizenbaum was professor emeritus of computer science at Massachusetts Institute of Technology and a known proponent of scientific and educative responsibility. From what he says, developing our ability for thinking and reflecting on ourselves and on the environment that surround us, is a goal that cannot be evaded at school.

From Weizenbaum's point of view, a high percentage of parents and teachers still think that computing is the essential element of the teaching of students, with no understanding that, very often, the use of the computers is a merely operative activity, where reasoning is not always committed. So, for him, reverting to thinking is, narrowly, related to the return to reading. Reading allows the students to increase their imaginative ability, enriching their vocabulary and improving their thinking, while simultaneously improving their oral and written expression.

In accordance with (Weizenbaum, 1972), it is necessary to know where to place computers within the learning process and what their use should be. For him and for us as educators, a commitment to promoting a liking for reading among students and to discovering new ways to push them into contact with the texts should be a priority. Reading is an eminently intellectual

activity that improves the dominion of the language and as a communication tool allows to the human being to establish social relationships and be able to access to different cultural values. So the appropriate use of language here appears as not only a technical question, but an ethical one, too. This meaning of the use of language is very important for us and it is presented throughout the whole current study because it will be an essential pedagogical tool to take into account in regards to communication when ethical issues are addressed.

1.5. Stephen Toulmin

Stephen Toulmin is an influential educator, philosopher and mathematician. He has conducted wide-ranging inquiries into ethics, science and moral reasoning. Toulmin's study is focused on the meaning of arguments and the importance that argumentative competences (knowledge, skills, attitudes and necessary values to argue) have not only in the teaching field, but also in the social and political fields. Thanks to these competences the human being is able to solve conflicts and make decisions about disciplinary, theoretical and practical issues, and everyday life in an individual or collective way.

Argumentative competences are required within the engineer profile in order to know what is relevant to specific decision-making and the ways to communicate those decisions, what to attend to in a stressful and conflictive context and when to make exceptions to general rules depending on circumstances. Having good communicative skills and the ability to articulate decisions through strong arguments promotes professionals who are well adapted to making decisions under adverse conditions (time pressure, lack of information and budget, technical and social constraints, conflict of interests, etc.) helping them to handle the inherent moral dilemmas. Indeed, engineers have to argue not only to settle the differences of opinions that arise in the daily

workplace with other professionals, but likewise to reach agreements with them, for instance, when the professionals want to undertake or to avoid the achievement of certain actions.

The Toulmin model has two dimensions. The first dimension is based on propositions that configure a pattern from which one can elaborate reasoning, namely, the assertion or data, the warrant, the backing, the rebuttal and qualifier. With this set of propositions Toulmin intends to reflect the practical use of reasoning in contrast to the existing distance between the formal logic and the practical one. It is a set of propositions that one justify the truth of other. The second dimension gives rise to reasoning, strictly speaking, this means, a set of linguistic and non linguistic acts that allow us to modify the beliefs, the attitudes, the values and even the conduct of a person. In the face of these two dimensions the second is the coherent alternative with disciplinary and everyday life reasoning. Because of this, a dialogical point of view (Toulmin, Rieke and Janik, 1984) is required in order to construct a set of outlines that can be useful to write argumentative texts or also to participate in argumentative dialogues. In this case, he emphasizes the dialogical elements which will allow engineers to persuade, to convince or to reach agreement.

Thus it is advisable when managing communication skills that the use of language strategies be focused on specific language choices because some will be "better" than others depending on the scenario (formal, scientific, colloquial, etc.). In accordance with him, "word choice influences meaning", for this reason some language strategies that we consider appropriate to achieve our pedagogical goals have to be implemented in order to develop communication competences in ethics within the new technological surroundings.

Finally, to cite another feature of Toulmin's model, the rhetoric interpretation of the model. Toulmin not only presupposes the existence of an interlocutor (dialogical approach), but also he takes into account the possible beliefs, attitudes and values of

this such as: the grounds, the warranties and the backings to be provided in reasoning. All of them will depend on the interlocutor, the person to be persuaded or to be convinced. What we are saying is that it is necessary to include the argumentative field or forum where reasoning is being carried out.

In sum, Toulmin's model strives to take into account the particular and changing circumstances in which an argument is produced and used, a typical feature to emphasize when engineers are facing a moral dilemma.

1.6. Teun A. Van Dijk

Teun Adrianus Van Dijk is a well-known linguist and educator. His researcher career is focused on the linguistic field and Critical Discourse Analysis (CDA).

CDA is focused on the manner in which the abuse of social power, control and inequality are practiced, reproduced and occasionally combated by the texts and speech within the social and political context. The main goal of CDA is to contribute, in an effective way, to the resistance against the social inequality. The experts or analysts of CDA aspire to promote and produce acknowledgment and opinions and to commit to professional practices that which can be useful within the social and political change. So in the real world of social problems the appropriate research should be multidisciplinary. The use of language, speech and communication among the people has intrinsically cognitive, emotional, socials, politics, cultural and historical dimensions. Arriving at this point, it is legitimate to talk about the important role of discourse within the social order.

For these summarized reasons, the analysis of the discourse necessarily incorporates a study of the language used, the beliefs and values communicated and the existing interaction within situations of a social nature. It is focused on how social relationships, identity, knowledge and power are built through written

and spoken texts within communities, schools and classrooms. Therefore it is necessary to establish relationships between the teachers' and students' discourse acknowledging CDA within the basis of our work. To achieve the study of the discourse's content not only is it necessary to know what to say, but also how to say it and why we say it. If we know the communication processes better and the way in which they flow, we are going to be able to transmit certain kind of contents expanding the opportunities and the improvements of the learning process.

1.7. Hubert L. Dreyfus

Hubert Dreyfus is a famous humanist and professor of philosophy. To begin with, we will take one of his later works, "On the internet" (Dreyfus, 2001). In this work he makes a persistent and decided demand of the body and reflects on the consequences of the disappearance of it and the sensory relationship among people within the Net, a fact that directly influences the learning process. He examines the lack of embodied presence brought about by the advent of the World Wide Web. At present, anyone at any location and at any time can express their thoughts to others. The Internet has provided an unprecedented opportunity for people to communicate without actually being in the presence of other people. From his point of view this new context of communication has effects, both positive and the negative, in relation to this disembodied mode of operation in the world.

For Dreyfus the body is fundamental for the learning process as the body is the whole of the personal abilities such as interpersonal relationships and it is within these we discover a relevant place for language. A face to face environment encourages and motivates the students by means of self-expression through movement, a fact that is lost within the Net. Consequently, this lack of physical presence and sensory input means that distance education has a greater dependence on the context, at least, in the beginning of the

student's learning process. The sensory ability of our body and a person's disposition is what makes the involvement within society, fitting into a community, possible. Having arrived at this point, if we achieve a parallelism with the learning process to get a certain type of contents (for example, awakening sensitivities as in our question under study), we will see that they are closely linked with interpersonal relationships and, therefore, the subjective connotations constantly present. This fact obliges us to look for methods and mechanisms that give us support and help us throughout this process to get an appropriate and useful apprenticeship.

As Dreyfus says, accurately, in his thesis's statement: "In sum, as long as we continue to affirm our bodies, the Net can be useful to us in spite of its tendency to offer the worst of a series of asymmetric trade-offs: economy over efficacy in education, the virtual over the real in our relation to things and people, and anonymity over commitment in our lives". In other words, use the Web carefully, but don't let it become your reality. Certainly Dreyfus' book is reminder that chats, blogs, social networks, forums, and the endless possibilities of the Web are not reality, though they can be tools to help us as we live in reality.

1.8. Socrates

A Socratic dialogue is an exchange of thoughts with the goal of finding an answer to a particular question. According to it, the central feature is Socrates' way of asking questions (question matters, provoke participants, search for tensions and conflicts between the stakeholders opinions, and so on), frequently referred to beliefs, where sustained cross-examination and the use of counter-examples reveal contradictions that would otherwise go unrecognised. Socratic dialogue is characterised by an incessant inquiry to seek the truth. Thus, Socratic dialogue is a mechanism for identifying incoherence and inconsistency in our own and others' sets of beliefs.

From a Socratic point of view the conversation is meant to be a dialogue, rather than a formal debate or informal discussion. The participants try to understand each other and engage in a common enterprise. This does not necessarily mean that participants have to find a consensus on the answer to the question in order to have a successful dialogue. An awareness of the complexity of the investigation is often much more satisfactory than a constructed consensus. The attempt to think carefully, deliberately and in depth distinguishes itself from other forms of conversation like debates or brainstorming sessions. In sum, in this method, participants try to investigate in a more or less structured way the truth and the value of their opinions in attempting to respond to a self-chosen question. In engaging thoroughly in the investigation with a suitable question (the dialogue's focus), sooner or later one can experience and investigate the very subject one is talking about through her own behaviour in the here and now, or even an experience undergone in the past of one or more of the participants. When participants engage in Socratic dialogue more than once, the urge to defend own judgements is replaced slowly by an attitude of constructive doubt and constant investigation.

The evidence of our understanding is to be found in our actions because according to Socratic dialogue, true understanding leads to correct behaviour. For this reason, engineering students, having finished their degree and while studying for it, are responsible for defining their professional goals, taking into account the interests of their colleagues and appropriate ethical action. At that point, they need to explore, for example, the boundaries of their responsibilities and what it implies for the development of personal and professional skills related to all of the ethical questions raised; questions concerning integrity, responsibility, flexibility, success, motivation, effectiveness, mutuality, leadership, empowerment, openness, autonomy etc. In this way, students are encouraged to take responsibility for their own thinking and at the same time stimulated to think together,

with their colleagues. The Socratic dialogue constitutes an ethical practice searching for fair actions in order to consider ethical issues in accordance with the way one thinks and lives.

1.9. David Bohm

David Bohm was an eminent physicist and thinker of our times. From this key figure we are most interested in the way that he understands the dialogue.

Modern technology has woven a vast network of communication that connects all the people of the world. However, now more than ever there is a general feeling that genuine communication has been broken. In his opinion, dialogue constitutes a multifaceted exercise that goes beyond the typical notions of chat or exchange of communication. The Bohm's dialogue (Bohm, 2001) explores a wide spectrum of the human experience, from the perception of values to the emotional factors, from the guidelines of logical thought to the functions of the memory. It also involves the way in which our neuro- physiological structures organize the experience. Even though, above all, dialogue explores the manner in which thought is generated and sustained collectively. In this sense, the dialogue constitutes an invitation to determine the validity of the traditional definitions about the human being and to investigate collectively the possibilities of the development of humankind.

Our interest is focused on the meaning of Bohm's dialogue, especially with regard to the way that sensitivity to similarities and differences affects scientific and artistic work and communication in everyday life. Both Bohm and we are interested in listening, a part of the process of dialogue which is very often misunderstood. The comprehension of this point is essential to understand the steam of meaning in a dialogue.

Through this discursive method ethics students are invited to develop new, shared ways of seeing and acting. Therefore,

dialogue plays an important role in helping students to feel the essential empathy involved in a conversation on values, norms and virtues in order to make "good" choices in solving cases that arise in their daily personal and professional development.

1.10. Jürgen Habermas

Jürgen Habermas is a well-known philosopher and sociologist. According to him, the nature of language as a means of communication is that the listener and the speaker must have a common interest, a priori, to achieve a mutual understanding (Habermas, 1997). This understanding means that participants in a conversation reach an agreement or consensus because there is a predisposition for real understanding on both sides. This agreement is the central value of Habermas' theory: the "inter-subjectivity agreement" (rational, negotiated assent, responsible individuals). Inter-subjectivity invokes the German hermeneutic tradition which Habermas sees not only as a set of rules for interpreting difficult texts (its historical origin), but also as an alternative for understanding human behavior and society (Habermas, 1984).

Habermas recognizes that people may reach an agreement or consensus satisfying to themselves, but that others would judge as non valid. This consensus must be supported by rational argumentation, open to the questioning of assumptions, addressed by speakers free from inequality, coercion, and domination. This raises the possibility that people need not choose at all between the value of consensus and that of diversity, between the need to harmonize their actions through dialogue aimed at consensus and the value of dissenting voices.

1.11. Hans-Georg Gadamer

Hans-Georg Gadamer was an important humanist and educator and he was the founder of the Hermeneutics school. From

Gadamer's hermeneutic perspective, all individuals belong to a society and therefore are immersed within the tradition of this societal context (Gadamer, 1988). This tradition configures in the individual a set of prejudgments that allow him to understand within his contextual and historical moment. Thus the individual has his historical reality present in his prejudgments.

Additionally, for Gadamer the reading of a text means going to meet another individual and this encounter should be a moment of beginning a dialogue where the "I" and the "other" enter into a relationship. From his view point the interpretation of historical texts includes a thorough incorporation of one's own pre-existing opinions and preconceptions.

From this position, a dialogue belongs to the interlocutors and makes a comprehension of meaning possible which we must clear up. According to Gadamer, dialogue results in learning processes. This means that one learns to address the situation in a different way, and to find solutions which one did not have in mind before. One does not learn by taking things over mechanically, but by investigating the validity and meaning of the other's perspective. Hermeneutics starts from the idea that human life is a process of interpretation. Human actions are not caused by the environment; they embody a specific understanding of the situation. One sees the situation from a certain perspective, which is the result of both prior experiences and current perspectives. From a hermeneutic view point, perspectives of a situation at hand are not rigid and closed. They can change through dialogue.

As we have said, the meaning of a dialogue emerges from the interactions between people involved in real problems and their willingness to engage. According to Gadamer, through non-adversarial dialogue it is possible to get the ability to create meaning, but there is never the possibility of arriving at a final, conclusive meaning. Therefore, meaning is always temporal, situational, progressive and shared through interactions, and open to interpretation and reinterpretation. Meaning, to Gadamer, is not static.

1.12. Jacques Ellul

Jacques Ellul was a philosopher, sociologist, theologian and law professor. His constant concern was the emergence of a "technological tyranny" over the humanity. Ellul advanced the most consistent critical analyses of the role of technology in transforming society. We are interested in this technological influence over the human being and its side's effects.

Going by what Ellul says, technology transforms economics, the "State" and the man. On one hand, technology possess the feature of autonomy meaning that modern technology is not determined by the values and ends established by human beings, but guides itself and it makes its own law. It escapes human control because it has its own impulse and ways of shaping human activity. For him modern technology is an unstoppable power that determines and crushes man, pushing him into its service and in many cases replacing him.

On the other hand, modern technology implies a certain number of unforeseen effects. Innovation in methods, in machines and in organizations has desirable, foreseeable and unforeseeable consequences. These latter are very often irreversible. The problem of the unforeseeable effects increases if we think about the rapid implementation of scientific and technological advances when solving problems when under the pressure of economic interests.

Ellul's thought (Florensa, 2010) is useful to raise our future students' awareness of the controversial connotations and involvements in the exercise of the engineering profession because technology exerts its own, very often disconcerting, influence not only over all of us, but also over the technologists. It is essential to remind our students that in the face of technological development we are all of us different and some more adjusted to it than others. Moreover, a great part of our cultural identity disappears since traditional practices are missed with the forced transfer of

technology. Therefore, it is necessary to incorporate the ethical reflection on technology into the training of our future engineers in order to understand the world in which they are living and the meaning of their eminent social profession within this world. This ethical introduction to technology should be made in a global manner because technology is a system and it spreads its tentacles to all human spheres. Within this framework Ellul's thinking is an idea to bear in mind when training ethical issues of technology.

Additionally, we should emphasize a particular position of Ellul with regard to his argument about the "ethics of non-power", which calls for a voluntary limitation of technological power. His ethical proposal starts to bring up the limitation of the power of modern technology. This means the human has to accept that he can't do all he wants to do through technology, because technology is the origin of a set of serious problems that humanity currently has to confront. As educators we have the responsibility to show our future engineers the way to correlate our power to act and our ability to judge. Our students have to be able to decide when to do something and when not to do it on the basis of the consequences of their actions.

1.13. Hans Jonas

Hans Jonas was an illustrious philosopher. His work was focused on the ethical and social issues created by technology. Jonas insists that human survival depends on our efforts to take care of our planet and its future. He formulates a new supreme moral principle: "Acting in such a way as the effects of your act are compatibles with the permanence of a genuine human life". To begin with, in his book on ethics of technology (Jonas, 1995), the philosopher states:

"Modern technology, informed by an ever deeper penetration of nature and propelled by the forces of market and politics,

has enhanced human power beyond anything known or even dreamed of before. It is a power over matter, over life on earth, and over man himself; and it keeps growing at an accelerating pace. Its unfettered exercise for about two centuries has raised the material estate of its wielders and main beneficiaries, the industrial 'West,' to heights equally unknown in the history of mankind. But lately, the other side of the triumphal advance has begun to show its face, disturbing the euphoria of success with threats that are as novel as its welcomed fruits, the peaceful and constructive use of worldwide technological power, a use in which all of us are collaborators as captive beneficiaries through rising production, consumption and sheer population growth - that poses threats much harder to counter. The net total of these threats is the overtaxing of nature, environmental and (perhaps) human as well. Thresholds may be reached in one direction or another, points of no return, where processes initiated by us will run away from us on their own momentum and toward disaster."

Technology often begins with a near-term and often short-sighted response to human needs. And, while it addresses the immediate needs, it often causes long-term consequences that are deleterious, for instance, this is most evident in the state of the natural environment and in the rise of human chronic diseases. So it becomes necessary to predict and avoid the consequences by wiser design and use of technology through the mobilization of the social and environmental conscience.

The huge development of technology is not only very beneficial for human life quality, but it is also full of uncertainty. We don't know with accuracy what the potential side effects of its massive implementation could be. Thus today we have the obligation of care in order to ensure that technology doesn't harm the natural environment, the physical means where life is possible, in an irrecoverable way. So the conservation of nature is only feasible through the rational use of natural resources and, consequently, through strict controls of the use and development

of technology. In this sense, we are talking about man's responsibility with regard to nature conservation.

This responsibility for nature is present in Jonas's "principle of responsibility". In this work Jonas formulates an ethics for the future and he presents a particular moral imperative. This imperative establishes as an essential duty a collective behavior of the humankind for man's future that claims an ethical order distinguished by calm, prudence and equilibrium and, at the same time, there is a duty for the future of nature, the environment where human existence is possible. That is why the human subject has to assume responsibility in order to protect and safeguard this.

Therefore, the professional practice of engineering has to demand this responsibility related to the technological power that man has achieved because it puts the continuation or the abolition of human life in our hands and, in general, that of all the living creatures on our planet. Such responsibility, in return for the freedom and power that we have now, has to be based on *prudence*, a desirable typical feature of the engineer's profile mentioned in Chapter 2, section 2. In this sense, as professionals we should take the commitment to refrain from actions than can threaten the maintenance of human life for the next generations.

Finally and in the same line of the preceding figure, Jacques Ellul, Jonas proposes the practice of a "heuristics of fear" that would always consider the worst-case scenarios before undertaking any technological project. These kinds of reflections and practices are necessary among the future professionals in order to develop a criterion to discern whether to refuse to start the development of any modern technology.

1.14. Aristotle

Virtue ethics, stemming largely from the Nicomachean Ethics of Aristotle, has been enjoying a revival in ethics discourse in the past few years (Grodzinsky, 1999; Aiken and Epstein, 2000;

Moriarty, 2001). Though increasingly relevant to contemporary engineering practice, virtue ethics provides an essential measure for gauging the character of the traditional engineer.

Aristotle believed that the purpose of human existence is to achieve a state of "eudaemonia". Eudaemonia is a difficult word to translate. One way to translate it is "happiness" but this is too superficial. We think that a closer approximation could be "flourishing" or leading a worthwhile life. This means a person flourishes and leads a good life when she fulfills the purpose of human beings. In order to flourish, to be eudaemon, a person will possess virtues and exercise them with practical wisdom (rationality) in order to make good choices in acting well. The virtues will become integral to her character and so become part of her flourishing, not just a means to an end. So the virtues benefit the possessor as they become so deeply entrenched in a person's character that she deeply desires to be better.

We want to emphasize that the character is developed over a long period of time and requires the practice of the virtues. Aristotle describes virtue as a practice or habit, something that is learned through doing.

So, from our view point, virtue ethics might suggest the practice of virtues to distinguish the engineer as a person of integrity. The habituation of virtuous action, done to learn virtue, enhances the good tendencies and discourages the negative ones within a person. It is a method for developing moral character that, as educators, we should show to our future engineers within the training process when they are learning to face the ethical issues of their profession. Through virtue ethics, the moral agent, the engineer, can reflect upon and choose the virtuous action knowingly and for its own sake. It is not enough to act justly by accident or because it is standard practice. The future engineers should learn to act justly because that is the right/virtuous way to improve themselves as professionals and because the concept of ethics demands an understanding of the society in which it oper-

ates and, simultaneously, in which the engineers act, too. Virtue operates to achieve the good internal to common social practices, one of the most important goals of the engineering profession.

2. Organisations and Associations

The engineering profession is directly associated with social improvement through technological means. This means that engineering brings about social wellbeing and the responsibility of the engineer lies in to knowing how to carry it out while taking into account the contextual constraints (social, environmental, financial and politics). This inherent social connotation of the engineering profession should be achieved within certain conditions such as: effectiveness, rigour, efficiency and ethical commitment. This ethical commitment is expressed in many ways throughout the development and the experience of the profession. For instance, when making decisions, what are the motivations to act in a certain way, anticipating the consequences of the acts and so on. For this reason, engineering students need to graduate with a complex set of skills and abilities, both technical and ethical, to be able to address issues of diverse nature when exercising their profession. These skills and abilities are the tangible knowledge gained from their education. In consequence, a set of organisations and associations are needed when framing an engineering program's educational objectives and defining its outcomes. Among the educational objectives our interest is centred on the ethical aspects of the engineering profession, a question that is present in all the well-known organisations and associations to which we refer in this section. Next, representative samples of them are highlighted in order to note their influence within the engineering professional world through their codes and rules. As we already know, the goal of a code is to engage the members of an association to work and behave according to the principles of

that association, but also to protect their own interests. So, the declarations achieved by these associations through their codes and statements clearly show what their scope is.

The representative sample is as follows:

- *Accreditation Board for Engineering and Technology (ABET)*:
  Provides world leadership in assuring quality and in stimulating innovation in applied science, computing, engineering, and technology education. Its mission is concerned mainly with the accreditation of educational programs and promoting quality and innovation in education, assisting in the development and advancement of education worldwide in a financially self-sustaining manner. Working for the changing environment and future needs and, finally, managing the operations and resources to enable them to be effective and fiscally responsible. In summary, a professional body dedicated to the education, accreditation, regulation and professional development of engineering professionals and students.
  "Viewpoints" is ABET's white paper series and explores issues such as ethics, international mobility of technical professionals, distance and continuing education, diversity in the technical professions, and dual-level accreditation. In the following link we find the document of the "viewpoint" where the ethical issues are treated in a deep way: http://www.abet.org/uploadedFiles/Publications/Special_Reports/Viewpoints_Vol1.pdf.
- *Conceiving-Designing-Implementing-Operating (CDIO)*:
  An innovative educational framework for producing the next generation of engineers. It is universally adaptable for all engineering schools and is being adopted by a growing number of engineering educational institutions around the world. CDIO is currently in use in aerospace, applied physics, electrical engineering and mechanical engineering

university departments. CDIO is based on the commonly shared premise that engineering graduates should be able to: Conceive-Design-Implement-Operate complex value-added engineering systems in a modern team-based engineering environment to create systems and products. The CDIO Initiative thus offers an education model stressing engineering fundamentals, set in the context of the Conceiving-Designing- Implementing-Operating process. The CDIO Initiative's goals are: to educate students to master a deeper working knowledge of the technical fundamentals; to educate engineers to lead in the creation and operation of new products and systems and to educate future researchers to understand the importance and strategic value of their work. The CDIO Initiative was specifically designed as a template that could be adapted and adopted by any university engineering school. Because CDIO is an open architecture model, it is available to all university engineering programs to adapt to their specific needs.

In Chapter 2 of the CDIO syllabus we find the section "Personal and professional skills and attributes" where the ethical issues are placed "2.5. PROFESSIONAL SKILLS AND ATTITUDES, 2.5.1. Professional Ethics, Integrity, Responsibility and Accountability". The CDIO syllabus is contained in the following link: http://www.cdio.org/files/project/file/cdio_syllabus_v2.pdf.

- *American Society of Civil Engineers (ASCE)*:

  Civil engineers are global leaders building a better quality of life. It provides essential values to members and partners, to advance civil engineering and serve the public good. Its main goals are: facilitating the advancement of technology to enhance quality, knowledge, competitiveness, sustainability, and environmental stewardship; encouraging and providing the tools for lifelong learning to aid the mem-

bers' continued growth throughout their careers; promoting professionalism and the profession throughout society to enhance the stature of civil engineers and to influence public policy; developing and supporting civil engineer leaders to broaden its members' perspectives, enhance their career growth, and promote the public interest; advocating infrastructure and environmental stewardship to protect the public health and safety, and improve the quality of life and serve the public good.

As an example, one of the basic tenets of the ASCE with regard to the social function of the engineering profession placed within its code of ethics http://www.asce.org/Leadership-and-Management/Ethics/Code-of-Ethics/ is as follows: "Engineers shall hold paramount the safety, health and welfare of the public and shall strive key comply with the principles of sustainable development in the performance of their professional duties."

- *Association for Computing Machinery (ACM)*:

  This is the world's largest educational and scientific computing society, and delivers resources that advance computing as a science and a profession. It provides the computing field's premier Digital Library and serves its members and the computing profession with leading-edge publications, conferences, and career resources on the local-to-global scale, providing unlimited opportunities for sharing technical expertise and first-hand knowledge of the latest development trends.

  Commitment to ethical professional conduct is expected of every member (voting members, associate members, and student members) of the ACM. The ACM code http://www.acm.org/about/code-of-ethics, consisting of a set of imperatives formulated as statements of personal responsibility, identifies the elements of such a commitment. It contains many, but not all, issues professionals

are likely to face. For this reason, the code is supplemented by a set of guidelines that are intended to serve as a basis for ethical decision making in the conduct of professional work. Secondarily, they may serve as a basis for judging the merit of a formal complaint pertaining to violation of professional ethical standards.

As we cited in the Chapter 1, in section 2, we find two paragraphs that contain the ethical issues that are pursued in this research work.

- *Institute of Electrical and Electronics Engineers (IEEE)*:
  This is the world's largest professional association dedicated to advancing technological innovation and excellence for the benefit of humanity. IEEE and its members inspire a global community through IEEE's highly cited publications, conferences, technology standards, and professional and educational activities. IEEE will be essential to the global technical community and to technical professionals everywhere and be universally recognized for the contributions of technology and of technical professionals in improving global conditions.
  The IEEE focuses on environmental, health, and safety implications of technology; engineering ethics and professional responsibility; the history of electro technology; technical expertise and public policy; peace technology; as well as on social issues related to energy, information technology and telecommunications. The ethical issues are present in the following document belonging to the code of ethics: http://www.ieee.org/about/corporate/governance/p7-8.html.
- *Tuning project*:
  The main aim and objective of this project is to contribute significantly to the elaboration of a framework of comparable and compatible qualifications in each of the (potential) signatory countries of the Bologna process, which

should be described in terms of workload, level, learning outcomes, competences and profile. The Tuning project has developed a methodology and a common language which can serve as a common basis, and will make it possible to develop an overarching European framework of qualifications. To strengthen and improve the foundation of the Tuning approach, main stakeholders, operating on an international market and in international organisations, are asked to reflect on its methodology of defining programmes of study, on the notions of social needs, available resources, professional and academic profiles and learning outcomes and competences.

According to Tuning, learning outcomes are expressed in terms of the level of competence to be obtained by the learner: "Competences represent a dynamic combination of cognitive and meta-cognitive skills, knowledge and understanding, interpersonal, intellectual and practical skills, and ethical values". Additionally, the Tuning project emphasizes the ethical commitment which is included within the "Interpersonal competences: individual abilities relating to the capacity to express one's own feelings, critical and self-critical abilities. Social skills relating to interpersonal skills and team-work and, the expression of social and ethical commitment. These tend to facilitate processes of social interaction and of co-operation". The Tuning General Brochure where the whole methodology and goals are contained is: http://www.unideusto.org/tuningeu/images/stories/documents/General_Brochure_final_version.pdf. The objective of the Tuning project with regard to ethics is to inform the students what the standards and the values of the subject area are. However, as the Tuning project points out "It is more complicated to develop or foster the other component of the basic general knowledge, the mindset of the discipline,

its values, and its methodological or even ethical base". More explanations and references to the ethical field are described within the Tuning General Brochure as an essential knowledge area that a future professional should learn and possess within his academic profile.

- *National Society of Professionals Engineers (NSPE)*:
  According to the NSPE; "Engineering is an important and learned profession. As members of this profession, engineers are expected to exhibit the highest standards of honesty and integrity. Engineering has a direct and vital impact on the quality of life for all people. Accordingly, the services provided by engineers require honesty, impartiality, fairness, and equity, and must be dedicated to the protection of the public health, safety, and welfare. Engineers must perform under a standard of professional behaviour that requires adherence to the highest principles of ethical conduct". As engineers they have professional duties to fulfill such as: to "hold paramount the safety, health, and welfare of the public; issue public statements only in an objective and truthful manner; act for each employer or client as faithful agents or trustees... and conduct themselves honourably, responsibly, ethically, and lawfully so as to enhance the honour, reputation, and usefulness of the profession".
  Although engineers often make decisions using precise scientific principles, answers to ethical questions are often varying shades of grey. NSPE provides members with a wide selection of ethics resources that can help prepare them for dealing with difficult issues. For this reason, it is important to highlight that this engineering association has special resources, tools and methodologies to achieve the ethical behaviour that it pursues for its professionals. This association supplies a set of ethical resources that can be found in: http://www.nspe.org/Ethics/

EthicsResources/index.html. It is a way to complement the technological skills that an engineer possesses by default.

- *European Federation of National Engineering Associations (FEANI)*:
  This is a federation of professional engineers that unites national engineering associations from 31 European countries. Through its activities and services FEANI aims to facilitate the mutual recognition of engineering qualifications in Europe and to strengthen the position, role and responsibility of engineers in society. FEANI's objectives are: "to affirm the professional identity of the engineers of Europe; by ensuring that professional qualifications of engineers of the member countries are acknowledged in Europe and worldwide; by asserting the status, role and responsibility of engineers in society; by safeguarding and promoting the professional interests of engineers and by facilitating their free movement within Europe and worldwide".
  FENAI's Ethical Principle says: "The decisions and actions of engineers have a large impact on the environment and on society. The engineering profession thus has an obligation to ensure that it works in the public interest and with regard for health, safety and sustainability". FENAI has code of conduct http://www.tendrup.dk/feani.htm which has the intent of implementing the above ethical principle. As a result of this convergence the European engineering profession as a whole can make a universal statement regarding the conduct of professional engineers: "Individual engineers have a personal obligation to act with integrity, in the public interest, and to exercise all reasonable skill and care in carrying out their work".
- *UNESCO*:
  Works to create the conditions for dialogue among civilizations, cultures and peoples, based upon respect for

commonly shared values. It is through this dialogue that the world can achieve global visions of sustainable development encompassing observance of human rights, mutual respect and the alleviation of poverty. The organization focuses on global priorities and on a number of overarching objectives, for instance, addressing emerging social and ethical challenges: http://www.unesco.org/new/en/social-and-human-sciences/themes/about-ethics.

In the Ethics of Science and Technology Programme UNESCO continues to build and reinforce linkages among ethicists, scientists, policy-makers and civil society in order to apply policies on ethical issues in science and technology. The World Commission on the Ethics of Scientific Knowledge and Technology (COMEST): http://www.unesco.org/new/en/social-and-human-sciences/themes/science-and-technology/comest/ is the Commission mandated to formulate ethical principles that could provide decision-makers with criteria that extend beyond purely economic considerations. Currently, COMEST is working in several areas: environmental ethics, with reference inter alia to climate change, biodiversity, water and disaster prevention; the ethics of nanotechnologies along with related new and emerging issues in converging technologies; ethical issues relating to the technologies of the information society; science ethics; and gender issues in ethics of science and technology. UNESCO has the responsibility to address the emerging ethical challenges by providing an intellectual forum for multidisciplinary, pluralistic and multicultural reflection on ethics of science and technology via education programs, seminars, congresses, committees, and so on.

- *ANECA*:

  Its mission is to provide external quality assurance for the Higher Education System and to contribute to its constant

improvement. The fulfilment of this mission is structured in the following functions: to strengthen the enhancement of teaching, research and University Management activities; to contribute to the performance appraisal of Higher Education according to objective; procedures and transparent processes; to provide to the Public Administrations with appropriate information for the decision making; to keep the society informed about target achievement of Universities in their activities.

ANECA has also achieved a set of specific reports called "Libros Blancos" in which the design of the new degrees of engineering are expounded in detail. We can find these reports directly in the following link http://www.aneca.es/Documentos-y-publicaciones/Libros-Blancos. For instance, the new Computer Science degree has its own references to the ethical issues for future engineers such as: "Competencias transversales genéricas" in which we find "Subcategoría 3.2. Ética, Legislación y Profesión" which means, legal and ethical aspects of ICT, professional regulations, computing and society. The competence is called as follows "15. Compromiso ético". For every new engineering degree the particular competences are described, taking into account the whole of the syllabus and its diverse knowledge areas.

As a final remark after this general review of important institutions and agencies, we would like to underline the future need for the implementation of some kind of mechanism of versatility to tackle the constant and rapid technological and social changes which should be reflected within the new requirements of future professional codes, regulations and rules belonging to engineering, a profession in a constant process of innovation. For instance, taking as a starting point what the ACM achieve, a complementary report of the ethical codes is required in order to

easily introduce modifications and updated versions of a concrete code. ACM proposes that the code should be supplemented by a set of guidelines, which provide explanation to assist members in dealing with the various issues contained in the code. In other words, it is expected that the guidelines will be changed more frequently than the code and consequently they become a useful tool which can be adapted to the time current to the ICT society. This is a question to keep in mind for further work when talking about new codes of ethics.

3. Catalogue of universities

Taking into account that the engineer's professional environment is, more and more, an environment designed and developed based on technology and, consequently, dependent on it, the presence of computer systems is usual in every sphere of our life, as much private as public. For this reason, from the educational framework, we are expected to think of the higher education of the future experts that contribute to the design, development and exploitation of software tools and hardware systems typical of computer science and telecommunication engineering careers.

In this light, the present section presents a catalog of universities, Appendix 1, together with their technical degrees and the corresponding subjects which are related to the teaching of ethics, with the intention of showing the degree of consideration of the ethical contents within the educational institutions. The list is composed of virtual and face to face, national, European and American. Also, the exploration has been made through technical syllabus belonging to computer science and telecommunication degrees.

The main conclusion of the corresponding exploration is that the status of ethical issues within the engineering educational world starts from kinds of contents that are not optional for the

engineer's profile. This overview shows us that the trend towards ethical issues in field of engineering is necessary and implemented in some different ways such as: subjects, seminars, degrees, masters and advanced research. This significant trend obligates us, as educators, to make sure that ethical experiences should start where it should, at the universities, because without formal training in engineering ethics, graduates may fall into wrongdoing, not out of evil will or malicious intent, but rather out of ignorance. For this reason, universities should be a source of ethical education playing a supportive role to other institutions in society, such as professional associations, and even including the family.

In this direction, additional conclusions have been deduced throughout the process of data collection. Firstly, the majority of the subjects are related to ethics and technology and how this relationship influences society. Secondly, in general, the indexed subjects are obligatory. This is a very relevant fact in that engineering ethics, or the closely related subjects of professional ethics, are offered as electives at many engineering schools. These kinds of subjects are, very often, treated by engineering programs in a cursory or marginal fashion, if at all. Anecdotal evidence of this kind of content indicates that most of the programs which require students to take engineering ethics are, for instance, environmental, civil and biotechnological engineering. However, electrical, telecommunication and computer engineering, no less important than other engineering degrees, do not require anything more than a few classes on ethics in an introductory beginner engineering course. The catalogue of ethical experiences presented here is based on the concern about why engineering schools have avoided, over the years, facing the challenge of training ethics systematically. However, the current trend indicates that this refusal is, gradually, disappearing, and that universities are realising that this challenge should be faced. This could be owing to the fact that in the past technology was simply something that people did, but at present, when this tech-

nological activity is a part of our daily life and, simultaneously has become a subject of academic study, an important transition has taking place. This tendency is a sign of a distinction between doing engineering in an ethical way, and the intellectual discipline or study of such doing. The types of skills and thought processes needed to study *why* and *how* engineers act ethically are often different from those abilities, both technical and non technical, which engineers need in order simply to *do* engineering ethically. We can note that engineering ethics is becoming, nowadays, a respected academic discipline in its own right. In this sense, engineering schools show that they take advantage of the growing body of practical knowledge in the field by passing it on to their students in a systematic and consistent way such as we can see in the list of the ethical training experiences of different universities of around the world. Finally, few subjects (or any) are orientated towards the development of speaking and writing skills. It is important to highlight the need for communicative skills among engineering students when defending or presenting reports and projects at their workplace or, simply, in their near and future, the academic environment.

We hope that despite some systemic difficulties that are likely to impede the full effectiveness of ethics education within engineering degrees, from the educational position we continue to persist with a commitment to working in this direction. We believe that one way to address the difficulties that can remain at the undergraduate level is through an open-minded change in the nature of graduate engineering education to include a component on ethical and societal concerns.

As a result of our exploration we present Appendix 1 which shows the increasing interest and need for this kind of content within the technical programs. A table is located in this appendix in order to represent our main conclusion through a representative sample of universities. The table is made up of the name of the university, website and the name of the subject or course.

4. Survey

Ethical factors within the corporate world have a strong human dimension affecting the behavior and actions of decision makers in their daily professional activity. Many professional decisions, practices and attitudes have an influence on the issues such as: the social, economic, political and environmental. Because of this, it is very important to know how to motivate all the participants (users, customers, stakeholders, managers, etc.) who are involved in the development of the professional activity of an organization in order to promote a high degree of cooperation amongst them to benefit the whole corporate community (internal and external). This commitment involves integrating into the culture of the corporation an ethical professional behavior which deserves, more than ever, a more serious consideration taking thanks to the new changes and needs of the ICT society.

In this context, an opinion poll is presented and carried out through a questionnaire found in Appendix 2. On one hand we look for, in broad brushstrokes, the perception of, and trends in, different ethical experiences from a corporate and engineer association point of view. On the other hand, it should help us to improve the comprehension of the role of the ethical factors within these organizations in contrast with the ethical goals that the academic part pursues.

A set of personal interviews with some local corporations and professional associations were undertaken and also an opinion poll was carried out through a questionnaire which was responded to by multinational and national companies. The main goal, by means of these combined actions, is to sound out the perception of the different ethical experiences (if there are any). To a certain extent we want to measure the degree of consideration for ethical issues within the professional world and what actions could be undertaken in order to become aware of the notion that

they are necessary for the social role of the engineering profession. For this reason, this survey can serve as an indication that the ethical issues has not adequately taken deep root within the corporate culture, a question that is important to resolve progressively from, first the education field and, second, from the collective work of the whole corporation (internal and external participants).

The opinion poll is made up of 22 questions. It is designed to elicit responses that can be easily quantified statistically. Thus, the questions are relatively simple so that the response is closed (yes/no/don't know) or multiple choice, in which case the choice is limited to those contained in the questionnaire. From 41 questionnaires sent, we received 19 answers. A high percentage of replies, taking into account firstly, that the survey was directly addressed to high executives and managers (busy people with a lot of responsibilities) of national and multinational companies and, secondly, the subject dealt with could be a delicate and complex issue to tackle, or even an issue removed from what are the essential corporate questions.

The set of conclusions presented here in no way determine our attitude from the academic view point and in any case are concluded in order to make a generalized assumption from which to act. These conclusions come mostly from the managerial sector acting as an accessory to our academic side. However, a fact confirmed by this set of questions, has helped us to determine whether a corporation considers ethical issues. The main conclusion has been that the majority of the corporations don't take into account ethical issues as a part of its basic scaffolds of the corporate culture. So, as educators knowledgeable about the importance of the transverse character of the ethics, we should work in the direction of putting into practice the ethical aspects within the technical degrees for an integral training of engineering.

Next we present some of the notable conclusions:

Professional associations' interview:

- From their point of view all the engineers have to be a member of the professional association of engineers to work as an engineer. For them is essential to be a member of a professional body to develop the profession following the guidelines of the deontological codes. If an engineer is not a member of a professional body there is no organization to corroborate whether a certain behavior is correct (or not). Being a member gives a framework of action for all the professionals that belong to it.
- Another element to take into account is the works committee that represents all the workers of an organization and, consequently, is responsible for regulation and preventing the abuse of authority within this organization. Additionally, each corporation has its own policies that every one of its workers has to know and the obligation to achieve them. So, the works committee jointly with the corporation's policies should be the regulation tool of the profession.
- More legal aspects to have in mind are the trade agreement of every sector of the corporation. This agreement includes the guidelines to take follow when developing the profession or in case of conflict. For this reason, it is very important that this agreement is included within the worker's contract in order to have more legal tools when exercising the profession.
- The more usual conflicts and the most typified are not mainly ethical. In general the conflicts faced are in regard to the lack of requirements or functionalities within a project, failure to comply with the established deadline to finish the project, breach of contract for unclear and ill-defined things during the project, etc.
- The intervention of professional associations within the

educational context is required to explain to the future engineers the meaning of their profession and its social involvement. The presence of these kinds of associations in daily academic activity is tangible evidence of the profession. It could be a way to reinforce the importance of the engineering profession and it is the warranty of the existence of legal measures that ensure the correct execution of the profession.

Local corporations' interview:

- From their point of view the first way to bind people to the corporation is through their trajectory with regard to the salary, social advantages, flexi-time, and so on. The second way is to incorporate people into a relational context in order to cultivate cooperation, collaboration, sharing synergies, values and talent. It is a means of collective enrichment. What is more, the main goal of sharing values converges towards a socialization of the workers looking for positive behaviours and a balance between the different abilities of every one of them. Talent is not enough.
- For these corporations ethics within ICT means a positive way of dealing with professional attitudes. The selection process looks for additional values in people, for instance, sensitivity. They are not interested in people with very good technical skills without any social skill (commitment to the customer, being of service to the client, etc.).
- Throughout the selection process the corporations promote the idea of a pre-determined framework and desirable behavior is transmitted to the future employee. The human resources department is responsible for achieving this task. In the case of these corporations, human resources is the transversal tool when transmitting the corporation's values.

- When a moral conflict or dilemma with a customer arises, the corporation, through human resources, attempts to ensure that the boss, the employee and the customer come to an agreement within an atmosphere of mutual truth. So, the decision-making is done collectively, never in a situation where the employee is isolated. Other corporations decide to contract an external company which manages the conflicts with the customer, for instance, sexual harassment. There is a telephone number where the employees can detail his case in an anonymous and objective way without any kind of influencing factor.
- Another essential aspect that the organizations emphasize it is the endemic lack within the IT sector in respect to the social skills. The professionals of this sector are not able to manage teamwork because, when learning the technological side of the engineering profession, nobody was worried about social skills. It seems that there are two separate sides within a corporation: the technological one and the social one. Personal and interpersonal work is necessary. Because of this, from a corporate view point, the creation of a powerful human resources department to awake the social responsibilities of the profession is suggested. In other words, to promote a corporate culture because the technological profiles are "amateurs of the people".
- In many cases the deontological codes are not applied and deployed by the companies. On the contrary, there are companies that create their own codes of conduct to transmit the values and the excellence focused on the professional commitment towards the customer and the promotion of the equality of values (sex, race, disabled people, etc.).
- Some corporations try to inculcate the corporate spirit through Corporate Social Responsibility (CSR) but this is an incipient process at the current moment. The way to

do it is by participating within the context of the neighborhood with volunteers that, for instance, gathering old computers, teaching courses of basic computing to be in touch with ICT, news bulletins, informative seminars, etc.
- Other values that are important for the corporations are: personal hygiene, dress code, the language used when communicating with the customer, and clean appearance (no tattoos, no piercings, etc.).

Survey:

- The general opinion was that ethical issues can be useful and are necessary.
- Eight corporations have their own code of ethics but the rest of them do not.
- The majority think that taking into account ethical corporative aspects won't help to correct some behaviours. These require more measures, more applied legislation with real sanctions.
- With regard to the answers received we can notice that the corporations know of the existence of the ethical issues but they don't apply and deploy them.
- In general, all the organizations coincide in the view that the university should be the forerunner and should announce the existence of these ethical aspects.
- The majority recognize that the ethical issues have to be promoted from all the spheres of the organization but especially from the management team and experts. It is necessary that their spread comes from the top of the corporation leading by example.
- In general, courses promoting the ethical aspects among the employees are missing.
- The most important values for the majority have been: respect and defence of human rights; application of the

values of the specific corporation; fulfillment of rules and regulations; concern about environmental questions.

- The majority of the organizations don't have mechanisms to guard against undesirable behaviors in spite of the existing codes.
- When there is an opportunity of business some of the corporations admit to breaking the rules and undertaking the business whilst looking for any kind of compensatory measures to justify the illegality of actions undertaken.
- Those organizations that possess codes of ethics say that the solution to avoid undesirable behaviors it is through a corporative ethics in addition to other measures.
- Despite the lack of codes of ethics within the corporate culture, the majority of the organizations admit that they can help to improve their competitiveness and increase trust between customers, employees and stakeholders.
- One of the answers refers to the acceptance of a code of ethics by the students when they enroll to the university for the first time as in American universities. This could be a way to integrate the ethical issues within their lives.

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APPENDIX 1: Catalogue of universities: ethics training experiences

University and website	Subject or course
UNED (www.uned.es/)	"Ética y legislación"
UDIMA (www.udima.es/)	"Deontología profesional"
URJC (www.urjc.es/estudios/grado_online)	" Ética, legislación y profesión"
UCAV (online.ucavila.es/)	"Ética y deontología profesional"
UCAM (www.ucam.edu/)	"Deontología y legislación" and "Ética fundamental"
UAB (http://www.uab.cat/)	"Ètica per a l'enginyeria"
UPC (http://www.upc.edu/)	"Tecnologia i societat" and "Technoethics"
URL (www.url.edu)	"Corporate social responsability"
IQS (http://www.iqs.edu/)	"Ètica professional"
UD (www.deusto.es)	"Desafíos éticos en el mundo global"
UPM (www.upm.es)	"Aspectos sociales, legales, éticos y profesionales" and "Ciencia, tecnología y sociedad"
Universidad Carlos III (www.uc3m.es)	"Habilidades: humanidades" and "Humanidades"
UV (www.uv.es)	"Ètica, legislació i professió" and "Enginyeria, societat i universitat"
US (www.us.es)	"Tecnología, informàtica y sociedad"

UB (www.ubu.es)	"Fundamentos deontológicos y jurídicos de las TiC"
UCLM (http://www.esiiab.uclm.es)	"Aspectos profesionales de la informàtica"
UGR (www.ugr.es)	"Ética, derecho y empresa" and "Ingeniería, empresa y sociedad"
ULPGC (www.ulpgc.es/)	"Ingeniería de la telecomunicación y sociedad" and "Ética y legilación en el entorno social y profesional de la informàtica"
URV (www.urv.cat)	"Orientació professional i acadèmica
FIB (http://www.fib.upc.edu/es.html)	"Aspectes socials i mediambientals de la informàtica"
UCM (http://www.ucm.es/)	"Ética, legislación y profesión"
UOC (www.uoc.edu/)	"Ètica per a les TiC"
Universidad del Estado de Río de Janeiro (www.uerj.br)	"Ética profesional y Humanidades"
Universidad Católica de Brasilia (www.ucb.br)	"Ética"
Universidad de Brasilia (www.unb.br)	"Introducción a la sociología profesional"
Universidad Pontifícia Católica de Sao Paulo (www.pucsp.br/)	"Ética profesional"
Universidad de Buenos Aires (www.uba.ar)	"Legislación y ejercicio profesional de la ingeniería informática"
Universidad Argentina de la Empresa (www.uade.edu.ar)	"Ética" and "Aspectos éticos y legales de la ingeniería"
Universidad Santiago de Chile (www.usach.cl)	"Comportamiento Humano en el trabajo"

Pontificia Universidad Católica de Chile (www.uc.cl)	"Ética para ingenieros"
Universidad Católica Pontifícia de Valparaíso (www.inf.ucv.cl)	"Informática y sociedad (comportamiento ético)"
Universidad Católica de Colombia (www.ucatolica.edu.co)	"Ética general" and "Ética"
Universidad Simón Bolívar (http://www.usb.ve/)	"Educación ambiental" and "Marco legal, ético, regulatorio y estándares de la telecomunicaciones" and "Curso de cooperación social"
Universidad de los Andes (http://www.ula.ve/)	"Complejidad en gerencia y toma de decisiones profesionales" and "Desarrollo, habilidades del pensamiento" and "Lectura crítica" and "Lengua y comunicación I y II"
Berkeley University (http://berkeley.edu/)	"Social implications of computers"
Harvard University (http://www.harvard.edu/)	The Center for Research in Computation and Society offers subjects related to computers and society The Berkman center for internet and society offers subjects related to the ciberspace and the social behaviour
Massachussets Institut of Technology (MIT) (http://web.mit.edu/)	"The Technology and Policy Program" offers subjects related to the role of the technology versus society "Undergraduate Practice Opportunities Program (UPOP)" offers subjects related to ethical implications of engineering decisions
Stanford University (http://www.stanford.edu/):	"Computer, ethics and public policy"

Columbia University in the City of New York (http://www.columbia.edu/)	"Computing and the Humanities"
Illinois de Urbana-Champaign University (http://illinois.edu/)	"Ethical and professional issues"
McHill University (www.mcgill.ca)	"Impact of technology on society"
Toronto University (www.utoronto.ca)	"Computers and Society" (Professionalism and the ethics of computers) and "Introduction to Software Engineering" (discussion of ethical issues, and professional responsibility)
Vancouver University (http://www.ubc.ca/)	"Survey of Social Psychology" (professional behaviour within technology)
Universidad Nacional Autónoma de México (www.unam.mx)	"Ética profesional"
Universidad Iberoamericana Ciudad de México (www.uia.mx)	"Problemas actuales de la bioética" and " Pensamiento científico y humanismo" and "Lo ético-social en los profetas de Israel"
Universidad Anáhuac – México Norte (www.anahuac.mx)	"Ética del ingeniero"
Auckland University (www.auckland.ac.nz)	"Professional and Sustainability Issues"
Otago – Wellington University (www.otago.ac.nz/wellington)	"Computers and people. The work of ethics" and "Computer awareness. Attitudes towards the work of ethics"
Canterbury – Christchurch University (www.canterbury.ac.nz)	"Ethics, Politics and Justice"
Queensland – Brisbane University (www.uq.edu.au)	" Ethics and Human Rights"

Sydney University (www.sydney.edu.au)	"Business, ethics and law" and "Environmental, law and ethics" and "Science and ethics" and "Reality, ethics and beauty" and "History of ethics" and "Practical ethics" and "Management and Organisational ethics"
Melbourne University (www.unimelb.edu.au)	"Postgraduate Diploma in Professional Ethics" and "Postgraduate Certificate in Professional Ethics"
Cambridge University (http://www.cam.ac.uk/)	"Introduction to Technology policy" and "Concepts, Values and Change Processes"
Oxford University (http://www.ox.ac.uk/)	"Groups projects in ethics research"
Twente University (http://www.utwente.nl/en)	"Ethics and Technology"
Oslo University (http://www.uio.no/english/)	"Science technology society ethics"
Helsinki University (http://www.helsinki.fi/university/):	"Ethics and social responsibility in research"
York University (http://www.york.ac.uk/)	"Computer science and philosphy programme" (Technology and ethical issues)
École Polytechnique Fédérale de Lausanne (http://www.epfl.ch/)	"Sciences humaines et sociales I" and "Sciences humaines et sociales II"
Trinity College of Dublin (https://www.scss.tcd.ie/)	"Computers and society" and "The engineer, Management and Society
Technical University of Munich (http://portal.mytum.de/welcome/)	"Scientists and ethics"

IWE – Institut für Wissenschaft und Ethik (http://www.iwe.uni-bonn.de/deutsch/index_fix.html)	The "Institute of Science and Ethics" was founded in 1993 on the initiative of the University of Bonn, the University of Essen, the Forschungszentrum Jülich (FZJ) and the Deutsches Zentrum für Luft- und Raumfahrt (DLR). The main focus of the IWE's work is in the field of biomedical ethics and the ethics of science and technology.
NTNU – Trondheim Norwegian University of Science and Tehcnology (http://www.ntnu.edu/studies/manvetikk)	"Master in Applied Ethics"
KTH – Royal Institute of Technology of Sweden (http://www.kth.se/2.875?l=en_UK)	"Technology and Ethics" and "Litterature seminar on engineering ethics" and "Engineering Ethics seminar"
Eindhoven University of Technology (http://www.tue.nl/en/)	"Philosophy and Ethics of Technology" and " Ethics and Aesthetics in Intelligent Product and System Design"
Delft University of Technology (http://home.tudelft.nl/)	"Ethics and Technology " and " Governance and Ethics"

APPENDIX 2: Survey's questionnaire

The questionnaire is as follows:

1. In your company the ethical issues are
__ Useful
__ Meaningless or not relevant
__ A concern

2. Ethics is something that one
__ Can learn at home
__ Can learn along your life
__ Can not change if you are elderly, you can not change attitudes and behaviours

3. Does your company have any kind of code of ethics?
__ Yes
__ No

4. Does your company think about?
Choose the answer, "yes" or "no", that suit you best
___ A code of ethics or collection of principles
___ A clearly defined ethics and compliance policy
___ A key ethical risk mapping: sharing experiences, talking with experts, etc.
___ A dedicated team (ethics director, deontologist, etc.)
___ An ethical programme (courses, seminars, etc.)

5. If you answered "yes" in question 3, does your company have plans or programmes to encourage the ethical issues among its workers?
__ Yes
__ No

6. If your company has a code of ethics, does your company, really, put it into practice?

__ Yes

__ No

7. If your company give ethical plans or programmes to their workers, do you think that is, really, its responsibility?

__ No. It is not its responsibility because it interferes in personal affairs

__ No. It is an investment involving a big expenditure for the company

__ Yes. It is necessary to encourage a new behaviour improving social welfare and professional commitment

8. How often does your company give ethical plans or programmes?

__ At the beginning of the year

__ On a regular and scheduled basis

__ Rarely or never

9. Who has address ethical issues?

__ Only among Board members

__ Board members in collaboration with experts as: ethical committee, environmental department, social assistants, etc.

__ Collectively: users, suppliers, managers, Board members, stakeholders, experts, etc.

10. Who has to give and instil the importance of ethical plans or programmes?

__ School and university

__ Human resources

__ Board members and experts

__ No one

11. If you answered "school and university" in question number 10, which kind of contents should give these institutions?

You can choose more than one option

__ Theoretical business moral principles

__ Case study analysis

__ Human's relationships management (personal virtue)

__ Law, standards and regulations

__ Management of the organization's procedures and codes of ethics

__ Business strategies (commitment, responsibility, confidence) among customers, employees, stakeholders, suppliers, etc.

__ Others (What?)

12. Thinking in workers' welfare and to commit with customers' satisfaction means business ethics?

__ No. It is not related with ethics

__ Yes. Because the company has a social and a labour responsibility with them

__ No. Because the company is not responsible for their actions and behaviours

13. Does your company inform about social welfare plans and environmental protection plans among its workers?

__ Yes

__ No

14. Does your company have any kind of mechanism against unethical behaviours as: conflict of interests, unfair competition, power misuse, etc.?

__ Yes

__ No

15. For your company which are the most important ethical areas

Rank the following in decreasing order of importance (from 1 to 9)

__ Enforcement of the company's core values
__ Respect and defence of human rights
__ Sustainable development
__ Dialogue and communication transparency
__ Social integrity and valuable social practices
__ Compliance with rules and regulations
__ Welfare of people (users, stakeholders, managers, suppliers, etc.)
__ Cooperation among people solving a problem
__ Take care over environmental concerns

16. The ethical position of your company depends on

__ Customers and suppliers
__ Financial solidity to impose its values in the markets
__ The values promoted by your company and never from the external agents

17. Your company has a business opportunity but it has to leave out some social and environmental regulations. What does your company do?

__ Not do it
__ Try to find mechanisms to obviate regulations and do it
__ It is a big opportunity, so, do it. In case of find out, try to sort it out with inspectors
__ Others (What?)

18. Ethical issues within a company requires

__ State regulation
__ Corporate self regulation
__ A balance between both
__ No external regulation

19. The following reasons, to introduce in the business ethics of your company, are good enough for you?

Choose the answer, "yes" or "no", that suit you best

___ Protecting Board members from risks and penalties
___ Standing the pressure of external agents (employee, consumer, trade union, ecologist, stakeholders, etc.)
___ Reinforcing the regulations and the law
___ Implementing a set of corporation values
___ Contributing to human talent and excellence
___ Add others (What ?)

20. Do you think that business ethics (declaration of principles, declaration of values, code of conduct, code of ethics), is the solution to avoid undesirable conducts within the company or is necessary to apply additional measures?

__ Yes
__ No

21. If you answered "no" in question 19, what's the meaning of the implementation of the ethical concept within your company?

You can choose more than one option

__ An additional cosmetic marketing element

__ A deep conviction that ethical issues improve the relationships with costumers, users, suppliers, etc., also, the society (environmental, healthy, safety)

__ A set of principles and values that the company includes in its operation and anyone can notice in all their external and internal actions

__ An expenditure of time and economical effort

__ It is a way to establish a solid structure, mission, culture and goals of developing and economic growth based on mutual trust

22. In summary, do you think that the ethical principles of a company can improve the competitiveness and increase the confidence and, consequently, the loyalty of the workers, costumers and stakeholders?

__ Yes

__ No

__ I don't know

CHAPTER 4

Engineering ethics beyond engineer's ethics

In this chapter the starting point is the following set of assumptions:

- Engineering ethics has been mainly focused on the definition of an ethics for engineers; professional codes are a clear example of this.
- The professional activity of the engineer is carried out, in general, within a corporation. Thus, the technological as much as the ethical result of the work developed depends not only on the engineer, but also on all the actors involved in the resolution of the task.
- Professional codes are a combination of two kinds of heterogeneous qualities which are demanded of all engineers in order for them to be a good professional. Some qualities are going to be achieved through the learning process of the technical degree; others are eventually going to be integrated within the engineer's profile as a mature individual. In that case the cultivation of set features of the engineer's character is required.

- An adjustment of the engineer's image is needed in order to reflect a real model for this professional. It is not credible that the ethical engineer is like a hero who has all things under control and who has to solve all social troubles, sacrificing himself for the common good.

Our main goal we seek to achieve at this point of the research work is the defence of three important aspects related to the engineer's profile. These are as follows:

- To understand that the engineer's responsibility is a complex subject that requires special attention and a detailed exposition.
- To put into practice a deep revision of the learning process in order to provide the academic foundations of the professional profile we pursue as educators in the field of applied ethics within technical degrees (ethics should be a set of transverse contents).
- To strengthen professional responsibility tending towards an active responsibility based on prudence, foresight and the pleasure of doing good work, in other words, the search for excellence.

The contents of this chapter are based on the paper: J.M. Basart and M. Serra, "Engineering Ethics Beyond Engineer's Ethics", *Science and Engineering Ethics Journal*, 2011.DOI: 10.1007/s11948-011-9293-z.

1. Engineering ethics or engineer's ethics?

Engineering ethics is usually focused on engineers' ethics, engineers acting as individuals. Certainly, these professionals play a central role in the matter, but engineers are not a singularity

inside engineering; they exist and operate as a part of a complex network of mutual relationships between many other people, organizations and groups. When engineering ethics and engineers' ethics are taken as one and the same thing the paradigm of the ethical engineer which prevails is that of the heroic engineer, a particular model of the ideal engineer: someone both quite individualistic and strong enough to deal with all the moral challenges that may arise. We argue that this is not the best approach, at least today in our interrelated world. We have achieved a high degree of independence from nature by means of technology. In exchange for this autonomy we have become increasingly tied up with very complex systems to which we constantly delegate new tasks and powers. Concerns about safety keep growing everywhere due to the fact that we now have a sensitive awareness of the huge amount of power we are both consuming and deploying, thus, new forms of dialogue and consensus have to be incorporated at different levels, in different forums and at different times. Within these democratic channels of participation not just the needs and interests, but also the responsibilities and mutual commitments of all parties should be taken into account.

1.1. Engineering and engineers

It seems to be a frequent practice in academic papers to transform any analysis of professional ethics into a study of ethics for the respective professional. Whenever this transformation occurs in engineering the outcome is that engineering ethics becomes engineers' ethics. Due to the fact that this shift is so subtle and common, it quite often goes unnoticed. There is no doubt that both elements are closely related because engineering and engineers need each other to operate, but they are not the same thing. In particular, the engineers' ethics is just a part, even though a very important one, of a number that must be considered when talking about engineering ethics.

This trend has somewhat established a tradition in the field, therefore it is also reflected in many well-known textbooks on engineering ethics (for instance, Fleddermann, 2004; Harris *et al.*, 2009; Johnson, 1999; and Martin & Schinzinger, 2005). After taking a look at their contents page it becomes apparent that the core of the approach is mainly engineers' ethics. This observation intends no criticism of any of these well-respected books; it simply states that they are also included in this tradition. A very important aspect of this fact is that by using these publications in the classroom, technical schools prepare our future engineers under the same paradigm: engineering ethics is something particular to engineers' activities. Textbooks open relationships and create influences: they do not just present what the author thinks or knows about a certain subject, but also form a starting point from which many readers will develop their thinking.

Despite their many virtues, professional codes of ethics do not do much to reveal this distinction. Certainly, that is not surprising; they cannot help because they are openly addressed to professional engineers, not to the whole set of different actors involved in the world of engineering. Thus, the goal of a code is to encourage the members of an association to work and behave according to the principles of the association, but also to protect their own interests. The starting points in these solemn declarations clearly show what their scope is. For instance: "Engineers, in the fulfillment of their professional duties, shall:" (NSPE, 2007); "We, the members of the IEEE, in recognition of the importance of our technologies in affecting the quality of life throughout the world and in accepting a personal obligation to our profession, its members and the communities we serve, do hereby commit ourselves to the highest ethical and professional conduct and agree:" (IEEE, 2006), and "Individual engineers have a personal obligation to act with integrity, in the public interest, and to exercise all reasonable skill and care in carrying out their work." (FEANI, 2006).

Taking all of this into account, then maybe it makes sense to ask a question: Who does engineering ethics concern? In his work on the meaning of several problematic concepts, engineering being one of them, Davis (2003) makes an appropriate observation: "Such connections between engineering ethics and lively parts of moral or political theory suggest how little we understand engineering ethics, how deeply confused the subject remains." This suggested confusion is twofold. First, engineering is more than what engineers do in their work. While working there is always a private or a public organization by whom the engineer is employed. This organization is a more or less complex entity where many stakeholders, interests, and boundaries (external as well as internal) interrelate. Suppliers also play a role as another organization with an analogous structure. Laws and public regulations establish what is allowed and what is forbidden. Finally, the result of his or her work is delivered and acts upon the client or society who had previously commissioned, under certain conditions, a specific product or service. Second, what engineers can do and how they do it depends on all of these people, organizations, requirements and regulations. The quality of their work, the degree of responsibility they are willing to take, and the commitment to good service, all are under the influence of the elements named above. Engineers are not a singularity inside engineering; they exist and operate as a node in a complex network of mutual relationships with many other nodes.

1.2. Heroic engineer or responsible engineer?

Now we are going to consider the paradigm of the ethical engineer which prevails when engineering ethics and engineers' ethics are taken as one and the same thing.

Whenever a complex undertaking is broken into separate parts, and the people assigned to work on these parts have a high degree of autonomy, the responsibility for the whole project

begins to blur. If, for instance, the undertaking is the design and implementation of a building's security system, then every person working on the project could try to avoid taking responsibility for the outcome by arguing that they, as an individual, have simply produced a particular piece of hardware or software and that the system as a whole was not within their remit. It goes without saying that when something goes wrong in an engineering project the responsibility falls heavily on engineers. This is so for several reasons; their professional status and the pressure exerted by managers, clients, and professional associations amongst them. Certainly, when failures happen they cannot deny their share of the blame, but many other instances, social or professional practices, and people have also often had a role in the outcome (Lynch & Kline, 2000). Nevertheless, these influences remain at least partially hidden behind the huge volume of obligations taken on by engineers. When attention is paid to ethics this pressure becomes even more emphasized.

Now, in view of this tense situation there are, at least, two possible courses of action. The first is to ask for a revision of the notion of responsibility in engineering, a question which we develop later. The second is to seek out an engineer strong enough to deal with any ethical challenges that may arise. This ideal engineer represents someone capable of acting alone and with an independent mind, by using his or her own means and resources; here, the result is close to the paradigm of the *heroic engineer*. Broome & Peirce (1997) described the characteristics and virtues which, in their opinion, this model has. According to these authors several studies published all through the second half of the last century (e.g., Boyer, 1987; and Buck *et al.*, 1945) show that immaturity in adults (specifically, American ones) has grown to be one of the main problems in university education, and a real risk to democracy. New generations of students are alarmingly self-centered and find it difficult to care for others or live a principled life. In their proposal it is a central point to

emphasize the character development of these students. This maturation becomes crucial and could be accomplished in the university classroom by promoting, through several methods and strategies, the figure of the heroic engineer: a self-reliant engineer both ready and willing to confront many challenges and perils for the sake of others.

Adam (2001) pointed out two handicaps of this brave engineer. The first is that it proposes a very individualistic engineer. The heroic engineer needs to travel alone through long journeys, and this certainly will provide many opportunities of personal maturation and character development. However, this deaf solitude is also dangerous for all: the engineer, the engineer's work, their employer, and society. Today, engineering projects require the collaboration of many workers and several specialists from different disciplines, seldom can an engineer work in isolation without interacting with a team. Therefore, many decisions will have to be taken together as a team after weighing up possibilities, interests and resources. The second handicap is that it has quite masculine connotations: the epic warrior, so prevalent in both our cultural tradition and our various modern forms of competition. Although the matter is quite complex, this aspect could contribute to an explanation of why the majority of engineering students are still coming from the male sex. It is not by chance that the deontological tradition in Western ethics also values this ideal. According to Kant, you have to decide by yourself what is right, neither consensus nor dialogue is required at all, and to act on that decision without hesitation. Reason always provides the only safe guide to ethical behavior, whereas emotions and particular circumstances should not interfere with principles.

It is our belief that a *responsible* engineer does not need to be a heroic engineer. This affirmation is compatible with the fact that some characteristics of the heroic engineer are also desirable in every engineer; for example, discipline, courage, and tenacity. Moreover, there are heroic engineers who, in special circumstances,

sacrifice themselves, putting their job or their career, and sometimes even their life at serious risk. These attitudes deserve much admiration and respect, but heroism is far from what can or should be demanded of professionals. Responsible engineers should know better than to try to be solitary heroes. If ethics is to be a reflection on how we should live together, not just 'you' or 'me' but 'we', then engineering ethics ought to be the reflection on how we all should integrate sustainable engineering into our common life.

2. Ethics, rights and Corporate Social Responsibility

As we already have pointed out in the Chapter 2, section 2, it is possible to identify three generations in the historical evolution of ethics, rights, and corporate social responsibility (CSR). These three issues are closely related, so at each stage of the evolution there appear some parallels or affinities between them. At this point, our interest in these processes is mainly due to the fact that engineering ethics is a particular case of applied ethics; so it seems a good idea to contrast its current paradigm to the present paradigm in ethics and the two neighboring spheres, rights and CSR. From this comparison it is possible to obtain a clearer understanding of where we are. Also, the chance of discovering what aspects could be useful to introduce or to modify in our current treatment of engineering ethics may appear. With this purpose in mind, now, we are going to elaborate on these three processes according to Stohl, Stohl, and Popovas (2009) description in order to introduce the new direction for the ethical issues.

Ethics

First generation ethics is personal ethics. It comes vertically from God and is fixed for ever. God is the supreme good, so the right path for every human being is always that which leads one to

honor His precepts. Second generation ethics is social. Through different and complex influences during the seventeenth and eighteenth centuries a new stage of ethics arose. At this point ethics spreads horizontally; it comes from and depends on law and human rights. This ethics is not discovered, but built on our interests as human beings. This permits its development according to future social changes. Finally, third generation ethics, our current challenge, is global. It does not deny personal and social ethics but goes further because it includes sustainability, non-human beings and systemic relations. So third generation ethics demands a worldwide common ethics where the scenario is the whole planet and responsibility extends, to different degrees, to all life on it, not just human life.

Rights

First generation rights are centered on some of the most critical requirements for human life, for example, the right to own property, freedom from arbitrary execution or detention, freedom from torture, freedom of speech and so on. These rights are devoted to protecting the individual against the absolute power of the state. Second generation rights moved to demand primarily rights for workers (i.e.: wages, leisure and health care). These rights should be guaranteed by the state to promote equality. Third generation rights refer to humankind. They are collective rights such as living in peace or in a healthy environment rather than individual rights. The implementation of these new rights requires agreement and cooperation between many groups, organizations and people.

CSR

First generation CSR has little to do with any real responsibility. In fact, the motto is simply to maximize benefits while

respecting the law. There are neither other limits nor any commitment to anything else. In second generation CSR responsibility is admitted, although it is limited to groups directly associated with the organization, that is, employees and their families. Finally, third generation CSR acknowledges globalization and the complex impact of the corporation's activities. At this point both material and social conditions are considered and the responsibility extends beyond the members of the corporation. The United Nations Global Compact (1999) adopted a common framework that has helped to promote and direct these changes worldwide.

These three stages in the historical evolution of ethics, rights, and corporate social responsibility (CSR) outline the new approach that ethics takes. We come to the conclusion that global ethical issues are the way to become more aware of the commitment that every one of us and, in general, all organizations have towards acting for the global good of people, living creatures and environment through a flourishing advance within different fields such as medical advances, health foods and forest maintenance in order to enrich and contribute to the development of the mankind. Only in this way will it be possible to move forward.

2.1. A broader concept of responsibility

Following on from the previous sketch of the third generation of all three concepts, rights, ethics and CSR, it seems appropriate to inquire how this threefold social evolution is or could be reflected in the engineering ethics of today. At first glance, if our previous description is correct, that is to say, if engineering ethics is understood in a routine way as engineers' ethics and this shift favors the moral model of an isolated heroic engineer, then, engineering ethics is quite removed from those third generational features. Day by day, we transform the planet in which we live. Engineering is one of the activities which contributes most to

this transformation in its demand of raw materials, consumption of energy, waste products, and the side effects on trades and the work place, and so it is necessary to take its influence on the life of all human and non-human beings into careful consideration. An open and clear mind is essential. For instance, we are quite conscious that, regarding the environment, there are no strictly local problems. Our health and welfare depends on the activities we carry out in every corner of the planet. Globalization implies much more than the free market worldwide. Decisions about what we construct, design, use, visit, eat, or wear, in, say, New York, may have very tangible consequences for people living in Rwanda, Argentina or Indonesia.

To quote two fine observers of this disparity, Lynch and Kline (2000) pointed out that: "[…] the promotion of ethical decision making can be facilitated by developing an understanding of the sociological and cultural context of engineering practice and its effect on ongoing, mundane engineering practice. Direct, intentional conflicts of ethical values may be less important than the historically and sociologically explicable outcome of unintended consequences of intentional action and the cultural normalization of practices that would be questionable if the disparate effects of these practices could be traced." More recently, Durbin (2008) suggested that: "Engineers and their professional societies need to broaden their outlook, moving beyond a focus on individual misconduct to broader social responsibilities." To say this in other words, engineering ethics should abandon the suffocating scenario of engineers trying to discover in their conscience or wisdom both: a) the correct answer to a moral dilemma they are confronted with, and b) the courage to carry it out unhesitatingly.

The demand for a new framework of engineering responsibility can be dated back, at least, to the nineties. In their well-known study on the Therac-25 accidents, Leveson and Turner (1993) came to the conclusion that today, with so many complex technical attainments surrounding us, responsibility is no longer

restricted to single individuals; "Accidents are seldom simple, they usually involve a complex web of interacting events with multiple contributing technical, human, and organizational factors." It is also important to remember that such a complex of interacting events had also been indicated in the Report of the Presidential Commission on the Space Shuttle Challenger Accident (1986), where a set of nine groups of recommendations were made affecting different subjects; design, independent oversight, management structure, safety organization and maintenance safeguards amongst them. These well-known accidents showed that, in regards to sophisticated technological products, such as those produced by engineering, there are a great number of factors and relationships to be taken into account. However, that is not all. Some factors and relationships, not all of them properly identified, may change over time. Moreover, some human practices, decisions and actions, which cannot be easily predicted, may also interfere. Thus, one lesson to learn from these failures is that responsibility means responsibilities. The ethical question is not, "Who is guilty?" but "What has been my contribution to the outcome?"

With regard to the technical degrees where ICT has an important role, professional responsibility exists because, as we already know, the engineering profession has its social connotations when developing a technological project. So in relation to the framework of engineering responsibility, we will differentiate two ways through which we can make reference to this professional responsibility and the need to attain the objectives of this responsibility.

2.1.1. Passive and active responsibility

On one hand, the engineer and his actions when exercising the profession should be held to account by society, the customer, colleagues, and the law and so on. It has to assume responsibility for damages or the failure to comply with the commitment (qual-

ity, costs, terms ...) stipulated within a contract when developing a project. This is passive responsibility. In other words [it] "refers to accountability for something that has occurred in the past" (van de Poel and Verbeek, 2006). When we talk about this kind of responsibility, we infer that it is possible to make some kind of civil responsibility, meaning, a norm or law that has been violated in the action (i.e.: an offense), the breaking of a contractual agreement or both things simultaneously. The consequences could involve the repetition of the task, financial compensation or, in the worst case, a prison sentence.

On the other hand, active responsibility involves acting a priori. This means paying enough attention to, and interest in, what we are doing at the workplace in order to minimize the possibility of error, accident, the worsening of quality or failure in the agreement stipulated. In others words, "It refers to responsibility as a virtue" (van de Poel and Verbeek, 2006). It involves thinking about the consequences of the undertaken project and the interests of those who will encounter the effects of our actions. So this responsibility implies the willingness to carry out a task or work of high quality, a commitment towards excellence, a feature that distinguishes the good professional. In parallel, it also justifies the social prestige of the engineering profession.

To conclude we must say that active responsibility within the professional practice of the engineering it is not just a possibility, but a requirement. Many of the well-known thinkers such as Hans Jonas and Jacques Ellul cited in the Chapter 3, section 1, refer to that responsibility in relation to the technological world. Acting responsibly within the context of ICT consists of being able to give appropriate use to the power that, as professional of the engineering, one possesses when interacting with technological advances.

In addition, it is well known that the engineering profession has a large scope of works related to the engineer's roles and responsibilities. Engineers take their significant roles and respon-

sibilities across a multi disciplinary environment and, in this light we want to distinguish two responsibilities and their respective roles, the technical and the professional profiles, within the computing profession.

2.1.2 Technical and professional responsibility

Technical responsibility is merely based on the technical knowledge and skills belonging to the sphere of activity. This profile promotes the idea that engineers are capable of continuously learning in their branch of engineering through the assimilation of varied information and applications in order to develop products of quality following regulations and rules. This case is the first stage for an engineering practitioner at the beginning of the exercise of his profession. The following stage should be that they are put in a position to make contributions to the development of engineering, its application and anything further necessary to change an engineering practitioner into a computing professional.

To make the distinction between the technical and professional profiles we have to know which the distinctive feature that will allow us to go beyond the concept of responsibility is. According to (Gotterbarn, 2001) "In a profession, the members pledge to use their skills for the good of society and not to merely act as agents for the client doing whatever a client asks". This means, the professional profile that Gotterbarn points out is someone who by virtue of deeper reflection and wider practical experience of a given professional enterprise can clearly explain the evaluative and practical implications (consequences) of a given professional problem. This professional profile is based on lessons learned from experience or failures of responsibility. We refer to what Gotterbarn calls "positive responsibility". This is another layer of responsibility focused on what ought to be done rather than on blaming or punishing others for irresponsible behavior. In others words, "The emphasis in positive responsibil-

ity is on the virtue of having or being obliged to have regard for the consequences of his or her actions on others". Certainly, this responsibility is based on values.

These two types of responsibilities are a part of the evolution of the engineer's responsibility and they are necessary within the maturation process of any engineer. The main goal is to tend towards professional responsibility in order to ensure that social wellbeing is advanced by individuals doing good acts which have good consequences for society. Thus a professional engineer is competent by virtue of his fundamental education and training and able to apply the scientific method and outlook to the analysis and resolution of engineering problems. He is able to assume personal responsibility for the development and application of engineering, notably in research, designing, construction, manufacturing, managing and, in the education of the engineer, all of this is based on predominantly intellectual work and on the exercise of original thought and judgement.

2.2. A network of intertwined responsibilities

In the last two centuries, we have achieved a high degree of independence from nature by means of technology. In exchange for this autonomy we have increasingly become tied up with very complex systems to which we constantly delegate more and more tasks and powers. One of the implications of this strategy is the contribution to the development of the so called "risk society" (Beck, 1992). This is not an especially dangerous society but one in which we are far from being conscious of, let alone fully controlling, all the processes and effects of the technological systems we have introduced. Engineering is today impossible without relying upon very sophisticated technologies. This dependence forces us to think about good and evil with regard to the consequences of choosing, when possible, one technology or another; when there is no choice, this is even more risky.

In this delicate context, engineering cannot keep acting in isolation. Engineering is a profession; but it is also a field of study and research, a business, a service and, finally, a means to affect, for good or ill, not just nature but also our other environments: political, economic, social and cultural. This web of different types of relationships (influences, dependencies, cooperation or opposition) between many kinds of stakeholders (public or private, individual or group) demands a more open, participatory and decentralized way of approaching engineering ethics. The role of the engineer, with its own characteristics and singularities, is central and highly influential but it is only one more element in a scene full of heterogeneous relationships. Therefore, it is necessary to achieve an opening of the prospects by taking care of the existing relationships, but it is also necessary to be aware that there may be opportunities for creating, facilitating or recognizing new relationships between stakeholders. Quite often there are hidden relationships, which are not visible because they remain suffocated through force of habit and by rigid structures and dominant powers. Nevertheless, in our present world of critical interdependencies, the most pressing issue is not to prevail but, firstly to understand what we do and where we are going, and secondly to act in accordance with this understanding.

We experience, day in and day out, the way that concerns about safety continue to grow everywhere due to the fact that we are developing a more sensitive awareness of the huge power we are both using and deploying through the use of new technologies. This awareness should be neither deprecated nor underestimated by anybody; an answer is called for, and the proper answer should be a democratic one. In this respect, a good example of what is required can be drawn from Leveson and Turner (1993): "Some of the most effective standards and efforts for safety come from users. Manufacturers have more incentive to satisfy customers than to satisfy government agencies." In a similar way, criticism of and worries about our unsustainable way of life

have appeared on the agenda. Making a different choice is something that should concern the whole of society and not just be a decision to be taken by some company, politician, institution, administration or social leader. Whatever the case, new forms of dialogue and consensus have to be incorporated at different levels, in different forums and at different times. This dialogue requires all parties to put aside their misgivings. In the end, ethical interests are common to all of us; they should not hinder the work of engineers or harm the legitimate interests of companies and institutions. Within these channels of participation, not just interests and necessities but also responsibilities and commitments should be weighed up properly.

To have a good chance of success in any particular case, this suggestion of a broader concept of responsibility in engineering ethics requires the personal commitment of all interested people. Everyone has to contribute to the creation of the necessary conditions for its growth, although this involvement can be neither imposed nor learnt in the abstract. It has to come from a proper understanding of what is at stake. Nevertheless, we have to admit that an intellectual understanding is not enough. Abstract ideas without emotions and feelings do not engage people. If this proposal is to be successful then a greater flow of empathy, trust, and respect in all directions has to be generated. How? There are no highways; ethics constantly demands the opening and exploration of new trails. However, one thing is certain, all of us are setting off right now, bearing in mind that in our job we are at the service of society. From there, everyone has to act according to his or her own position, capacity and responsibility.

However, with regard to engineers, much of this vocation is discovered and acquired during the years of education and training. In this respect, technical schools and universities have an important influence and responsibility, because important habits, attitudes, and values, can be effectively promoted or neglected there (Fleischmann, 2004). One or two courses about applied

ethics and some rudiments of social implications of technology do not work. Bucciarelli (2007) and Whitbeck (1995) insist that even the standard study of cases does not produce many results. Engineering curricula afford very little time to these analyses; this limitation leads to great simplifications and the loss of real context. Study of cases often becomes a kind of game where the students learn to guess the right answers to the teacher's questions. Kline (2001) pointed out that a relevant presence of STS studies could be really helpful, and we agree. With the additional treatment of history, sociology and philosophy of technology, students could get the opportunity to realize that engineering did not start when they were born, that there is a past to know and from which to learn. They would discover that all around them there are different ways of looking at things, different ways of doing the same task, and that maybe all of them are equally good.

Finally, we should remark on an additional field which is being revived in order to promote the moral life of our students, literature. Literature can "[…] supply the kind of experience needed to develop a person's faculty of moral judgment" (DePaul, 1988). It is another proposal to explore and to implement within the learning process of future engineers. This can allow us to work through ethical implications outside of the professional context, but it incorporates all the elements and actors necessary to configure a suitable context in order to examine the ethical aspects of a concrete circumstance located within it. Literature is a means of shaping human experiences (DePaul, 1988). By means of all these sets of learning tools students would realize that ethics is not another type of problem-solving subject where at the end of the process you get a clear-cut answer saying, right/wrong, good/bad, or just/unjust.

It seems that today all three issues, ethics, rights, and CSR are moving in the same direction. Many people are too. If engineering ethics excludes itself from these moral developments then it could seriously damage both the appropriate evolution of engineering and its engagement with society at large.

2.3. Channels of distribution of responsibility

According to (Vallaeys, 2006), social responsibility appears as a complement of individual moral responsibility (the first generation of ethics) and of legal responsibility (the second generation of ethics) in order to become aware of the new features of the current society in the global technological-scientific age. We come from a society based on the problem of the production and redistribution of wealth between social classes and now, we are heading towards a society based on risk prevention for all social classes.

Understanding social responsibility implies understanding CSR in real terms as the risk management cited in the Chapter 2, section 2. The ambivalence of ethics with regard to science is present at this point. Science is not only responsible for the generation of risks (i.e., toxic and pollution consumed), but also it is responsible for protection from them (i.e., research and technological solutions). Also, we can notice that the organizations are the main protagonists of the generation and diffusion of risk because they are the intersection between the technological discoveries with daily life. Therefore, the businesswoman and the scientist are the central actors of the ethical issues of modern society and they should accept the responsibility for their decisive activity versus it, which means CSR and USR, respectively. That is why the importance of social responsibility strategies concerns not only the corporations, but also all social actors, such as universities, Non-Governmental Organization (NGO), the environmental lobby, etc.

2.3.1. Corporate Social Responsibility (CSR)

In respect to this social responsibility, developed in Chapter 2, some remarks are going to be added. To begin with, strategies such as new codes of ethics are only one means of achieving the ultimate goal of having ethical global responsibility in the

engagement of corporations worldwide. As we stated in Chapter 2, section 2, there are many ethical responsibilities faced by the organizations. These ethical concerns within the culture of the corporation should be emphasized in order to cultivate a broader concept of corporative culture such as the meaning of CSR. In this sense, the culture within CSR is believed to be more associated with the deeper beliefs, values and assumptions of an organisation.

Therefore, from our view point, CSR is a way to promote the third generation of ethics among the professionals of the engineering. Just as one can value an individual's culture by his or her actions and personal activities, the ethical atmosphere can be observed on a larger scale, in our case, the organization. In consequence, the employee's actions or global corporative behaviour will reflect the kind of involvement and commitment that every member (external or internal) of a corporation has integrated and assumed responsibility when facing ethical conflicts in their daily professional life. CSR is a moving target, making it increasingly necessary to adapt and change not only the ways employees act, but also to pervade all the interrelationships and interdependencies. So strengthening ethical issues among employees is a tool in steering the behavior of an organization's members.

2.3.2. University social responsibility (USR)

The second element to which the responsibility to spread the third generation of ethics falls is USR. According to (Vallaeys, 2006) the university has to promote the creation of "socially responsible" organizations. Thus, the university has to play an important role in arbitrating the moral training of modern humanity. It is very important to know the risks tied to professional and technological-scientific activities in order to understand the meaning of the individual and collective responsibility. For this reason, ethical training within technical degrees is a necessity in order to achieve an "integral citizen teaching".

Referring to (Vallaeys, 2008) USR is an new way of looking at the social commitment that universities have to their surroundings such as; ethical and environmental management, academic training looking at the responsible and caring citizen, knowledge production and dissemination and social participation in order to promote a more human and sustainable development. This commitment is placed principally in the ethical management of institutional processes. USR represents a great opportunity to consolidate this social commitment as universities inspired by ethical principles (institutional coherence and social bond). Thus USR seeks to align the four previous basic university processes required by a more just and sustainable local and global development. Additionally, in linkage with society we believe that USR offers a learning experience in the execution and assessment of innovating projects, in establishing applied research and by involving teachers and students in the solution of real problems.

Since the universities are the main organisations in charge of the professional training of the next generations and of the definition and evolution of science, the ethical and transparent management of its institutional processes involves:

- Promoting ethical, democratic and environmental behaviours with the aim of having a responsible and congruent campus with the identifying values of the university.
- Academic training of responsible citizens in order to promote sustainable human development through the teaching of the essential knowledge of citizenship, the use of the learning methods related to the management of social problems, etc.
- Social management of knowledge in order to spread it appropriately through the research and the teaching carried out in the classroom. The main idea is to target the scientific activity and the expert praxis towards its social responsibility taking into account all the voices, academic

or not, promoting the participation of the citizenship within a criticism reflection of the processes and results of this scientific activity (social accessibility to knowledge).

- A solidarity and efficient social involvement through social and environmental projects, communities of mutual learning for the human development, creation of new social networks for decision-making which affects the whole of the community, etc.

USR as a global policy for the continuous improvement of the university towards the effective fulfilling of its social mission through the previous four processes, should include all of the institution's academics and administrative processes. In this sense, if USR contributes to a new field of study and of practice, it is because it promotes strategies of participation for interest groups (teachers, students, authorities, research lines, administrative, graduate, etc.) within the life of the university such as the congruence of the university's discourse, institutional transparency, the communication of the institutional results to interested parties and so on.

What is more, the university as an institution of social responsibility is as much a part of the problem as the solution to the situations of social injustice and inequality (de la Cruz and Sasia, 2008). The university's responsibility should be able to promote teaching, research and social projection in the service of the social justice. In consequence, the university not only has to train responsible citizens and contribute to economic, social, and cultural development together with the generation of new knowledge through research, but it also has to influence the transformation process of social vulnerability and economic fields of current societies. The university must respond to the demands of the society, which is the real impact of its activity within the society in terms of transformation. Thus it has to prioritize the social welfare of its activity ahead of its own economic

interests. Therefore, the university's responsibility is based on its transformative character, in other words, in its capacity for social innovation and cooperation with other social agents towards inclusion and social justice.

In this light, the university must deal with: the diversity of needs of the society in relation to different social spheres, all people should have the same opportunity to access the university in order to promote social cohesion; it has to encourage the creation of appropriate conditions and channels for social networks, critical and active citizenship and cooperation with other social agents (i.e., corporations); the research deployed from the university should be in accordance with corporate requirements; transparency, self-regulation and trading balance; it has to achieve the improvement of teaching and research quality through continuous assessment; and so on. However, this set of assumptions is not a guarantee of achieving a responsible university. They are only facilitators for the transformative character of the university. To carry out the transformation process the university should be able to assume the challenges of justice that the social context raises. The realities of exclusion are the first challenge to face with the university listening to the victims of this exclusion. The second challenge is the multidimensional conditions of fighting against injustice. The university could be an effective tool to manage social differences (sex, race, social status, religion, etc.). Lastly, the university should propose new forms of inclusion for its teachers, researchers, students, management personal, and all the integral agents of the university's structure (external and internal). It involves the participation of all the university community pulling in the same direction and a constant dialogue amongst them all as well.

The university as a social organisation and the educative, cognitive and social impact that its activity generates, are powerful factors when teaching people because from its interior many future politicians, researchers, directors, etc. leave think-

ing in the way that the university has taught them. After their graduation from the university, these people disseminate the prejudgements, preconceptions and deontological habits established from the roots of their university professional education. Therefore from our view point it is fundamental to communicate to the whole university community the approach and meaning of USR in order to make it understandable for all university "stakeholders" with the intention of constantly improving the institutional processes and to carry out the final purpose, institutional commitment, based on ethical duties such as integrated teaching of the professional and the citizen, social development and justice.

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THIRD PART

PROFESSIONAL ETHICS: INSIDE THE LEARNING PROCESS

CHAPTER 5

Dealing with the learning process of professional ethics

Today, one of the most dynamic areas in applied ethics is that of professional ethics (e.g., medical ethics, business ethics and engineering ethics). The necessity of this ethics is grounded in the reality that as future professionals of the engineering field our students will always be faced with alternative courses of action when developing their professional activity. Thus ethics is our attempt to provide to the students guidance in regards to their freedom to choose when making decisions, from a range of possibilities that is being increasingly widened both in and through engineering. Because of this, first of all, in this chapter, we will focus on the teaching of professional ethics to undergraduate students in engineering schools, mainly in the specialities of Information and Communication Technologies (ICT). More specifically, we will explore how some characteristics of a virtue ethics approach could help to both improve and add depth to this process, because for us, what is really central to moral behaviour may be argued to be the development of good habits or virtues, in an engineers' character. The introduction of the virtue ethics approach, within the educational process, which focuses on the character of the moral agent, rather than the rightness of an

action, can help us to address the ethical dilemmas raised in the exercise of the engineering profession.

Professional ethical development has become an increasingly important feature of professional engineering life. It plays a central role in the training of future engineers and a supportive approach, such as virtue ethics, is the place to cultivate it. Therefore the second point to develop in this chapter is the knowledge of how to perform this approach within the learning process in order to promote the development of character. Classroom analysis of ethically relevant professional engineering dilemmas (cases) is one of the most useful strategies to explore this kind of professional ethics in engineering schools. Dialogue and debate are two quite different approaches to the analysis and evaluation of these cases. In addition, a hermeneutic perspective and dialogical ethics appear here as very suitable approaches for students learning engineering ethics. From a hermeneutic perspective, understanding is based upon cases and takes the form of a dialogue. In dialogical ethics, through dialogue, students are invited to develop new, shared ways of seeing and acting. Therefore, dialogue plays an important role in helping students to feel the essential empathy involved within a conversation on values, norms and virtues in order to make "good" choices when analyzing cases that arise in their daily personal and professional development.

Furthermore, in order to gain a good understanding of moral issues, concrete detailed experiences and perspectives need to be exchanged among students through both the hermeneutic perspective and discursive ethics. From our view point it is necessary to emphasize the need for moral inquiry by eliciting stories from participants, exchanging experiences and drawing conclusions for the future professional practice. By combining these traditions we develop both a theoretical and a practical approach to empirical ethics, in which ethical issues are addressed and shaped, together with all the participants (i.e., stakeholders) in practice.

Immediately after, we will introduce a set of distinctive features that demonstrate why dialogue rather than debate should be promoted among students in order to improve practice concerning deliberation and interaction between them. It is a fact that the current globalized society is characterized by strong cultural differences, contrasts, and oppositions that serve to strengthen diversity. For this reason, we are convinced that fundamental differences in an intensely interconnected world not only require dialogical relationships between people to help them to understand each other, but also a society that has developed the capacity to deal with its own differences, contrasts, tensions, and uncertainties. Thus, cultural and historical divergences require a well developed dialogical capacity in order to perceive, recognize, and deal with these differences, contrasts and oppositions, and to arrive at workable negotiations and agreements in the face of conflicts and challenges.

In this light and drawing on the work of Gadamer (1988), the role of foreknowledge, the interpretations and understanding that the student brings with them is worthy of note. Within the learning process, the student should enter into a dialogue with others in order to become attuned to new perspectives. The student is confronted with new ideas and experiences, which are then reinterpreted in the light of their own starting viewpoint. In this sense, knowledge is always new for the student as it is part of the process of adjusting their own foreknowledge in new circumstances. This new knowledge, coming about through reflection on the process of learning, does not come about in isolation but through the engagement with new contexts belonging to different and wide relationships.

Lastly, because case study often becomes a kind of game where the students learn to guess the right answers to the teacher's questions, additional learning tools are required to provide different options when analyzing cases. In this chapter we will present an additional resource which is being revived in order to promote the moral life of our students, literature. This is another

possible proposal to explore and fulfill within the learning process of ethical issues for future engineers. This learning tool can allow us to work through ethical implications outside of the professional context, but still incorporates all the elements and actors necessary to configure a suitable context in order to examine the ethical aspects of a concrete circumstance located within it.

By means of this set of approaches and learning tools students would realize that ethics is not just another type of problem-solving subject where at the end of the process you get a clear-cut answer. We show them that the learning process of ethical issues involves an intense exchange of ideas in order to achieve a consensus or resolution with regard to a concrete conflict and that this exchange demands effective communication among participants.

In summary, the main goal of this chapter is to show how the scaffolds of the learning process in engineering ethics could be based on a combination of both hermeneutics and dialogical ethics *together* with the study of cases and literature. Each of these approaches stress, with more or less intensity, the importance of practical processes such as: improving the moral competencies of a professional, increasing the skills involved with decision-making processes, fostering a culture of constructive dialogue among multi-disciplinary professionals, and enhancing the quality of professional development, in relation to the moral dilemmas of concrete professional and personal situations.

The contents of this chapter are based on the following paper:

- M. Serra and J.M. Basart, "A Dialogical Approach when Learning Engineering Ethics in a Virtual Education Frame", The "Backwards, forwards and sideways" changes of ICT. Proceedings of the ETHICOMP 2010. Universitat Rovira i Virgili (URV), Tarragona (Catalonia).
- J.M. Basart and M. Serra, "Applied ethics in engineering schools". VIIth European conference on Philosophy and Computing, ECAP 2009, Bellaterra (Catalonia).

1. Applied Ethics within the training of engineering professionals

Applied ethics displays a strong philosophical stamp constituted primarily of interdisciplinary knowledge and, in an eagerness for criticism and of axiological renewal, it establishes actors such as the ethicist (expert in applied ethics), social and professional practices (i.e.: ethics committees, advice to professional associations and a legislative body) and a new ethical turn within teaching and research, based on the notion of a particular ethics, the ethics which is oriented towards professionalism (Harris, Pritchard and Rabins, 2009).

Teaching applied ethics can increase student sensitivity to ethical issues simply by making students aware that they, as professionals of engineering, will have to analyse certain ethical problems. Just being exposed to a few examples of a particular problem, and having them identified and explained, will make it more likely that the students will recognise a problem of that sort when it arises in the workplace. By way of example, a student who reads a code of ethics is more likely to know what the meaning and purpose in it is than a student who does not. A student who has to answer questions about the code is more likely to recall the relevant provisions than one who has not. In this case, the knowledge of standards involves more than just knowing what is written in codes or handbooks, it involves understanding the rationale for them, especially the consequences of departing from them.

Furthermore, in order to be prepared for a practice that embodies ethical issues, students need to develop a keen awareness of the potential risks of their work, both immediate and long-term; they need to experience grappling with the inevitable trade-off between safety or environmental sustainability and other concerns, such as cost and time pressures; they need help thinking about whether and how their responsibilities regarding

safety and human welfare vary depending on their particular role in their workplace; and they need support in developing personal qualities like the courage needed to make and carry out difficult decisions, hence the requirement for an applied ethics that will help educators to carry out with all the previous professional goals within an integral and complete engineer's curricula.

1.1. Applied ethics: the ethics of professionals

The specific features of a concrete profession have brought about the development and consolidation of the emergent ethics, professional ethics which have been gathered and presented through the professional codes of ethics. These codified professionals ethics collect the standards of conduct of all professionals closely bound to a set profession and they also reflect a consensus in relation to the basic principles that have to govern the exercising of the profession, as well as a commitment to respect them in respect to society.

Over the whole field of the engineering this ethical dimension of professional activity has been consolidated too. So nowadays, one can talk about the ethics of engineering, even about specialized ethics corresponding to the different specialities of the engineering or other activities related to technology, such as bioethics or ICT's ethics. It is a question of recognizing that a person who is dedicated to the engineering profession has a commitment to the profession and society as a whole. Currently, within this commitment, environmental issues are included in order to respect human welfare while also taking into account animals, plants, earth, the atmosphere and water.

From the start professional ethics has a great complexity due to several factors. The first is the professional in question, a person with their own moral option which influences her professional behaviour. Secondly, this professional belongs to a collective which has regulative elements of conduct (i.e.: professional

codes). This means her professional activity is developed within a concrete context made up of corporations, public administrations, consultancies, etc. which have their own goals and orientations that the professional has to know how to integrate appropriately. Finally, this professional has relationships which involve interaction with users and customers with their own moral conception, and as a professional, she also has to take this into account. This set of elements needs to be considered and managed adequately through mechanisms and tools in such a way that the professional feels comfortable in the midst of such strain (corporate ethics, code of ethics, personal moral of the professional, the moral of the costumer, etc.).

In accordance with (Bilbao, Fuertes and Guibert, 2006) the moral issue has two aspects:

- The first dimension is the search for happiness through the development of certain ways of conduct, based on the application of attitudes called virtues (Aristotle and teleological ethics). (Chapter 1, section 4)
- The second dimension is the juridical. It involves the fulfilment of duties, the establishment of procedures that enact correct rules (Kant and the deontological ethics). It assigns the duties that every one of us has towards the rest of society. (Chapter 1, section 3)

Transferring this distinction to the professional field we can state that professional ethics is the expression of diverse and plural ethics existing in each professional of a determined specialty, called personal ethics. This ethics is exclusively personal since it affects the sense of perfection and happiness of everyone. It defines the duties that we have only towards ourselves and not to the others (Cortina, 2009) whereas deontology expresses the minimalist ethics (Chapter 1, section 4) as that which all personal ethics share and are obligated to fulfill despite their differences.

Having arrived at this point we can say that the deontological dimension should be complemented by the teleological dimension and vice versa (Bilbao, Fuertes and Guibert, 2006) in order to configure the foundations of an applied ethics. In other words, whereas teleology, as a trend toward a horizon (the good), finds its reference in the individual, deontology, as an expression of an obligation, refers basically to a collective context, to a normative text elaborated and countersigned by the corresponding professional association. From these two approaches, an applied ethics should avoid, not only the great moral principles empty of practical contents (too abstract theories), but also dull pragmatism based on the mere fulfillment of the deontological casuistry.

Therefore professional ethics has to be understood as being an applied ethics with, at least, a double meaning. Firstly, from the perspective of each particular professional, who has her own personal moral approach together with the particular specificities and conditions of the activity that she develops. In this case, in the professional ethics of the subject, the teleological dimension should integrate the deontological dimension. Secondly, from the perspective of the professional collective of a concrete activity, the professional ethics will be an applied ethics where the management of the teleological dimension and the deontological dimension is more complex. In this case, because the subject is a collection of a set of features which should be taken into account such as: it is not an individual ethics but rather a set of shared values applied to a professional field to achieve a common goal; it is a case of self- regulation where the professionals think about and agree to a code of ethics; it is an opportunity to constantly and explicitly formulate proposals of virtues, ideals and ends for their professional activity and it is the way to participate in a dialogue with a similar moral sensitivity in order to construct a civil ethics.

The purposes of the applied ethics range over the deepening of the philosophical aspects such as: supportive tools (moral reasoning, discursive ethics, virtue ethics, etc.); its concerns about

social issues; its critical approach when facing moral conflicts; its binding with the context in which it is applied and the recognition of the diverse ways of living within the context of plural societies, it involves a set of guiding principles in order to build the professional ethics that as educators of engineering we pursue. Thus one of the guiding principles to emphasise within the perspective of the engineering profession is the "doing of good". This principle when applied to the profession means that professional activity is a kind of human practice based on excellence or, what is the same, developing concrete attitudes, materialized in habits called virtues (Aristotle). Accordingly, the professional is expected to render a good service to the user, acting for benefit of her without harm or prejudice. This is the inherent end of the professional practice. Even so, professional practice focused on good service will depend of the personal morals of the subject and in many cases it is possible that there is not a complete convergence between professional and customer. For this reason, applied ethics within engineering schools is not a trivial subject to teach and a learning framework to strengthen the moral experience, as virtue ethics, is necessary.

According to (Grodzinsky, 1999) virtue ethics proposes evaluating actions not so much in terms of rules and consequences as in relation to what might be called their personal experiental character. In Grodzinsky's words "The concept that we live a certain way and that our actions grow out of the vision of who we are is too important to jettison. Personal intentions and dispositions guide actions, and people who care about morality think of others as well as themselves. Morality is knowing how to live and act well. Doing the right thing is no about an action divorced from the self. It is an action that flows from the self; it is internally rather than externally imposed".

Consequently, our interest, as educators, lies in showing the core values embedded in the virtues that will offer the basis for the development of character and personal ethics in order to

lead to the professional ethics that we pursue. Again, in accordance with Grodzinsky "Ethical responsibility begins by taking the ethical point of view. We must respect others and their core values. If we can avoid policies that result in significant harm to others that would be a good beginning toward responsible ethical behaviour". Virtue ethics has a deep understanding of the social and interpersonal nature of our human existence and how this can affect and be influenced by our moral behaviour. In this light Grodzinsky says "Before asking our students to examine the complex and novel issues of computer technology, we must first ask them to examine themselves as human beings with values that motivate them to live their lives in a particular manner". The core values are those which give us reasons to favour some courses of action over others. This fact is particularly evident within the global nature of the ICT world where the engineers will deal with multiculturalism forcing them to find a constant mutual consensus, comprehension and respect. Furthermore, and following the line of Grodzinsky, the concept of core values "[...] offers the computer ethics professor a means of examining human behaviour and illustrating examples of living well, respect for others and flourishing [...]" in order to get prepared for serious ethical discussions involving the policy issues of computer ethics. In this way, virtue ethics as character-forming theory challenges students to become more self-aware and reflective so that they can appreciate the seriousness of these conflicts and engaging with them in an appropriate way.

1.2. The teaching of professional ethics through virtue ethics

ofessor is essential when students are learning. Without doubt, the professor needs to master the subject and also has to know how to communicate it efficiently, whatever the subject may be. When the subject is some type of applied ethics, trust becomes critical because in it, the goal is not to describe ethics theories,

but to *convince* the students that ethical points should be taken into account, and to show them how to do it (Basart, 2008). As Aristotle would put it, "Here, we are not interested in what applied ethics is, but in how to integrate it in our life".

The fact is that there is often a great gap between what is shown and analysed in classroom exercises and the tougher working environment professionals meet (Lynch and Kline, 2000). From one side, this disparity generates disbelief and scepticism among many students; they are aware of this gap and therefore feel that ethical considerations do not have any power when we leave the *idealistic* academic debates and come to the *real* world of business. The problem can be formulated by means of the question: "Dear professor: Why should I [a student] believe what you say about professional ethics?" A standard answer to this might explain how great the computers' influence in so many activities of our day-to-day life is. Consequently, some - at least - professional responsibility springs from the power of those technicians designing, manufacturing, programming or operating any kind of computer. "However -our student goes on- I agree that these reasons are convincing *as long as* these ethical requirements do not damage my personal interests. Otherwise, why should I harm myself?" On the other side, this strong challenge can make professors feel uneasy and somehow helpless when they are accused by students -or colleagues- of being too naïve.

When the main tool in classroom exercises is considered, that is to say real (or realistic) case analysis where serious ethical dilemmas appear, virtue ethics appears to be the most useful approach; more so than deontological or utilitarian ethics. We note, firstly, that these stories and accounts allow the tutor to show the students concrete situations where several values are confronted, what personal interests are in opposition to professional duties or responsibilities, who could be damaged or threatened and how, who and how could be benefited and how, what different outcomes are possible, and so on. In these accounts, it

is possible to show, through the main character's behaviour, what attitudes and decisions are ethically preferable and why. This kind of analysis fits very well with the assumptions established in virtue ethics. One of those is that, in professional practice, it is not always possible or desirable to establish a clear cut distinction between personal responsibility and professional responsibility. This is known to be the case with doctors, teachers and journalists. No doubt with engineers too, although not all of them are equally aware of this connexion.

This important feature in virtue ethics opens a good line of reasoning to take up, again, the student's objection -although not to give a solution to his anguish, for serious moral dilemmas always require a risky personal commitment that no formal arguments can avoid. The "flourishing" or "well-being" translation of the Greek noun *eudaimonia* points to an integrated conception of the human being in which both moral and intellectual powers (*arête*, virtues) develop together in harmony (Cafaro, 1998) this evolution happening in a social environment where self-interest is not opposed to social-interest because there is neither a community without people nor a person outside society. Any clear-cut separation between the values and attitudes I respect and promote as an engineer, and the ones important to me in my private life, is not only difficult, it becomes impossible. All attempts to keep oneself safe and sound under this moral schizophrenia are damned from the start, for what is really important to us is always important to us; it does not easily accord to frequent exceptions and conditions. Therefore, it is in my self-interest, not only as a person, but also as a competent professional, to firstly understand the social responsibilities attached to my work as an engineer and to secondly take care of them. Furthermore, this moral consistency among different spheres of a life has a twofold benefit, personal and public. On the one hand, to act with consistency provides sense (meaning) to one's life. This sense is most valuable because it does not become established by something

external to the individual (as is the case with duty in deontological ethics or calculation in utilitarian ethics), it comes from inside oneself. On the other hand, consistency is an essential quality in any one asking for trust.

Finally, we cannot forget the tutor on the other side in the learning process. So far, all said here was addressed to the student; now, what about our helpless educator? Again, coherence will make the difference. Being a tutor is to hold a position, but every tutor is, first of all, a person. In the classroom, all the words, gestures, acts and attitudes coming from the tutor count; from day to day each one has an effect on the students. Thus, for tutors aiming at minds and hearts, confidence from students cannot be assured just by means of well organised speeches from third parties. It has to be earned, little by little.

2. Hermeneutic and dialogical: suitable approaches for the learning process

A traditional approach to teaching engineering ethics aims to provide knowledge about ethics. This is in line with an epistemological view on ethics in which moral expertise is assumed to be located in theoretical knowledge and not in the moral experience of the engineer's profession. Yet this traditional way of teaching engineering ethics has its limitations. The theoretical contents of the ethics' textbooks make engineers feel removed from their own values and moral experiences (Basart, 2008). Learning ethical concepts and principles is needed, but engineers are not adequately trained when they have to face real moral dilemmas and make moral decisions about them. There is a lack of correspondence between theoretical knowledge and practical application of it. For this reason, it becomes necessary to pay attention to the training of moral competences, virtues and to dialogue and have deliberation among engineers in order to develop analytical

skills to solve real cases. Thus a contextual approach to teaching ethics, which can be grounded in a hermeneutic and dialogical ethics, is required as an alternative. In this alternative, on one hand, hermeneutics implies: investigate what the situation is, who is involved in it, what solutions to envisage and the problems to encounter. In this way, engineers are obligated to be open to the context and unforeseen happening, driving them to find new solutions and possibilities. On the other hand, dialogical ethics focuses on extending one's perspective through a dialogue. In other words, being open to what the other has to say, being prepared to accept it as relevant and valid for oneself.

This alternative allows us to describe the development and meaning of the moral competence of engineering students in terms of practical experience, meaning, how moral competence works in practice, and accordingly, in daily professional engineering dilemmas (cases). Therefore, real (or realistic) case analyses where serious ethical dilemmas appear allow the teachers to show the students: concrete situations where several values are confronted, what personal interests are in opposition to professional duties or responsibilities, who could be hurt or threatened and how, who could be benefited and how, and finally, what different outcomes are possible. All of this makes decision-making feasible in their daily professional practice. In these cases, it is possible to show through the main character's behaviour what attitudes and decisions are ethically preferable and why.

In order to gain a good understanding of moral issues embedded in professional ethics (for instance, engineering ethics), a hermeneutic ethics dialogue is useful as a vehicle for moral learning, helping students to find answers to the cases and to develop moral competencies. A dialogue assumes that the participants already have some interest in and insight into the matter at hand. It also presupposes that the participants can elaborate their interest and knowledge through an exchange of perspectives. Dialogue requires openness towards the views of others.

Therefore, dialogue can be seen as a way of making sense of cases and coming to joint interpretations of these cases and, simultaneously, dialogue as a learning tool is able to promote: understanding (paying attention to other arguments, ideas or proposals); flexibility (integrating cultural diversity); equality (all voices have the same weight); empathy and sensitivity (emotional awareness in regard to each other).

Thus dialogue becomes the main tool of interaction between people. It is a way of expressing our experiences and feelings. Furthermore, the dialogue is a declaration of values. The learning process is achieved through inquiry and the content is actually the vehicle for sharing in creative ways using technology. By which is meant, students create questions and topics of inquiry to explore the contents to learn. In this way, they feel actively involved as they learn from multiple resources such as print, electronic, media, plus student responses and reflections. As they develop computer and critical thinking skills, they are empowered to share their discoveries with others. Through empowerment, students can achieve their potential not only in the cognitive domain but also through feelings of self-worth and values shaped along the course of their professional and private life (Kohlberg, 1976).

In sum, dialogue occurs through technology (email, video conference, chat, group discussion and bulletin boards) and provides the opportunity for active construction of ideas, reflection and participation among students. This new vision of learning based on inquiry through dialogue, where the students' questions take the most important role within the learning process, should be implemented to improve ethical behaviour.

2.1. Hermeneutic ethics and dialogical ethics background

Engineering profession is an inherently moral profession. The good professional exercise of an engineer involves choosing a moral position when moral dilemmas arise in their daily profes-

sional practice. The definition of morally good exercise of the profession is an ongoing contextual process, based on concrete experiences with different stakeholders (engineer, manager, customer, organization, etc.). In this process, all of them are, and will be, confronted with moral issues. Although all the participants involved in a situation are facing moral issues every day, normally the opportunity for dealing with moral issues is lacking. For this reason, specific moral deliberation methods are needed in order to support participants taking on these moral issues in a more reflective, dialogical and understandable way.

Hermeneutic and dialogical ethics appear as very suitable approaches for students learning engineering ethics. By combining these two approaches in helping to solve moral dilemmas, stakeholders are involved in the process of reflection and analysis, which takes place in a dialogue between participants. To begin such reflection and analysis we take, as a starting point, the works of: Socrates, Gadamer and Habermas. So next we are going to comment, broadly speaking, on the essential ideas on which our work is based (more information about these thinkers can be found in Chapter 3).

Socrates (Socratic dialogue)

Dialogue promotes the identification and examination of our assumptions and tacit beliefs and, at the same time, allows us to prepare and evaluate our arguments. These elements are important in the practice of professional ethics (for instance, engineering ethics).

The Socratic dialogue, through a set of questions, allows us to provoke a state of confusion in the people involved in a conversation, offering the opportunity to develop the skills of argumentation. Therefore, it is possible to learn something from the experience, as this confusion can be the precursor to a profound change in one's conversational attitude from which a

dialogical attitude may follow, or in other words, an attitude of open mindedness towards what others have to say to us. Without this open conversational attitude it is difficult to deal with ethical issues well.

In this light, Socratic questions are fundamental and closely related to ethical issues. The stakeholders involved not only need to come to grips with these questions, but they are also forced to practice the insights gained during the inquiry and learn from them. Thus, they should take the opportunity to learn from the whole experience in dealing with ethical dilemmas while working and living together in the everyday life. Besides this, the use of Socratic dialogue in engineer ethics helps and indeed forces people to clarify their own aims and goals, in fact their true interests.

In practice, all kinds of tensions appear. People working and living together inevitably develop all kinds of interdependencies. The actions of everyone depend on the way they deal with their own interests (as engineer, as client or as manager). The use of Socratic Dialogue can help one to learn from the failures and successes of oneself and others through genuine inquiry in order to settle: conflict analysing and mediation or policy making. To successfully carry out Socratic dialogue, it is necessary to feed it with the new participants' questions and experiences. Instead of excluding people's voices, it is important to form a group to exchange perspectives, work and live together and account for all attempts. Dialogue shows the way to share experiences, develop common communicative rules, and maintain manners of doing and including newcomers.

Gadamer (Hermeneutics) and Habermas (Dialogical ethics)

Dialogue is crucial in order to find consensus towards moral dilemmas and for developing shared understandings and improving social praxis. This idea is present in hermeneutic ethics, which is grounded in the hermeneutic philosophy of Gadamer (Gadamer, 1988).

In the first place, hermeneutic ethics aims to articulate and explore the various, sometimes conflicting, perspectives and interpretations in a morally complex situation. Consequently, hermeneutics can help the engineering students to develop new and richer ways of dealing with actual moral dilemmas.

According to Gadamer, understanding a text belonging to a certain tradition is a similar process to understanding a person in a dialogue or conversation. Thus hermeneutics can be seen in dialogical sense, in which we open ourselves, not only to receiving the message of another, but in a sense transforming our consciousness after contact with him or her. In other words, being open to what the other has to say in her context, instead of ignoring the response, and being prepared to accept it as potentially relevant and valid for oneself. Because of this, language becomes a means of communication in which concepts and ideas are related to other view points throughout time, life, experiences, etc. As a result, a dialogical approach emphasizes the fact that ethics is concrete and contextual and human beings interpret their situation and try to make sense of it.

In addition, hermeneutic ethics implies a set of elements such as the notion of perspective, dialogue as a learning process, and practical rationality. Hermeneutics starts from the idea that human life is a process of interpretation. Human actions are not caused by the environment; they embody a specific understanding of the situation. One sees the situation from a certain perspective, which is the result of both prior experiences and current views. From a hermeneutic view point, perspectives on a situation at hand are not rigid and closed. They can change through dialogue.

Dialogue is not seen as an instrument or technique to reach better decisions; it is rather understood as an ongoing, social learning process in which people develop new and richer understandings of their practices. This process of developing more enriched practical understandings is grounded in concrete experiences. Hermeneutic ethics assists various stakeholders to

understand their practice from multiple perspectives. In dialogical interactions these multiple perspectives may evolve into new horizons, in terms of Gadamer. Communication as horizon fusion is possible because of language. In this case, language reveals itself as a way of opening up the meaning of being and without it nothing can be understood.

Secondly, from the Habermas position, hermeneutics allows us to understand the motives, values, feelings, and thoughts of others through of the concept of inter subjectivity which is entered through socialization, especially language acquisition (Habermas, 1984). Habermas says that speech must constitute an unconstrained exchange of opinions in which all speakers enjoy equal rights of participation. Participants are involved not only in a continuing search through ideas but in a comprehensive process of mutual agreement or consensus through common deliberation on shared goals. For this reason, this dialogical approach is important for us, as educators, when training students. In this way they are invited to develop new, shared ways of seeing and acting. Therefore, dialogue plays an important role in helping students to feel the essential empathy involved within a conversation on values, norms and virtues in order to make "good" choices when making decisions about cases that will arise in their professional world.

3. The leading role of dialogue within the training process

As we mentioned previously, case studies are the staple of ethics education and ethics training. Many of these cases are guaranteed to perplex engineering students enough to stimulate lengthy conversation and are substantial enough to create complex conversations about what is ethically correct. In fact, we pursue a dialogic interaction between engineering students to find out a response when the ethical dilemmas arise within the cases.

In this section dialogue is shown as a resource that helps students to answer the challenge provided by ethical dilemmas within the training process (cases). Furthermore, we will characterise what dialogue is by comparing it with debate and which features of the dialogue are promoted.

Why dialogue instead of debate? There many differences between a dialogue and a debate. Conversations that begin well (balanced exchange of ideas among people) often produce nothing, ending either with reproaches or the conversation evaporating into a non-committal conclusion. It seems to be that people are not naturally capable of having an effective good moral conversation, as we are not born with the skills needed for it. Instead we have to acquire and cultivate them through practice and for acquiring these skills we propose dialogue instead of debate. The main reason is that through dialogue we will be able to avoid the aforementioned pitfalls. Dialogue increases the likelihood that people will acquire the skills that promote a manner of doing (and living) in which ethical matters (and others) can be successfully discussed.

In contrast, debate could be another tool to take into account when it is necessary to analyse and evaluate cases, but debate pushes people to discuss within a rigid set of principles (preconceptions, beliefs), imposing a fixed position because one is not sympathetic with other positions and resists the idea of new possibilities. From our view point, this possibility is rejected because its connotations do not invite respect for other people's opinion, not addressing each other within a conversation. Thus debate does not seem to have the adequate features to arrive at comprehension while taking into account the different point of view inserted into a conversation. In fact, debate promotes confrontation and division between ideas instead of reconciling them and constructing new ones. Due to the preceding handicaps, debate does not appear to be the appropriate strategy to address cases when professional engineering dilemmas arise.

The following table summarizes the main differences between dialogue and debate:

	DIALOGUE	DEBATE
(1)	Etymologically refers to: "talk" or "meaning": construction and comprehension	Etymologically refers to: "beating" or "flowing": confrontation and division
(2)	Openness to change	Closed mind
(3)	Agreement, consensus, better understanding, new findings	Convincing desire
(4)	Neither winners nor losers	A single winner
(5)	Tolerance and respect	Inflexibility and rudeness
(6)	Appreciate silence and pauses	Interruptions and impoliteness
(7)	A way of living in harmony as a goal	A way to flatten as a medium

To begin with, this set of seven distinctive features shows why dialogue instead of debate should be promoted among engineering students, especially in the learning process of exploring ethical matters. In this case, cultural diversity calls for flexibility, tolerance and an open minded way of thinking.

In addition, it is necessary to emphasize that this set of features are supported by the works, previously mentioned (Socrates, Gadamer and Habermas) giving solidity and truthfulness to the dialogue pursued.

(1) The fundamental desire of partners in a dialogue is to investigate a matter to comprehend it through a constructive conversation. We are engaged in dialogue when we speak with one another on the assumption that there is something we have to say to each other. And this fact implies a clear understanding and a very special listening between the interlocutors. In relation to Gadamer's principles, in a dialogue it is very important to take into account the reception, attention and understanding of the

other because the dialogue has an ontological dimension. The dialogue constitutes the human being. Therefore, in a dialogue certain moral principles are implied because we ask for a responsive and understanding attitude from each other.

On the contrary, in a debate, the fundamental desire is to convince, in an immediate way, and to get one's opinion accepted. Furthermore, everyone involved in a debate is doing the same, thus confrontation inevitably appears because each of the participants is trying to impose their opinion. In practice, the final consequence is that participants are chiefly engaged in trying to prove each other to be wrong, to destroy the others opinions when they are not compatible with one's own.

(2) According to Socrates, in a dialogue, there is an increasing enrichment, or clarity, through the constant inquiries between one another. This means that I can not only gain insight into the questions, ideas and beliefs of the other, but also into my own questions, reflections and convictions because in a dialogue I can find out what it is that I want to explore with regard to a problem. For Socrates the problem dispels the human beings' ignorance. So, dialogue creates an openness to change because of the acceptance of each other's viewpoints and alternatives.

In a debate, arguments divergent from mine appear as obstacles or nuisances to be removed forcing the conversation off track. It becomes unclear what the subject of conversation is because, quite often, everyone talks about their own subject and not about the subject under discussion.

(3) In a dialogue participants strive for mutual understanding because what is looked for is an agreement, a consensus, new findings. However, according to Habermas, to reach this mutual understanding, the participants must show a real interest (predisposition) when they establish a conversation through a dialogue.

In a debate participants seek to convince each other that they are right, constantly demanding speaking time. In other words, participants undermine each other's standpoints and look upon each other's speaking time as lost time because the interest in understanding one another is null.

(4) In a dialogue, there are neither winners nor losers. Participants don't just accept each other's beliefs and persuasions, but will explore these. Listening, probing and questioning the arguments, the ideas that characterize the dialogue, rather than imposing a proposal as in a debate. Following Socrates' method, dialogue generates the best available atmosphere to persuade and dissuade and look for a mutual exchange of reasons in which participants gain a better understanding both of the problem or subject under discussion and of themselves.

(5) Dialogue actively promotes tolerance towards what is different as one of the main ways of showing respect to others. Participants are attentive to each other inquiries and explanations because all voices have the same weight, all of them count. Everybody involved has an opportunity to express and argue for their opinions. A fruitful dialogue consists of empathy and of a critical and reflexive attitude to self and to others making a rich understanding taking into account all different viewpoints. Because of this, the interplay of partners in a dialogue has the potential to generate shared meaning through what Gadamer calls the "fusing horizons" (Gadamer, 1988).

However, debate stifles the willingness to listen to each other due to the attempts to defeat the other participant. The fruit of this circumstance is a constant interruption of participants' contributions in a disrespectful manner of speaking. Debate promotes aggressiveness and high-handedness because all other viewpoints have to be overpowered.

(6) Dialogue values pauses and silence. Habermas recognizes that more is involved in communication than the grammatical comprehensibility of a sentence. Necessarily there is another feature to take into account in a speech, its social structure (Habermas, 1984). For him there are qualities of speech directed at understanding. For instance, such breaks need not necessarily be empty moments; they can allow the interlocutors to: think about the different opinions set out in the conversation, achieve shared appreciation, recognition of differences, construct new arguments and ideas, or simply, *leave* the dialogue to flow in a calm way promoting an appropriate atmosphere for reflection and understanding.

Debate tries to take advantage of these breaks. In this case, such breaks are useful to leave the opponent astounded because the speech from her is like an ear-splitting noise. The opponent has no time to react or response to the huge set of arguments received in a few moments because the main goal of the rival is to get his or her opinion accepted or imposed, not to reach mutual understanding.

(7) According to Socrates, a dialogue is a way of living in harmony. It is an end in itself. He is always looking for a constant argument, because without it would be impossible to discover what is fair, good and virtuous. Through dialogue we don't only analyse other people, but come to understand them and ourselves. In this way interlocutors are able to rearrange misunderstanding, blame, gestures, etc. promoting understanding of each other, re-evaluating themselves persistently and cultivating a well-balanced environment. Thus personal improvement is guaranteed and, consequently, coexistence is better.

In contrast, debate appears to be a technique that requires some skills. It is just a means to an end. When debating, one persists in trying to get all the speaking time in order to get all the credit. In a debate the interlocutor is thinking against the

other instead of thinking with them, imposing restraints instead looking for alternatives, acting in line with disagreements because her opinion is held to be above the others', avoiding depth and nuances of other viewpoints, and so on. In sum, in a debate there is no place for an open, straight, constructive communication and the moral sensitivity is null and void. With this set of ingredients, living in harmony seems to not be a goal, a utopia.

The features of dialogue considered above help the students to feel the essential empathy required during negotiation and critical discussion choices, necessities and consequences. To carry out this dialogue characterized by this set of features, first the participants must have some predisposition to respect and accept them in order to establish common communicative rules. And, second, the starting point of the participants, involved in a dialogue, must be a neutral stance, without any fixed ethical position. From here and through the dialogue, participants will get to put values into practice.

What is more, it is necessary to emphasize that dialogue, as a learning tool, reinforces each element that we have highlighted within the set of features because of their importance i.e. in order to establish a fruitful and respectful dialogue. The elements improved by the dialogue are: equal opportunities (inclusion and diversity of other perspectives and opinions), empathy, affection (balanced and rich coexistence within different kind of relationships) and comprehension (to be more aware of other people). All of these elements connote a mutual relationship within a dialogue, in the sense that all participants construct and give great solidity to it (Bach and Darder, 2007). This construction of the dialogue makes showing individual beliefs and feelings possible.

However, what is the effectiveness of the learning process, when students are learning engineering ethics through dialogue? Really, is there coherence between what the students learn through the meaning of this inquiry process and, afterwards,

what will they really apply in their workplace? Coherence is a very eloquent value to take into consideration because it shows the capacity, or not, for real compatibility between what we say and what we do. For this reason the learning process of ethical issues is possible if we keep in mind this coherence in order to evaluate, in an appropriate way, the acquisition of them. Coherence is a very important element when engineers analyse cases and ethical dilemmas arise. Dialogue, as a learning tool, will allow them to work with this coherence in order to come to an appropriate agreement on these cases. Thus, coherence as an ethical value will be an important ingredient when ethical issues are assessed throughout the learning process and when it is necessary to ensure its effectiveness.

In conclusion, using this dialogical frame it is possible to generate meaning around the beliefs and values embedded in professional ethics, i.e., engineering ethics and, concretely, how the practice of this meaning develops a greater understanding of the contradictions, ambiguities and distortions hidden within everyday interactions.

4. Complementing the learning process: literature

With regard to engineering, technical schools and universities have an important influence on, and responsibility towards, the education and training of the main habits, attitudes, and values that an engineer should acquire throughout her learning process. However, one or two courses on applied ethics and some rudiments of the social implications of technology are not enough. In (Bucciarelli, 2007; Whitbeck, 1995) there is an insistence that even the standard study of cases does not produce the expected results. Engineering curricula afford very little time to these analyses; this limitation leads to great simplifications and the loss of real context. Study of cases often becomes a kind of

game where the students learn to guess the right answers to the teacher's questions.

Other alternatives can help us with the learning process of ethical issues. With additional treatments of novels, biography, plays, history, sociology and philosophy of technology, students could get the opportunity to realize that engineering did not start when they were born, that there is a past to know and from which to learn. For instance, stories and popular tales that reflect myths and heroic references have remained through the ages. As educators, the use of these allows us to show which values have been embedded in every period of the history, the values belonging to a concrete context and circumstances. This set of learning tools is useful in order to represent examples of values and highlight their existence within the daily life of every human being. These include: courage, honor, confidence, willpower, perseverance, loyalty, all of them depending on the historical perspective. In this light, students would find that all around them there are different ways of looking at things, different ways of doing the same task, and that maybe all of them are equally good.

In spite of all these learning tools, the gap between the transference of knowledge (theoretical concepts and principles) and the development of attitudes (praxis) may be more pronounced than ever because many interdependencies, interactions, relationships and participants are present in the professional world of engineering. For this reason, facing these kinds of scenarios and stances requires another way of doing, inside the learning process, in order to show students what needs to be done to analyze and work through the ethical implications. Here we are talking about the close relationship between literature and ethics (Mendelson-Maoz, 2007). This field is being revived in order to enrich the moral life of our students. For (DePaul, 1988) literature can "supply the kind of experience needed to develop a person's faculty of moral judgment". This can allow educators to work through the ethical implications outside of the professional

context, but it incorporates all the elements and actors necessary to configure a suitable context in order to examine the ethical aspects of a concrete circumstance located within it. Literature is a way of shaping human experiences (DePaul, 1988).

4.1. The ethical value of literary work

The tradition that connects ethics with literature goes back to the classical Greek texts where the heroes, very well drawn and described by the author, present the profile of the ideal man that the following generations of men and women should follow as a model for their lives, aiming towards the epic achievement, the attitudes and the virtues that the legendary heroes personified. For instance, one could mention the Odyssey of Homer where many features such as customs, beliefs, values and feelings of a warrior (the human being of reference) are shown; perseverance, loyalty, bravery, patience, intelligence, astuteness, pride, hospitality, vulnerability and so on are all represented.

Works of literature offer us models of conduct, situations and psychological profiles for moral analysis. Literature is tied to ethics and is useful in personal ethical development, thought, and action (Sucher, 2008). This is seen most clearly in the stories that arise from experiences of oppression. People who have experienced suffering most bluntly often feel compelled to put their experience into story. And listening to that story with interest and compassion not only is our ethical duty, but has the power to change us. At this point we can cite the story telling of "One Day in the Life of Ivan Denisovich" (Alexandr Solschenizyn), in which a human being can try to understand or care about the suffering of another, in this case in a Siberian labour camp. The author suggests through this story that he believes such understanding is possible if he tells the story well enough putting the reader who is warm in the position to understand a man in a gulag who is cold. This relationship between the reader and the

writer has the potential to change us and is fraught with ethical considerations because these kinds of stories force us to be empathetic with the protagonist of the work through our moral imagination (Murdoch, 1970). According to Murdoch, the literary work forces us to consider reality from a decentralized position, because for an instant we are looking at the world not from our ego, but from the singularities of the other, thus avoiding the first enemy of the morality, the egoism. In this experience, the reader is able to open a parenthesis where herself is suspended and exposed to the other's reality.

In this light, we can say that literature requires our attention; it puts before us situations that demand of us a response, both in the context of the fictional world and, by implication, in the real world in which we are living. This ability of literature to generate valuable moments of attention points to the tie between story and memory. Part of literature's ethical value is that it preserves human experience for contemplation and evaluation. It snares fleeting human reality in characters, actions, metaphors, and all the other elements of literature, giving us the opportunity to sift, judge, reflect, evaluate, laugh about, cry over, and all the other things we are prone to do with our experience. So, the fundamental idea underlying the variety of claims on behalf of narrative is that narrative is an ingredient to understanding the self, social groups, and their contexts.

The existing bond between ethics and literature demands the distinction between two dimensions which deal with a relationship from two different points of view (Murdoch, 1970). On one hand, we have the influence of literature on the moral life of the individual in relation to the trace that the words of a concrete literary work have left on the people's life. Take, for example, two opposing works, "The Diary of Anne Frank" (Anne Frank) and "The Prince" (Machiavelli). Both talk about human existence but from two different points of view. Anne Frank, looking to understand the existence of herself and others, without any kind

of complacency or aspiration when describing herself and her surroundings and Machiavelli looking at the personal benefit of the human being through power and its maintenance. What we say is that certain relationships, between the literary work and the reader or what the writer says and the reader understands, have the potential to change us to a greater or lesser degree depending on our experience in respect to the literary work.

On the other hand, we have the use of literature for purposes of moral reflection. According to (Antonaccio, 2000) "The relation of the individual to language is the place where aesthetics and ethics meet. This understanding of language cuts across the supposed divide between literature and ethics by subjecting both of them to what I will call the ethical demand of reflexivity, the demand to assess the stories we tell about ourselves". Whereas moral vision is acquired in a social and linguistic context shared with others, language is the property of an individual's unique experience and inner life, too (Murdoch, 1970). In other words, language is the property of individuals that use it as the instrument of their own moral vision and not exclusively in terms of its public meanings and collective uses. Thus, "First, realistic narratives teach us primarily about society and the role of social convention in the formation of character and identity. In the second, these narratives teach us primarily about ourselves and our own moral sensibilities" (Antonaccio, 2000).

In this light, the dimension of the moral experience of literature spreads to different aspects (DePaul, 1988):

- Literature can stimulate the emulation of the characters' conduct in the literary work. The ability to identify herself with some of the decisions, actions and situations lived by a literary character should be understood as a consequence of the reflection to which the moral agent (reader) has been brought. This set of reflections made by the moral agent are created through the experiences lived by the lit-

erary character because the literary work talks through the feelings, interests and reasonings of the characters and this is done in a situation that can be very similar to the reader's situation. After all, people's lives have more similarities with what happens in works of literature than with the de-contextualized explanations of books of ethics. Maybe because of this, literary work is more able to move and shake us than a treatise on moral philosophy. As (Palmer, 1992) says "Our engagement with literature, as with any art, depends upon a particular kind of loss to the self, and one that we may therefore call love". The capacity that a literary work has to attain an effect on the reader depends on the reader as much as itself.

- Literary work suggests different kinds of answers and possibilities for a concrete situation. Without suffering the consequences of a particular situation in their own life, where the facts are irreversible, the reader can learn about things that the literary characters are undergoing, with one condition, that literary work should reflect the truth (Murdoch, 1970) and the reader should be able to grasp it. The literary text can reveal to the reader her self-knowledge, suggesting and helping to think those who possess an attentive mind.
- From an educational point of view, literature is a tool in the service of the tutor in leading the reflection of the pupil through the reconnoitring of values or the analyses of decisions that contribute to her moral progress. For this reason, literature allows an introduction to the moral concept through the induction from the literary practical case that has to then be complemented by the corresponding philosophical explanation.

Literature constitutes a good tool to illustrate reality and induce reflection on the situations (context), moral decisions and

moral life of human beings (Sucher, 2008). In other words, literary fiction can be a good simulacrum to help us to face real life. However, it is necessary to add that nothing can be a substitute for the personal moral experience. All things that not belong to this experience can illuminate it, damage it or be indifferent to it and literature works in these different ways depending on the attraction and willingness to be affected that the reader feels with regard to the literary work and the empathy that the literary work exercises with the reader through different resources such as: the language, the characters, the relationships among those characters, the context where it is developed and the values at stake.

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CHAPTER 6

Methodological and technological communication resources

Nowadays, engineering graduates are facing increasingly complex ethical and social issues in their work. Thus a well-defined training in professional ethics for future engineers is needed. Nevertheless, incorporating courses on ethics into engineering curricula is often a concession instead of a common academic requirement. For this reason, designing an effective introduction to ethics for the academic curriculum requires, on one hand, taking into account several constraints typical of the content and the context, and on the other hand, the approaches (Chapter 5) where ethics is put into practice. From now on, our main goal is to show what the meaning of an ethical communication is by means of some essential integral components such as a set of supportive communicative resources. Also, as a peripheral element in which the learning process could be supported, a set of technological resources will be highlighted in order to expand the horizons of such implementation.

First of all, in this chapter, a set of communicative means of ethical communication will be expounded in order to demonstrate how to help students to escape from individualism and to talk about the value of conflicts (personal and social). We describe

how learning resources such as dialogue, moral reasoning, and non judgemental language work and how their role should be measured in such a way that their ethical communicative function is fulfilled. Moreover, this involves analysing the fundamental requirements of the communication resources (i.e., genuine listening, non-conditioned thinking and open mind). Secondly, we will show that analysing moral conflicts requires appropriate strategies to generate a suitably intensive interaction in order to develop the open dialogue typical of the learning process of ethical contents. Then a heuristic analysis will be explored relating to the above mentioned learning resources.

Lastly, we will analyze which technological resources are suitable to give support in the development of the appropriate ethical communicative competences when deliberating on moral conflicts, based on the preceding framework. In this case the main idea is to reflect on the idea that the learning process of the ethical issues supported by web based technology is currently becoming more of a priority in the eyes of educators and practitioners because of the increasing use of ICT technologies. In others words, the learning process of ethical issues should make good use of technology in order to expand the opportunities for the implementation of the students' ethical training. Web based training, through its flexibility and its commitment to innovation, has the potential to engage with the ethical practices within engineering schools.

In this light, we will identify some of the principal and particular features that a virtual educational environment, supported by web based technology, brings about when the learning process of ethical issues is achieved. The exposition is based on the experience of the virtual campus of the Universitat Oberta de Catalunya (UOC) which has shaped and influenced, in some ways, the teaching process of this kind of content. It is important to know how the use of ICT technologies in education has widened the range of learning possibilities and the most relevant

of which is probably the feasibility of distance learning, in the form of e-learning (Bates and Poole, 2003). ICT gives us a new educational space in which is possible to learn and to construct educational frames where people join in to interpret the world of the meanings or values through which everybody expresses feels and lives, sharing personal and collective goals. In this sense, this additional issue has to be taken into account throughout the learning process of the contents under study owing to this new scenario, where the learning of moral process is developed. This new scenario has new rules and demands new roles because of virtuality shapes the potential for communication and interaction.

The contents of this chapter are based on the following papers:

- M. Serra, J.M. Basart and E. Santamaría, "Engineerging Ethics for an Integrated Online Teaching: What is Missing?", *The social impact of Social Computing. Proceedings of Ethicomp*, 2011, University of Sheffield, United Kingdom.
- M. Serra, D. Bañeres, E. Santamaría and J.M. Basart, "Acquiring Ethical Communicative Tools for An Online Ethics Training", *29th ACM International Conference on Design of Communication*. Proceedings of SIGDOC, 2011, Italy.
- M. Serra and J.M. Basart, "The improvement of autonomy in online learning environments". EDEN, 2008 Annual Conference. Proceedings of EDEN Annual Conference, Portugal.
- E. Rodríguez, M. Serra, J. Cabot and I. Guitart, "Evolution of the Teachers' Roles and Figures in E-learning Environments". The 6th IEEE International Conference on Advanced Learning Technologies ICALT, 2006. Proceedings of the 6th IEEE International Conference on Advanced Learning Technologies, the Netherlands.
- M. Serra, M.A. Huertas, A. Rius, E. Rodríguez and E. Santamaría, "Nuevos paradigmas de la educación: roles de acción docente en el entorno virtual de la UOC".

Simposio nacional de tecnologías de la información y las comunicaciones en la educación – SINTICE, 2005. Proceedings of the I Congreso Español de Informática (CEDI 2005), Spain.

1. Ethical communication issues when teaching professional ethics

For engineering professionals and, therefore, for our students, laws, professional regulations and codes of ethics are required and can help all of them when facing complex ethical and social issues within their (future) work, but the utility of these policies and resources depends on whether these future professionals understand where and how to take them into account. Thus from any concerned educational approach it is necessary to stake a claim for professional ethics in order to show how to develop engineers' work in an ethically and socially responsible way, because it is apparent that ethical issues are inherent to their profession (Huff and Frey, 2005).

Designing an effective introduction to ethics in the academic curriculum is more difficult than teachers imagine and admit, particularly where undergraduate students are concerned. Several constraints and resistances are present and merit special attention:

- Owing to our society becoming more and more dependent on technology, the role of the engineer is accentuated and his/her responsibilities (Pritchard, 1998) amplified. Thus, engineering instructors find it difficult to know how to weave applied ethics into a curriculum already full of technical subjects which are (all) considered intrinsic to a course.
- Spreading ethics across the curriculum asks for the contribution of experts from areas of the technical or engi-

neering sciences and experts from the humanities and social fields in order to achieve the expected goals. This collaboration is not always welcomed by either and so is rarely straightforward.

- The existence of doubts and objections within the teaching staff about whether ethics can be taught at all, even less so to grown-up students who are supposed to know the difference between right and wrong.
- Engineering students often think that ethical contents are not really relevant to their own field of study (Fleischmann, 2006).
- Finally, the frequent clash between students' scepticism towards learning ethics and teachers' conviction of its advisability requires a constant weighing up and adaptation of which contents to teach, which methodology to apply, which educational and technological resources to use, and also, which teaching staff.

From a traditional approach the teaching of engineering ethics aims to provide knowledge about ethics. This is in line with an epistemological view on ethics in which moral expertise is assumed to be located in theoretical knowledge and not in the moral experience of the engineer's profession. This traditional way of teaching the subject has its limitations. The theoretical contents of ethics textbooks make engineers feel removed from their own values and moral experiences (Basart, 2008), inviting the loss of interest in these kind of contents and a sense of removal from the subject. A theoretical knowledge, ethical concepts and principles, is certainly needed, but engineers are not currently properly trained when they have to face real moral dilemmas and make moral decisions about them. For this reason, it becomes necessary to give attention to the training of moral competences to achieve an applied ethics suited to a professional environment instead of a set of theoretical guidelines. So, when

training future engineers, a set of pedagogical tools is required in order to advance a genuine comprehension of the circumstances that define a moral conflict during the exercise of their profession. Although this comprehension is not a definitive and complete guarantee when analysing moral conflicts, we believe that it is a solid foundation from which to build.

In order for students to gain a good understanding of the moral issues embedded in applied ethics, three desirable communicative resources should be considered when dealing with them; dialogue, moral reasoning, and non judgemental language. Future engineers, when facing moral dilemmas, cannot rely solely on their professional expertise to persuade others to cooperate. They need means to improve their communication skills to influence rather than instruct or coax, to encourage others to reach decisions and to gain the commitment of others in the implementation of actions. It should be obvious that these communicative resources can help us throughout the learning process, acting as models for the development of moral competence in our engineering students. It is important to emphasize that thanks to these communicative resources a social interaction is woven contributing towards the collective construction of the tacit knowledge (Bohm, 1996). However, the use of these resources alone does not guarantee the desired outcome for the learning process. Thus the ever-present concern, on both a pedagogical and methodological level when designing a course of ethics, is to find a feasible path to follow when analysing a moral dilemma through, mostly, discursive ethics (Chapter 5, section 2).

In addition, guidelines such as moral heuristics will help students to make a contextual exploration when deliberating a moral conflict. Heuristics will give the support necessary to make reasonable decisions because through them students acquire the ability to elaborate on the details of a conflict (Maner, 2002). Heuristics has to be seen as a strategy to encourage and stimulate

brainstorming from all students in order to trigger ideas through the set of means mentioned above.

Next, we will characterise dialogue, constructive moral reasoning and, non judgemental language in order to know what they promote within the ethical communication that we pursue when analysing ethical issues.

1.1. Dialogue

The aim of this section, and the following one, is expound on how, through dialogue and constructive reasoning it is possible:

- To teach students the writing-related skills necessary to be a competent and effective ethical communicator.
- To foster ethical sensibilities in students and facilitate their moral development by highlighting the centrality of ethics through communicative practice.

Supporting these dual pedagogical goals, case study is essential and a thoughtful discourse about the ethical issues inherent to the case is required. Through discourse, students can apply moral reasoning to more fully consider the ethical choices and moral issues associated with the case. This type of engagement should leave students with a clearer understanding of what is fair, justified or right.

The Tuning Project (http://tuning.unideusto.org/tuningeu/) suggests the following interpersonal and systemic competences for all degrees in the European Higher Education Area: "teamwork and ability to work in an interdisciplinary team; ability to communicate with experts in other fields; ability to work in an international context; interpersonal skills; appreciation of diversity and multicultural approaches; critical and self-critical abilities; ethical commitment; ability to apply knowledge in practice; ability to learn (autonomous learning); ability to work autonomously;

research skills; capacity to adapt to new situations; capacity for generating new ideas; leadership; understanding of cultures and custom of other countries; project design and management; initiative and entrepreneurial spirit; concern for quality and will to succeed". Notice that dialogue ranges over the majority of competences mentioned before, improving and promoting them within the learning process.

Dialogue becomes the main tool for interaction among people. It is the means of expressing our experiences and feelings and, furthermore, is the declaration of values. The learning process is achieved through inquiry and the content is actually also the vehicle for sharing, in creative ways, through technology. We are engaged in dialogue when we speak with one another on the assumption that there is something we have to communicate to each other. This fact implies a clear understanding and a genuine interest between the interlocutors. So a fruitful dialogue consists of empathy and of a critical and reflexive attitude towards oneself and towards others, producing a rich understanding which takes into account all different viewpoints. Indeed, asynchronous dialogue promotes a deep reflection on the other's words taking advantage of a momentary delay in the conversation that allows thinking, calmly, before replying (Habermas, 1984).

One of the main goals within a discussion is to strive for mutual understanding because the purpose is to find an agreement, a consensus and a new position for both sides. This means that one can gain not only insight into the questions, ideas and beliefs of the other, but also into one's own questions, reflections and convictions (Brooke, 2006). Notice that the dialogue should avoid any kind of imperative (commanding, pressing, authoritative, and urgent) because these attitudes can reinforce misunderstandings, confusion and disagreement. Preventing or being aware of this is one way of achieving the dialogue's goal.

Finally, autonomy and teamwork may appear to be paradoxical words but are the two essential requirements for the construc-

tion of knowledge. Firstly, autonomy gives students the capacity to judge, decide and act in accordance with whatever rules they consider to be appropriate for the development of independence of the will and consistency in personal action. Secondly, teamwork involves the development of empathy and social perspective, enabling the students to have a greater consideration for others, which incorporates values such as cooperation, collaboration and solidarity. Both requirements need to be supported by a means to empower them and work as a contextual tool between the interlocutors involved in a dialogue, this is the moral imagination. According to (Johnson, 1993), moral imagination, as a tool to carry out applied ethics, is required to: "discern what is morally relevant in situations, understand empathetically how others experience things, and envision the full range of possibilities open to us in a particular case". So the moral imagination is a contextual learning tool that allows students to understand others' moral approaches, deriving benefit from autonomy as provider of self-sufficiency in the students' decisions, and from teamwork as provider of social skills to understand the others' point of view. So dialogue forces us to implement the moral imagination through autonomy and teamwork when a moral dilemma is under study.

From our view point, dialogue should be promoted among engineering students throughout the learning process in analysing ethical matters and when the current educational context of cultural diversity calls for flexibility, tolerance and an open minded way of thinking. Dialogue allows the development of social skills and these are connected with inter-personal behaviour, learned by the person and making up his own social performance.

1.2. Constructive moral reasoning

In the exercise of engineering there will always be moral and ethical decisions to deal with, especially where there is a conflict

between the interests of interlocutors (for instance, stakeholders and the personal values of employees). Managing them involves moral reasoning, cognitive and behavioural factors (among others as emotional ones).

Moral reasoning, as a formalisation of the idea that decisions are made on the basis of arguments for or against a claim, will help engineering students when analysing ethical matters. It promotes understanding and interpretation in communication rather than a mere transmission of information between interlocutors. Thus reasoning, as a means for communication that involves a good use of language, comes out through dialogue, and for the participants of this dialogue certain essential communication skills and language strategies are needed.

According to Kohlberg (1976), who was interested in the way that moral decision-making and moral reasoning take place, six stages in the development of moral reasoning were defined and grouped into three major levels; Pre Conventional (1st, 2nd stages), Conventional (3rd, 4th stages) and Post Conventional (5th, 6th stages), respectively. The progression through the stages reflects cognitive development in the understanding of moral issues.

Within this framework our educational concern is that students should get past, at least, the Pre Conventional level and to reach the Conventional Level of reasoning which entails hints of internalization, and yet the individual has not fully grasped the immensity of what she believes and may easily be persuaded to think and act against his or her newly rooted morals. It is at this level where: "[...] the individual regards to meet the expectations of his or her family, group or community, regardless of the immediate consequences. The attitude is one of conformity and loyalty to the expectations of the social order. The social order is actively maintained, supported and justified by those responsible" (Kohlberg, 1976). The *Interpersonal Concordance of Orientation* is the third stage in which the level of reasoning is characterized by the individual's need to gain parental praise. She knows that

she will gain parental approval if her attitude corresponds to being nice. Also, at this stage, the individual is able to consider the intentions of the other people involved in moral dilemmas. In the fourth stage of reasoning, *Law and Order Orientation*, choosing correct behaviour becomes important in upholding social order. It is characterized by a sense of duty towards following the rules for the sake of maintaining social order and avoiding chaos. The individual sees the merit in doing one's duty and understands that rules and laws are in place for the benefit of everyone.

The 3st and 4th stages of the Conventional level are fundamental for us and are achieved by the students constructing their own framework for reasoning about moral issues through social networks, shaping their interactions by their level of cognitive development. In this way, students gain the ability to understand the perspectives of others and the norms and laws that are necessary for society to function effectively. At this point the impact of a high level of interaction (brainstorming session) between the students is a very important factor because it is part of the constructing process of their moral reasoning framework where they try to discern an underlying moral value when a judgement is made.

However, the complex and varied nature of the ethical issues that arise in the professional ICT world demands that the moral development of our future engineers goes beyond the Conventional level. For this reason, as educators we aspire to make things challenging, achieving a higher moral development and reaching the next level in order to promote personal autonomy and personal rights as an important element of social order. Thus, the Post-Conventional level marks the individual's ability to follow her own set of internalized morals and values. These values may or may not reflect the societal group in which this individual is a part. The fifth stage is the *Social-Contract Legalistic Orientation*. The individual functioning at this level is able to clearly understand that laws exist for the good of all, yet if needed,

these laws can be changed to better represent the needs of all. The democratic avenue of arriving at laws and rules is viewed as most beneficial.

As Kohlberg stated, he believed that the development of a moral society is dependent upon the moral standards of the individuals that live within that society. It follows, then, that the way to aid society's progress is to aid the individual's progress in moral development. Moral education can coexist in and throughout the curriculum and it need not be a separate curriculum or a portion of curricula that is set aside for only religious institutions to address (Kohlberg, 1984).

An important conclusion comes from the previous assumptions, that communication skills are needed within the engineer profile in order to know what is relevant to specific decision-making and the way to communicate those decisions, what to attend to in a stressful and conflictive context and when to make exceptions to general rules dependent on the circumstance. Possessing good communication skills and the ability to articulate decisions through strong arguments leads to the development of professionals who are well adapted to their profession. By this is meant a professional who makes appropriate decisions under adverse conditions (time pressure, lack of information and budget, technical and social constraints, conflict of interests, etc.) helping them to handle the inherent moral dilemmas. Therefore, the next subsection will show us that it is advisable, when managing communication skills, that the use of language strategies be focused on because some language choices will be "better" than others depending on the scenario (formal, scientific, colloquial, etc.).

1.2.1. Language strategies

In accordance with the idea that (Toulmin, Rieke and Janik, 1984) "word choice influences meaning", for this reason some language strategies that we consider appropriate have to be implemented in order to develop communication competences in ethics:

- *Precision*: when managing ethical issues it is essential to control the meaning of the words because in every subject that we face, a set of pervasive, subjective elements (i.e.: opinions, reflections, assessments) are at stake. For instance, expressions such as *ought*, *should* and *must* may have their place when talking about rules, law, official procedures or technical issues, but not when analysing moral conflicts because an interlocutor could feel threatened or unsafe due to a feeling that we are trying to exert not only an influence over her will, but also an obligation or order
- *Intensity*: this refers to the degree to which language deviates from affective neutrality. Language intensity requires matching the expectations held by interlocutors in order to have a favourable effect on the communication. Some forms of intense language can be viewed as inappropriate and impinging negatively on the interlocutor. So, "highly intense language is fully appropriate and effective only in certain carefully chosen situations" (Toulmin, Rieke and Janik, 1984)
- *Metaphor*: this is a resource which allows students to create new ways of learning through "figurative" language. It can help them to improve "the comprehensibility, emphasis, and credibility of interlocutors and even to make their utterances more persuasive" (Toulmin, Rieke and Janik, 1984). In a conversation the choice of appropriate words and the way in which they are strung together within sentences influences the engagement of the interlocutor's interest and so metaphor is a means to achieve greater impact
- *Sentence order*: "The precise placing of different phrases and clauses within a sentence can itself influence emphasis and comprehension" (Toulmin, Rieke and Janik, 1984). Clarity and the presentation of all the elements that compose a sentence when constructing a speech is important. The

location of every sentence's component is essential in the understanding and interpretation of meaning

All the previous linguistic strategies demand consideration of their inherent ethical responsibilities when they are deployed throughout the learning process. These responsibilities are necessary to achieve comprehensible communication whilst carrying out constructive moral reasoning when moral decisions arise. In the next subsection some of the essential ethical issues involved in this kind of communication will be presented.

1.2.2. Communicative responsibilities

The particular case of reasoning within ethical contexts demands a good quality of communication because its subjective charge is a critical element when dealing with these kinds of content. Therefore, because of the personal commitment that we have to assume responsibility for the consequences of decision making on a concrete moral dilemma when deliberating, it is necessary to analyse the inherent ethical responsibilities embedded in this kind of communication. These responsibilities are as follows:

Speaking and listening

These two actions complement each other and coexist in all acts of communication. If one action is missing then the relationship between them is broken. When one person is speaking, she should be concerned with making oneself understood, to express herself in as clear and tidy way as possible. On the other hand, she is taking advantage of the attention and the time of the person who is listening to her.

Listening implies a rational and emotional reconciliation between interlocutors through the taking in of others' words in order to understand the meaning and the way that these words are transmitted. Listening demands an extra effort, to put oneself in the others' position to understand what is being said. This is

why communication depends on the capacity of the moral imagination.

Simultaneously, a reasonable response to time delay is required to get a sensation of engagement in the deliberation begun. So it is important to maintain an 'active' listening showing empathy with the interlocutor through questions and answers, in order to be receptive to the established interaction. The thread of the arguments will need to check understanding through the asking of questions for clarification of a complex answer and to minimize misunderstanding.

Through words we draw out some characteristics about a person's profile, we distinguish certain typical features of her, we define certain circumstances and, finally, we associate concepts and relate ideas. This set of a priori assumptions should help us to be aware of the advisability of prudence when expressing ourselves, in particular, when moral issues are at stake. As a result, it is preferable to avoid ideas, beliefs and opinions that we have formed a priori. In this way some aspects such as labelling and prejudgement should be minimised.

- *Attention and labelling*: Paying attention requires us to silence the mind in order to allow the entrance of the others' ideas without any preconceptions. In relation to this (Habermas, 1984), participants must show this real interest (predisposition) when they establish a conversation. For instance, paying attention can allow interlocutors to think about different opinions based on a structural and consistent speech, to recognize differences, to construct new arguments and ideas, or simply, to promote an appropriate atmosphere for reflection and mutual understanding. At the same time, appropriate attention should involve the lack of immediate response between questions and answers in order to provide time for opportunities to reflect on, interpret and internalize a message.

Labelling, in contrast, reflects an attitude which establishes a certain prejudice towards people and things based on preconceived ideas, beliefs and opinions without taking into account: the existence of others cultures, view points, ways of doing things and feelings and thoughts. It is a means of reduction, creating a mistaken image of a person, group or event. When people communicate through text alone, labelling prevents insight on the impact of communications or actions.

- *Prejudgement*: prejudgement is a kind of intolerance towards a person, group, attitude, habit or belief. As a part of our tradition it is necessary to be aware of its existence when we attempt to manage moral conflict in our daily social, professional and private lives. It is a subjective issue that requires our complete attention in order to control it. In this sense carefully choosing our words when a deliberation is in practice is necessary, not least because nowadays a wide variety of different cultures and disciplines within the engineering professional world are present.

  So, in accordance with (Gadamer, 1988), hermeneutics or 'the method' of interpretative understanding of the 'other' (another tradition, cultural group, a text, message, a new environment, etc.): "[...] tradition, far from being something that happens to us, is something in which we participate. The preservation and perpetuation of tradition does not happen by itself; it is the product of people affirming, embracing and cultivating what they inherit. The opportunity for questioning tradition arises when our participation in our tradition is informed by our interactions with other traditions, — during the 'fusion of horizons'. The opportunity for questioning our tradition takes the form of a questioning of our pre-judgements during such interactions. Although our pre-judgements are constitutive of our being, in our encounters with other horizons they are put at risk".

> What becomes apparent here is that we cannot escape our prejudgements, but through the discursive interaction with other perspectives the possibility arises for understanding ourselves (our prejudgements, our tradition) in the case of being mistaken of taking on board other perspectives with an open-minded attitude. For this reason, it is very important to set in context all the participants involved in a conversation to achieve a fully social process in order to understand the diversity of view points. Consequently, the means through which we can make ourselves aware of our own prejudgements is to implement a deliberation, based on moral reasoning as a way to allow us to engage with and to understand others' opinions, answers, behaviours, attitudes, etc., whilst taking into account all the elements (i.e.: environment, participants, constraints, and consequences) of the circumstances where we are situated.

1.3. Non-judgemental language

Judgemental does not mean stating an opinion. Even saying that something is "bad" or "good" is not necessarily judgemental. And, on the contrary, not being judgemental does not mean being opinion-less, spineless, sceptical, or indifferent to whatever. Being judgemental is when, based on a single quality of someone or something, one makes a conclusion about the whole nature, about all other qualities. Wholeness, based on one aspect, is judged and, consequently, a valuation is imposed. Thus it is very important to be accurate about the judgemental aspect of the language in use because when we are making a valuation we don't always have objective criteria or method with which to challenge the judgement's validity. Therefore respectful communication is essential, together with the avoidance of irresponsible forms of speech such as: defamation, harassment, flaming row and abusive language (i.e.: judgemental language) when addressing conflicts

in values and interests. Hence good quality of speech should be founded on assumptions such as: concision, focus on the issue under consideration, respect and appropriateness. Students have to learn that their communication, based on some form of opinion, choice or judgement, has to minimize, for instance, judgemental language when taking an opposing attitude. They should tend to non-judgemental language in order to emphasize others' qualities when making ethical decisions.

In relation to our study, one of the hindrances for engineering students is that they may not recognise when choices about technical matters have moral implications. For this reason, an effective introduction to ethics in the academic curriculum has the responsibility of teaching future professionals to identify such situations and hopefully ensure that their decisions will have considered all the relevant factors and have taken into account the interests of others as well as themselves. In this light, tools for ethical decision making are presented in the next section.

2. Heuristics: a supportive tool for deliberation

When facing ethical issues there is not much place for technical competences (i.e.: formal, logical issues or systematic algorithms). Even so, the existence of some guidelines should help students to make a contextualized exploration of a moral conflict. Moral heuristics appear here as a tool to help students to make reasonable decisions based on a clear deliberation. In the process of exploration through a moral heuristic, moral reasoning and ethical discursive capabilities become important resources to carry out with it.

In this section our main proposal is to show that moral heuristics allow the expression of the different positions of all the involved participants during a discussion about an ethical issue. There are also other factors that occur throughout the process of

analysis of a scenario such as the communicative resources used to perform it and the intense interaction that the entire process requires to be a fruitful one.

The stages that configure a strategy of analysis of ethical conflicts are as follows:

- *Taking the ethical approach*: becoming aware of the ethical conflict and developing sensitivity when confronting it. Respect and equanimity towards the diversity of viewpoints is required in order to allow knowledge exchange between participants whilst promoting the introduction of new and multiple approaches. Also, Socratic dialogue allows the exchange of these perspectives while acknowledging all contributions.
- *Complete description of the case study*: collect all the relevant information in order to make a clear and complete checklist of the case. Constructive moral reasoning can help us to describe it using the appropriate language.
- *The existence of precedent*: consider the existence of some known precedents to allow an appropriate decision to be made. In others words, search for analogies and reasonable comparisons between cases to come to a well-founded decision. This is also the right stage to encourage and stimulate associations between information through an intense exchange of ideas based on a dialogical process for identifying similarities, incoherencies and inconsistencies in order to inform the final determination.
- *Ethical frameworks*: use the well-known ethical approaches (virtue ethics, professional ethics, etc.) as referents to focus on the conflict and to ensure that the essential elements of the case are present. Deliberation is required as a resource to construct knowledge related to the case, reasoning will help students to justify their choices and autonomy will give consistency to those choices.

- *Moral imagination*: in accordance with (Coeckelbergh, 2006) "It could be argued that being morally mature includes being able to imagine how your actions influence others, being able to emphatically understand others, and being able to envisage alternative courses of action if necessary". This fact is relevant to engineers faced with ethical decisions because they need to access the subjective experiences of others to realise the consequences of their decisions.
- *Listening to the voice of experience*: learning something from the experience of people we can trust, because of their vocational training, integrity and coherence of action, involves a profound change in one's conversational attitude. Afterwards a dialogical attitude may follow an attitude of open mindedness towards what others can transmit to us. Without this attitude it is difficult to deal with ethical issues well. In fact, this attitude is present in the basis of every moral behaviour or action.
- *Collection and assessment of the final results*: this is the final stage where the process of exploration is closed and a decision is made based on all the elements collected throughout all the stages. Here, again, communicative means will help students to reach an understandable agreement based on unified behaviour and respectful communication that is composed of their own choices and judgements, but still remembering to minimize judgemental language when expressing their individual opinion. This means that each student should limit themselves to giving (good) reasons for her belief, present explanations and justifications when making a decision in order to show why the decision made is appropriate for the ethical question under exploration.

As a final remark, we want to note that the moral behaviour demanded by the engineering profession is complex and it is necessary to take into account the relative nature of people's behav-

iour depending on the different circumstances and relationships between participants. This relativity requires an attitude of tolerance rather than blind condemnation in order to reflect on the co-responsibility of consequences related to decision-making. In the light of this, moral reasoning becomes an essential communicative means in order to fulfil an appropriate argumentation performance. Additionally, the interaction between participants when analysing a moral conflict can be seen as a learning opportunity because it encourages them to consider the development of communication skills and the reflection on the ethical and moral issues inherent to communication practice.

The following sections will show how to fulfil the practice of these communicative resources and language strategies within a virtual educational context while taking into account its singular determining factors and supported by technological resources.

3. Shaping the communication process: the virtual educational context

As a foundation for our explanation of what virtual training involves we take the example of the Universitat Oberta de Catalunya (UOC). At the UOC, learning and teaching processes take place in an asynchronous and on-line environment (Sangrà and Duart, 2001). This environment is supported by web based technologies (i.e.: forum and wikis) where the students share knowledge, communicate with their teacher and other students, and also access some resources.

3.1. A set of features of the virtual educational context

Obviously, the learning process in a virtual educational environment is quite different from teaching in a conventional environment. For instance, there is not face-to-face contact between

teachers and students (temporal and spatial asynchrony). Therefore a key issue when preparing or starting a virtual experience (either a completely virtual degree or just some kind of e-learning course) we must carefully consider the teacher's roles and the methodological tools as well as the technological support they will need.

To carry out a discipline such as engineering ethics within an online environment involves constraints that are endemic to that context, and these special characteristics must be considered when developing any learning process. Teaching within an online environment is a social process which requires a specific setting, involving technological platforms and methodological tools, in order to facilitate online interaction such as the discussing of ideas and practising behaviours, or developing attitudes and skills for, finally, promoting an experiential and active learning (Sieber, 2005). In the case of engineering ethics these goals provide a challenge to educators to focus on real-world problems and practical solutions, when these requirements are not easy to meet within an online learning context (Demiray and Sharma, 2009). Thus, to succeed within an online context we cannot just try to replicate the methods used in traditional education. Values and morals exist as within a face-to-face context, because they are integral to people, but the means of expressing them and the environment in which they are declared changes. This new virtual educational context shapes and opens new communicative possibilities, challenges and relationships supported by synchronous versus asynchronous, text-based versus audio or video, one-to-one versus one-to-many, etc. and social interaction (Sangrà and Duart, 2001). However, "The new educational context, supported by the use of computers, imposes a distance and interposes its law in the communication process. As an example, a simple e-mail interchanges can degenerate into an open quarrel when strong differences appear in a controversy. Apart from other circumstances excluded by this new context such as touch, gesture, tone, silence, look, etc." (Basart, 2008).

We believe that learners need to develop a series of strategies and skills that will enable them to work individually or collectively in a virtual environment. This development will benefit the maturation of their learning process. This involves improving both the teachers' and students' learning experience and the relationship between teachers and students in the virtual environment (i.e.: how to motivate the students, how to identify the common problems that the students will face during the course, what kind of assessment they need throughout the learning process, how to communicate the contents with regard to the kind of subject, etc.). E-learning platforms supported by web based technologies need to evolve according to new methods of teaching and learning. These require a virtual context able to overcome certain issues that we will present in the following paragraphs. The principal determining factors to bear in mind within our study, throughout the learning process of ethical issues, are:

- *The ever-changing and versatile teacher's roles*
  The teacher's roles that some papers point out (Barajas, Scheuermann and Kikis, 2002) evolve thanks to a new understanding of learning promoted by the use of ICT. From our experience the role of a teacher within a virtual context should cover different kinds of functions at different levels, from the technical field (contents and methodological and technological resources) to social issues (personal support and academic advice) in order to offer full training assistance.
  We can cite the main functions that will allow us to improve the teaching goals we pursue within the virtual environment: the teacher guides the student learning process, but this guidance must shift from the role of knowledge contents provider (as in conventional classes) to knowledge contents facilitator. They need to develop specialized abilities to succeed (Hartnell-Young, 2003;

Kearsley, 1997) in teaching the students without a physical presence in class. Because of this lack, as a tutor of technical degrees, her main responsibility throughout the learning process of ethics subject is to sensitize the students, the future computer professionals and current users of technology, to the moral seriousness of these ethical issues. One question that arises is how to manage and address this kind of content? To achieve this important goal it is necessary to emphasize a constant interaction with the students in the virtual class in order not to lose the storyline of a concrete case study with all its possible casuistries and pay accurate attention to different points of view and its argumentations. Also, it is important the teacher encourages the students, helping them to differentiate valid and useful reasoning in order to reach a consensus which satisfies all the involved parties. More formally, she must help students to develop abilities such as autonomy, proactive attitude, self-organization, critical thought, and the capacity for acquiring, integrating and sharing knowledge in order to act according to her moral experience. The teacher should try to promote an atmosphere of constant self-reflection through her tireless support and communicative skills. This close collaboration between the teacher and the students, and between the students themselves, benefits (Bhagyavati, Kurkovsky, and Whitehead, 2005) the whole learning process because within a virtual context this interaction facilitates the task of shaking students used to dealing in binary decisions out of their complacency about ethical issues. In the absence of visual and auditory cues it is necessary to intensify written interaction. Moral agency requires more than the reading of handbooks and texts. Moral agency requires language because language is about action (Grodzinsky, 1999) and through appropriate communicative skills and

languages strategies it could be implemented and not merely theorized on. The exchange of the written word between participants is necessary to provide a base for further discussion and, simultaneously, the expansion of moral theory.

In addition, and according to Aristotle, morality cannot be taught but needs to be practised. Therefore, students are able to draw the correlation between the character of the person as manifested in the adjectives through which she describes her opinions, roles and reasoning in her messages in the virtual class. At the same time, this correlation is reflected in the support and care that a person offers to her community and is constantly reflected through the attitude and predisposition shown by her words (expressions, metaphors, etc.).

The challenge for the teacher, with regard to these contents and context, is to make the real, non-virtual, self aware of values and ethical issues. The teacher should know when it is appropriate to use the moral imagination to envision decision-making and consequences when analysing a moral dilemma. Through moral imagination the teacher reinforces virtual deliberation by aiding students in the interpretation of words of different argumentations. In this light, students are forced to justify their moral positions by exchanging opinions, in fact acting through the language which grows out of and is motivated by the behaviour of the character.

- *The subjective connotations of the contents*

  Deliberations are the foundation of the ethical conversational practices on which social interactions are built, even more so when the contents under study deal with personal and professional moral questions based mainly on this conversation and social interaction. Thus, in a virtual

learning context what we say and decide with our written speech, without visual and auditory clues, forces us to discern or guess the underlying moral value when a judgement is made with our written words. So the potential harm or the warm welcome caused by them is distanced depending on the educational environment where the training is carried out and the performance of the communication skills.

The students' written responses to ethical decision-making scenarios in engineering practice depend on the different kinds of abilities that the student possesses in order to perform an accurate reasoning. Because the written word is a very important element in a virtual context, before the execution of a response, the student should interpret in an appropriate way incoming opinions or the discussion about the dilemma under study and bear in mind factors such as the frame where the dilemma is located, the recognition and appropriate use of pertinent facts, the citation of analogous cases, the consideration and respect for multiple points of view and their argumentations, and the consideration of risk when developing alternatives to reach agreement. All of these actions are supported by the ethical reasoning which is based on written speech (language) and the multiple perspectives belonging to the participants involved in the virtual deliberation. If the students take care of this set of factors within the virtual communication the dialogue should be more effective, fluent and well understood, one of the most important goals when moral issues (personal and professional) are at stake. In this context, virtue ethics help students in what attitudes and decisions are ethically preferable to take when answering over distance.

All these previous assumptions becomes more noticeable when the contents have a subjective air, and for this

reason it is necessary to know, at the same time, not only what kind of language to use and which attitude to assume when answering, but also what could be the feelings or emotions to regulate in order to attain an appropriate written discourse, for instance: dependency on the teacher; loss of concentration ought to isolation and distance; wasting study time because of non-motivated attitude; intense stress and anxiety before exams and about exam results; inability to accept negative feedback when failing subjects; nonconformist with extra study activities; maladaptive and lacking study habits when missing sessions and homework and resistance to the errors when negative evaluation of activities done.

- *The communications means lacking in physical presence*
  As we have mentioned, the teaching of this kind of content will depend, above all, on the educational environment and the communications skills. Thus written speech has to be reinforced by methodological and pedagogical components to understand and interpret the meaning of our words in order to increase the effectiveness of the communication. In a virtual educational environment feedback is not instantaneous and there are non-vocal, visual and auditory cues. Because of this, within this age of rapid technological change, there is a growing interest in tools, strategies and technological resources for fostering a meaningful conversation when ethical issues are at stake. For this reason the values to cultivate among students are as follows: respect and tolerance for others' opinions; equality between people of different social spheres; discipline and personal commitment when working in a group or when cooperating in a project where different participants are involved; personal and professional responsibility when facing ethical judgements and decision-making;

proactive attitude; critical thought; self-organization and affect and empathy with the others.

Additionally, in our case, it is necessary to promote the main ethical aspects of the engineering profession (Unger, 1994) such as: the knowledge of codes of ethics and ethics theory, values, especially those related to science and technology like prudence and social commitment, a virtuous character and consistency in order to develop good engineering practices when communicating within a virtual context. In this light, virtual dialogue based on solid arguments facilitates fluency and understanding among the participants of a concrete moral deliberation. For this reason, teaching skills in order to put into practice working groups or team based activities provides excellent opportunities to highlight, in an immediate and compelling way, the virtues of responsibility and reliability, loyalty to and concern for the group, fairness in distribution of burdens and rewards, and mutual respect and consideration among students of the team.

- *The methodological and the pedagogical aspects*

  The appropriate moral development, throughout the engineering curricula, starts from theoretical knowledge, the cognitive domain, language strategies and communicative resources for ethical communication. Consequently, a set of methodological and pedagogical aspects are required to develop a complete ethical training process (i.e.: improving the students' awareness, developing decision-making skills, practising reflective and critical thinking and taking on responsibilities a priori) in order to improve, progressively, the process of expressing judgements and formulating reasoning when facing real ethical issues within non ideal situations or contexts.

  For this reason our written dialogue is going to be regulated by: communicative resources and language strate-

gies in order to avoid impolite and offensive expressions, misunderstandings and ambiguities; the use of judgemental language should be minimised or nullified when exchanging opinions in order to be aware of prejudices; using mechanisms like heuristics for analysis are required in order to resolve the group's conflicts through positive collaboration and cooperation between colleagues; a proactive attitude between teacher-student and student-student and active listening between them is necessary to avoid isolation, detachment, passive engagement and the use of the moral imagination in trying to understand the perspective of other colleagues all increase the degree of empathy thus facilitating interaction and the exchange of information.

What is more, from a virtue ethics approach we can make a comparison where Aristotle's theory is evident, we can say that teaching engineering ethics can improve ethical judgement which, like technical judgement, tends to improve with use, with experience. In the light of this, we insist that one benefit of discussing ethics in the classroom is that it shows students how much consensus there is (among engineers) but it requires an effective dialogue and this fact demands constant will-power in order to improve our ethical judgement. Again, attitudes as will-power and determination should be strengthened in the professional practice of our future engineers.

Finally, autonomy plays an important role in the virtual e-learning process of each student. One of the current well-known methodological approaches to deal with the motivation of people is to try to enhance the sense of autonomy that people feel during their learning process. Throughout the teaching practice autonomy is the way to make individual decisions within the learning process. This means that the student has an independent way of

working, identifying problems on their own, exploring for themselves without being told what things to test out. It is a way to forge their identity in the new context.

- *The technological resources*
  Technological resources must be properly selected bearing in mind the features of the methodological components. The use of web-based technology improves students' awareness of ethical issues within an online environment and further develops their decision making skills (section 4 of this present chapter).
  The implementation of technology-supported learning systems is linked to and reflects many of the demands of higher education in a globalised knowledge society. For instance, these demands imply a need for students to become more autonomous in their attitudes about learning. Additionally, e-learning platforms need to evolve according to new methods of teaching and learning. We need to take into account the fact that the impact of the use of ICT requires continuous training in pedagogical and methodological innovations without forgetting the sociological and ethical factors implied in this context. These issues, sociological and ethical, cannot be trivialized or ignored. From a methodological point of view further work should move in this direction.

As a final remark, developing ethical awareness in engineering includes not only gaining (technical) knowledge and intellectual understanding, but also skills, habits, and inclinations. For this reason, teaching moral issues benefits from methodologies of character-forming (virtue ethics) with models of expertise (i.e.: discursive ethics) and an intensive and informative interaction and feedback on performance because of the casuistry of the virtual educational context. From our educational position the focus

should be on how to develop "practical wisdom" and flourish (virtue ethics) rather than what to do in an isolated situation, in other words "knowing what to do in any serious sense requires good character; for the agent must have developed certain abilities of judgement and perception over time, and the exercise of these abilities is precisely what we mean by good character" (Louden, 1992).

In the next section, we describe how computing technology such as web based technology intended for educational purposes could be useful for the learners during the study process. This technology can provide support to the previously described methodological tools not only in relation to conversational ethical skills in order to intensify social interactions among students, but also offer a wide range of implementation practices when training ethical issues. In other words, the training of ethical issues should not only be limited to the use of face to face resources of a face to face context, but it could be reinforced by ICT technology which has become a commonplace integrated into the everyday life of the students (i.e.: chats, instant messaging and text messaging). Technology allows different ways to learn and teach values in a global view of ethics for the information age. It is just education developed in many formats.

4. Technological resources to support professional ethics training

Engineering is significantly correlated with ethics in some aspects. In society, an engineer and an individual are continually facing situations that must be dealt with a limited set of resources, a particular code and some accumulated experience. The engineer confronts technical problems while the individual finds herself immersed in moral conflicts (Toulmin, 1968). For this reason, good education and training in professional ethics is

needed to take into account the human factor that, very often, is forgotten when analysing technical difficulties. We expect that designing an appropriate course of applied ethics should help the students to understand how and why their work with technology can affect the life of other people (Dreyfus, 2001). Implementing this kind of course involves acquiring moral competences through an adequate set of communicative means supported by a technological collaborative workspace.

Tutors can teach applied ethics efficiently, making the students understand that different ethical points should be taken into account when analysing a case study (Loui, 2005; Brooke, 2006; Harris, Pritchard and Rabins, 2009). Therefore, putting into practice case analysis will promote a discursive approach by means of communicative resources. This kind of learning strategy avoids the pitfalls of traditional approaches where ethical knowledge was based on theoretical textbooks instead of practical experience (Lynch and Kline, 2000).

Based on study cases, which help students to become active and increase their interest towards the subject, the work to be achieved can be done individually or in groups. However, the final objective will be the same: to discuss and to reach a resolution to real world conflicts. Cases are a good vehicle for developing the following competences required in the area of ethics:

- Ability to analyse and synthesize conflicts
- Adapting to heterogeneous situations
- Decision-making
- Critical thinking
- Written communication

However, future engineers need integrate some communicative resources in addition to their professional expertise to persuade others to cooperate, such as dialogue, constructive moral reasoning, and non judgemental language (section 1 of this present

chapter). These resources will help students to reflectively and critically examine their own thoughts with regard to student's and teacher's opinions. These communicative ethical issues demand the appropriate technological resources in order to deploy them. This trend is reflected in many well-known textbooks and papers on engineering ethics. Some resources have been developed to teach ethics through a specific software (Coldwell, 2000; Goldin, Ashley and Pinkus, 2001; van der Burg and van de Poel, 2005). Others reuse generic web-based resources like forums or wikis to support the courses (Loui, 2005; Goold and Coldwell, 2005; Shrag, 2005; Brooke, 2006; Gobbo and Lanzarone, 2006; Mathers and Leigh, 2008; Leigh, Mathers and Towlson, 2009; Villanueva, 2010; Zhen and Zhou, 2010; Regueras, Verdu, Verdu and de Castro, 2011). All these approaches agree that the selected resources could provide educational experiences that would promote the development of the following processes:

- the students' engagement within a debate about realistic cases
- the use of case study for moral problem solving,
- the construction of social interaction to enhance collaboration
- peer to peer technological support.

It is therefore obvious that the relationship between ethical behaviour and its training is important for the future professionals of the ICT field, but supportive and appropriate technological resources are needed for its fulfilment.

Due to the particularity of the topic, we have identified a common denominator between all the previous revised works. Except for differences such as duration, which varies from short seminars to semester courses or annuals programmes, the courses converge on the overall approach to the subject. The majority of the approaches are based on case study methodology using realis-

tic cases to illustrate the ethical issues. All of them promote active participation of students in imaginary ethical decision making cases. Also, web-based technology has been adopted in general. And, what is more, in order to maximize students' participation, they utilize e-learning technologies to develop the course. There exists a combination between traditional teaching methods, such as lectures, with remote collaboration towards ethical decision making in a way that maximum student involvement and interaction is achieved, and maximum feedback can be collected for further work such as the ethical assessment.

Some of these aspects are in line with our perspective, such as the use of technological resources (web-based technologies) and the collaborative learning process. However, remaining faithful to our research and following the coherence of it, we differ on some aspects in relation to the previous works. It is very important to highlight these divergences because they form part of the foundations of the current work. They are as follows:

- *The methodology*
  Pedagogically, the case method not only allows students to actively and cooperatively engage in the analysis of a moral conflict (rather than passively listening to lectures) and to learn from others' points of view, but also to develop their moral imagination. We want to enhance the importance of this learning tool for ethics education because it allows students to examine a moral conflict from multiple perspectives. In this light, in comparison with the previous works we propose an additional resource to promote the moral life and to improve the moral imagination of our students, literature (Chapter 5, section 4). We think that the students' understanding of moral issues and their ability to share in the experiences of others can be enriched by reading novels, stories, plays and poetry. Why? For instance, in the professional world of the engineer, because

only by being able to imagine what it is like to be the other person, the customer, the stakeholder or the supplier, only by being able to enter imaginatively into the their context, is the professional of engineering able to properly consider the particular situation of the individual and the likely implications for that customer in that situation of alternative options. One valuable way of doing all of this is the moral imagination, stimulating, cultivating and nurturing it through literature. Literature can illuminate our interpretation of our colleagues in the workplace in order to improve how we ought to respond to them in certain circumstances. Case study together with literature would be the basis of the development of reasoning, of deliberation and counterargument when analysing a moral dilemma.

- *The open dialogue*
  In most cases, the previously referenced works talk about debate instead of dialogue (Chapter 5, section 3). We do not agree with this approach because, from our view point, dialogue is the means that helps students to answer the challenge provided by ethical dilemmas within the training process (i.e.: cases). Our dialogue requires openness towards the views of others. Therefore, dialogue can be seen as a way of making sense of cases and coming to joint interpretations of these cases and, simultaneously, dialogue as a learning resource is able to promote: understanding (paying attention to other arguments, ideas or proposals); flexibility (integrate cultural diversity); equality (all voices have the same weight); empathy and sensitivity (emotional awareness in regard to each other).

- *The moral conflict or dilemma*
  In contrast with the preceding works, we look at the "resolution/solving" of a moral "problem" from a differ-

ent angle. In our opinion it is important to emphasize that we are not resolving a moral problem, instead of this we talk about analysing or exploring a moral dilemma or conflict in order to find a first approximation (agreement or consensus) of it. This first approximation of the conflict is not the final one. The process to reach an agreement or consensus which is completely satisfactory for all the parties is a long journey and it might never be completed at all because in a moral conflict there is not one(unique) solution that is fully accepted by all the affected parties, there are a lot of values, interests and opposing views to satisfy. In a moral conflict there are feasible ways-out which should be evaluated in order to reach a decision about how to proceed in the face of the conflict raised.
What we are saying is that ethical conflicts are not technical problems to be resolved by proceeding through a routine or procedure. We don't have algorithms to manage them because each conflict is different, with its own casuistry and consequences. Taking into account the interdisciplinary and the multicultural context of the engineer profession it is necessary to find a way to reach an understanding and consensus.

- *The communicative resources and technology*
  From our point of view, communicative resources (section 1 of this present chapter) in conjunction with a series of appropriate teaching technologies are required to support the collaborative learning process and, simultaneously, to enhance learning outcomes. We agree that web-based technologies promote collaboration and interaction among students throughout the learning process, and facilitate communication among them. In addition, technological resources give more opportunities to access a large amount of information and to share it at any time.

> Thus, as educators we should use these technologies not only to replicate conventional methodologies, but also to promote an intellectual engagement. In this light, we promote the use of a set of communicative resources performed through technological means. Whilst we are talking about messages by e-mail and voice e-mail, or documents via fax and e-mail attachments, or post messages on electronic bulletin boards, or sending a questionnaire to collect the feedback, etc. in comparison with the referenced works, we are also talking about how communicative resources such as dialogue and moral reasoning work within the learning process. They involve analysing the essential requirements of an attentive communication, meaning genuine listening, attention, non-conditioned thinking, and an open mind in order to get an effective engagement with the participation in collaborative learning process.

In order for students to acquire these competencies, they need to do many activities based on case-based approach and literature. The cases will engage students in a deliberation with their fellow students and, simultaneously, they will give them the opportunity to express and argue for their own judgement or for a consensus reached by a group, and to react to counter-examples and criticism of others. Also, literature will allow students to analyse moral dilemmas from the stories of people who are the cases themselves, in all their complexity and particularity and in their contexts.

In this light, from the educational position we have to give students personal guidance through different kind of activities and communicative resources based on technological resources that allow students to think for themselves about morality. In the next section all these questions will be expounded.

4.1. Training activities

The objective is to train the future engineering graduates when facing ethical dilemmas through the previous communicative resources (section 1 of this present chapter). They need to acquire good communicative skills and the ability to articulate decisions with a strong argumentation.

We propose to design a course founded on a case-based approach (Dyrud, 2004; Harris, Pritchard and Rabins, 2009), even though literature could be an appropriate alternative to use. The case-based approach allows us to put these resources into practice. Moreover, the students will cooperate actively in the analysis of a moral conflict instead of passively attending lectures. We propose two kinds of activities:

- Individual activity related to a case study
- Teamwork activity related to a particular ethical dilemma

4.1.1. Individual activity

In this initial activity, an ethical dilemma is presented. Each student must carefully think about the case and present his viewpoint. The activity ends with a deliberation.

This activity is a good starting point in the learning process because it allows the generation of a discussion based on a written dialogue. During this exchange of messages to get to know each other, the student begins to be trained in the inquiry process required to share different approaches when a moral conflict is handled.

In this kind of activity, autonomy plays an important role because it is an essential requirement for the construction of knowledge. It gives the student, as an individual, the capacity to judge, decide and act in accordance with whatever rules he considers to be appropriate. So, this kind of activity is useful in improving self-sufficiency when facing a moral dilemma.

4.1.2. Teamwork activity

Teamwork activity considers a case study from several points of view. This activity incorporates values such as cooperation, collaboration and solidarity. Again, dialogue acts as the main communicative resource to develop empathy and the social perspective required when constructing knowledge collaboratively in a group.

Each team is assigned a possible conclusion. This perspective must be defended and, finally, the objective is to achieve consensus or agreement. This kind of activity consists of three exercises:

- Each team should reach a conclusion on the assigned perspective. The objective is to elaborate a well-built argument to defend. In this case, students should not only have the ability to recognize the social and ethical issues present in technology related to the assigned perspective, but should also be able to analyse moral conflicts in terms of facts, values, stakeholders and their interests related to it, too.
- Each team expounds its arguments. In this case, the arguments should be based on the ability to give moral judgement on the basis of different ethical theories and frameworks including the professional ethics learnt in the introductory lectures. Additionally, before constructing their arguments, students should think out different options for decision making in the light of (conflicting) moral values and the relevant facts detected within the case under study. Then, students should reflect on the previous ethical theories and frameworks, the decision being made by all of them. Thus, moral reasoning skills play an important role when justifying one's decisions.
- A deliberation is finally performed addressing all the presented arguments. In this case, students should discover that all the reasons presented are arguable. In this way,

students become aware of the moral dimensions of the analysed question and acquire the reasoning capabilities that are needed in a moral deliberation.

In the next section, we present some possible technological resources to use when putting the proposed activities into practice.

4.2. Technological resources

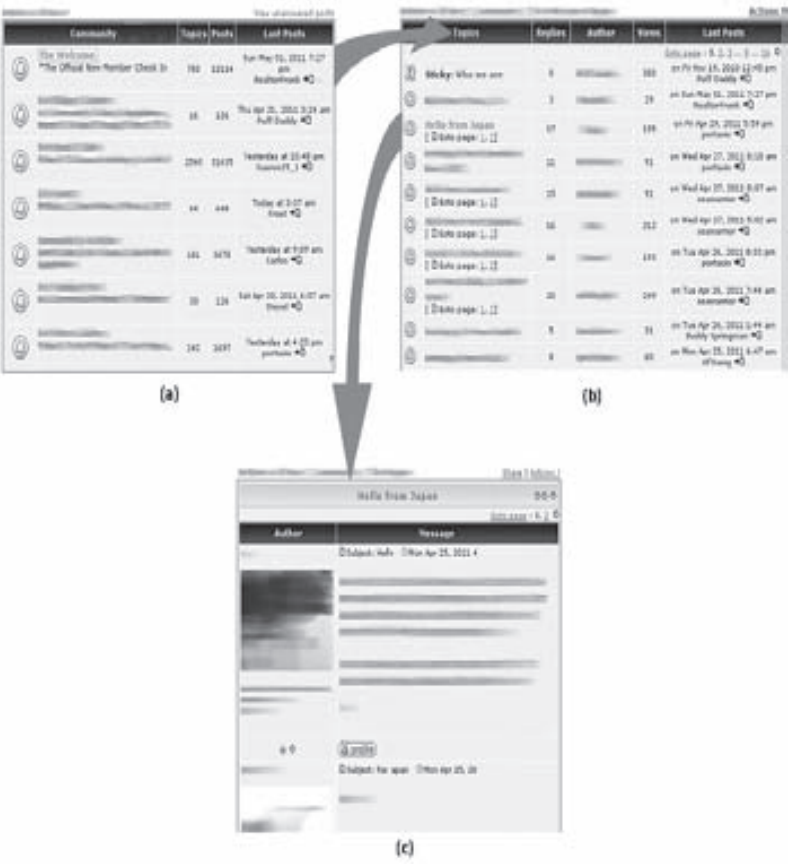
In this section we describe the technological resources that could be suitable for training communicative means. Note that there are many resources that could be used; however we select a set of them based on the educational benefits and requirements of our interest.

4.2.1. Internet Forum

The classic resource used for asynchronous communication among interlocutors is the *Forum*. A forum allows people to discuss different subjects or work-related topics as well as promoting social interaction. It consists of a tree-like structure, similar to a directory structure, which at the lowest level is composed of a set of entries called *threads* (Figure 1). Each thread deals with a single topic and, internally, has the users' posted messages and comments related to other messages. There are several types of users groups depending on their privileges. In our case, members and moderators are the main groups that will be used. Members would be the students with the rights to post messages. The moderator would be the teacher with the rights to post messages and supervise the forum. Note that the teacher should be a good e-moderator (Salmon, 2011) in order to manage properly the forum during the activity.

This resource is suitable for individual activities (Shrag, 2005; Goold and Coldwell, 2005; Loui, 2005) because students interact by posting new ideas and arguments in the discussion and

Figure 1. Example of the different pages of a forum. (a) Initial page, (b) List of threads page and (c) Posts pages



reply with messages based on their own arguments. This type of deliberation has some benefits in the learning process of ethical skills, for instance, the forum forces to students to improve their structuring of sentences in order to make their arguments understandable. At first, the discussion will be introduced only through exchanged greetings, and the language used is simple and close. After this preamble among students, interaction begins to take place, but in our case with course content in order to lead

the learning process. At this point the argumentations are based on technical questions about the topic under study. Afterwards, knowledge construction appears through the exchange of participants' ideas, learning from each other. Here the reasoning should be based on an appropriate language in order to make ideas intelligible. Finally, participants are engaged in challenging each other, in that case language should be accurate to defend their own positions in front of easily refuted and counter arguments. In other words, written reflection takes time and puts great demand on the writer in order to be understood in each moment of the discussion. Thus, moral reasoning skills, like the ability to morally justify one's decisions and to discuss and evaluate them together with other students, become essential.

What is more, asynchronous communication promotes this reflection by taking advantage of a momentary delay in the written dialogue for thinking, calmly, before replying (Habermas, 1984). Furthermore, teacher and students could take advantage of the asynchronous communication to post more complex questions. The result will be more elaborated answers that will be helpful when trying to reach a consensus during the discussion of ideas. Therefore, students need to engage in reflective dialogue and integrate different types of reflection to gain not only insight into the questions, ideas and beliefs of the others, but also of his own (Brooke, 2006).

This interaction promotes an intense social network where the standard cultural signifiers do not exist (sex, race, and origin). Within this virtual communication anonymity is possible and this fact benefits certain social sectors where an interlocutor could be marginalized. Hence the forum encourages the introduction of new and multiple approaches (interdisciplinary and multiculturalism) through the social network. Simultaneously, it involves a certain commitment to improving the students' personal development such as: responsibility, knowing how to share, knowing how to listen, the humility to accept mistakes and to change a

concrete position when it is not accepted by the rest. In other words, this is personal maturity.

In order to maximise students' interaction in the forum we propose the use of heuristics (section 2 of this present chapter) to assist in decision making for such conflicts. Heuristics have been proposed as procedures for ethical cases and decision support. They are used to support ethical decision-making by providing a series of steps that help the individual react to emerging ethical conflicts. They could be executed either individually or cooperatively. This last option is ideal where teams collaborate to select the appropriate decision depending on the case. Through heuristics we intend to intensify interaction among students when sharing and comparing information; exploring dissonances or inconsistencies among ideas, concepts or statements; negotiating meanings; testing and modifying the different proposals and agreement statements.

We expect that the forum, through a reflective dialogue, a collaborative context and peer support will have benefits in the training process with regard to students' engagement in their writing.

4.2.2. OpenStudy

The objective of the first exercise of the teamwork activity is to reach an agreement or consensus based on a coherent and consistent argumentation that justifies the global position of the team. This exercise demands an intense interaction among students and an effort towards mutual comprehension when making decisions. Consequently, teamwork activity, which is a provider of social skills to understand the others' point of view, needs an additional contextual tool between the interlocutors, the moral imagination. For our present work, we suggest that moral imagination is that aspect of the imagination which potentially becomes active in the moral student's attempt to consider which moral decisions to make. Moral imagination allows to students

to perceive the non-verbal cues and attend to the particular situation of the interlocutor through it. The lack of gestures, voice and facial expression, the elements that give us information about a situation in a face to face context, necessitates the search for a substitute. The moral imagination is proposed to overcome this absence. In addition, the Aristotelian point of view is supportive of our idea of moral imagination being an intellectual virtue. The intellectual virtues, in an Aristotelian framework, are built upon a foundation of moral virtues. The point being to attempt to stimulate, develop and educate the moral imagination as an element in the developing character of the student. It can be stimulated and nurtured through the use of case study and particularly the serious reading of literature, specifically, certain kind of novels as we mention in Chapter 5, section 4. Attentive reading of certain types of novels helps develop moral sensitivity and moral imagination by inviting the reader to go beyond her immediate experience, to see the importance of the specific context and yet also to perceive the links of common humanity which binds the reader to characters in stories. It is, perhaps, a way to develop sympathetic identification with the interests of the stakeholders one meets in the professional practice. Thus moral imagination appears a suitable learning tool to carry out applied ethics, helping students to develop moral sensitivity when understanding others' moral approaches and seeing the importance of the specific context of others. In addition, literature will provide an enrichment with regard to language and, simultaneously, to the thought processes of our students. Language influences thought (Vygotsky, 1986) and it is difficult to see how verbal thought does not affect the boundaries of imaginative activity. Even so, we should make good use of working through web-based technologies, for instance, in using a mixture of texts, and a mixture of media, both printed and visual. The use of novels and film has the advantage of historical perspective, and lengthy descriptions of context and character.

Some authors implemented this type of exercise with forums or Wikis (Biasutti, 2011; Regueras, Verdu, Verdu and de Castro, 2011) and even virtual worlds were proposed (Hobbs, Gordon and Brown, 2008; Monahan, McArdlea and Bertolottoa, 2008). In this case, forums and Wikis have an important inconvenience: it is difficult to converse in privacy. Virtual worlds allow private messages but are fundamentally based on synchronous communication. Therefore, another resource is needed to work in groups. At least, the tool should have the option to store information, i.e. a document, and the possibility for communication. We propose the use of a Web-based collaborative tool called OpenStudy (Ram, Ram and Spregue and Hill, 2011).[2]

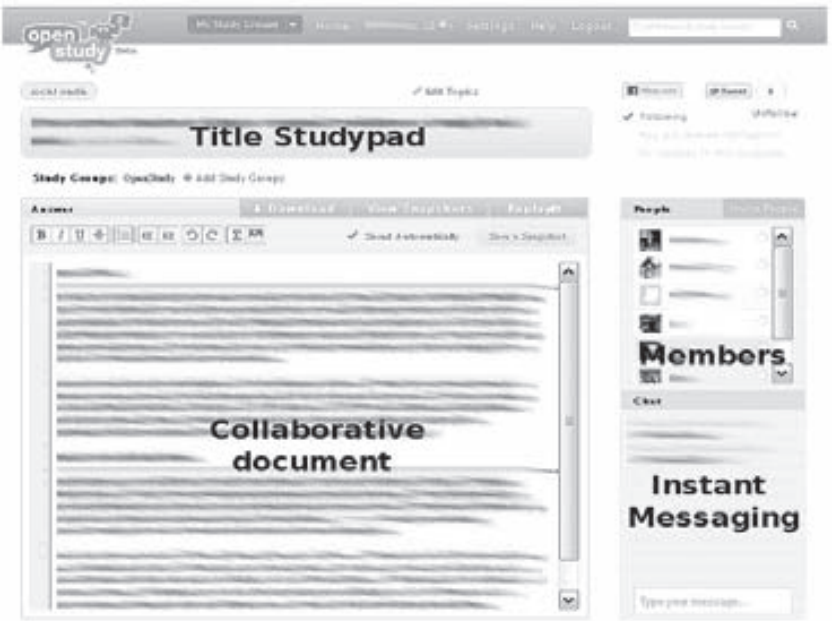
OpenStudy is a social learning network where the objective is to interconnect students studying the same topic. Similar to forums, a person posts a question and other people answer it. There are predefined groups (mathematics, physics, finance…) where questions can be posted. There is also the option to create new groups if existing ones are not suitable for a certain topic or question. OpenStudy has also a feature to create private groups or areas of studying called Studypads. These areas are controlled by the owner and a new user can only access them with an invitation. In our case, this functionality can be used to create a private group for each team to discuss their assigned perspective.

The structure of a Studypad is illustrated in Figure 2. Basically, a Studypad is a collaborative word processor combined with an instant messaging tool. The document is written in collaborative mode. The contribution of each member is highlighted in different colours to identify each addition. The instant messaging tool gathers all relevant conversation among members to build the document. Combining these two functionalities, a powerful resource is given with the option to create a document to store the arguments

2. This present article is based on the version retro.openstudy.com, but currently it is not accessible because it is in process of maintenance and development to incorporate new functionalities.

and the option to communicate asynchronously with the other members of the group. The generation of an argumentation cooperatively is essential in the learning process of the student.

Figure 2. Studypad description of OpenStudy



As a social online learning environment "OpenStudy is a large-scale open social learning community (SCL) that promotes effective social presence, cognitive presence and teaching presence online through state-of-the-art Web 2.0 technologies" (Ram, Ram and Spregue and Hill, 2011). *Social presence* is an essential factor because it promotes interaction and engagement among students in online courses. Students value and benefit from interaction with other students and the teacher, but to fulfil this, social presence as "[…] the ability of learners to project themselves socially and affectively into a community of inquiry

[…]" (Rourke, Anderson, Garrison and Archer, 1999) should be developed. Social presence is necessary to support the reflective and meaningful dialogue that we pursue in order to get students engaged in the cases under study. Students create social presence by the nature and content of their discussions and consequently, the interaction brought about as a result of these discussions. Additionally, in online courses the learning community is defined as some form of collaboration with an added element of social interaction. That is why (Harasim, 2000) "[...] the Web's asynchronous nature both enables and requires collaborative learning: collaboration provides the social glue of a community that engages students and motivates them to participate [...]. In this sense OpenStudy provides a social context within an online collaborative learning environment where the essential elements of a community (i.e.: interaction, shared values and beliefs, respect, responsiveness, openness and honesty) are performed. In our case, this performance is achieved through written dialogue because the dialogue is based on a constant interaction among students which goes beyond the contents; it goes towards making each individual's ideas available to others.

4.2.3. Wiki

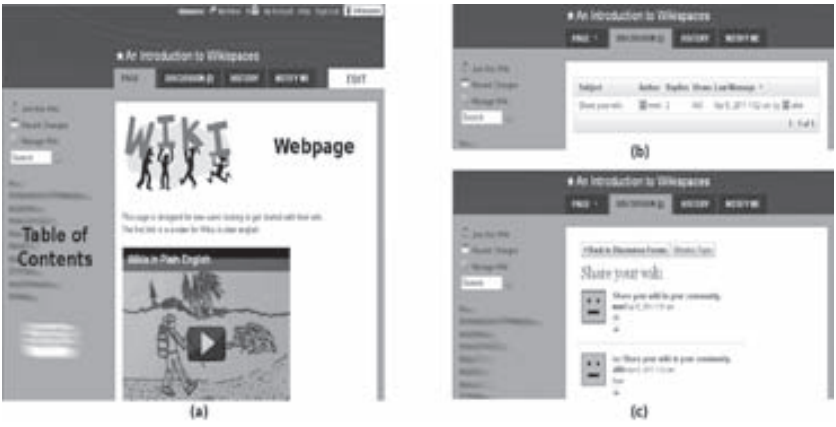
A forum is a valid resource for sharing arguments among different groups, although it is not enough to give a picture of the level of collaboration and interaction among students. However, it could be useful, from an educational point of view, to store the statements of each group together with the dialogue's thread about a particular case study (Loui, 2005). This collection of ethical cases together with all their corresponding information could be a valuable resource to: access to information about another kind of case, search for analogies in other cases for novice students, analyse the transcript of a discussion afterwards to evaluate the quality of the different contributions to a case, compare responses to the questions related to a case, etc.

Similar to (Biasutti, 2011; Gobbo and Lanzarone, 2006; Villanueva, 2010), we propose using a *wiki* in order to put the arguments of different groups in a common place. A wiki is a website that allows the creation and publication of web content in a collaborative mode with simplified mark-up language. Wikis can be used for different purposes, for instance, knowledge management (i.e. Wikipedia, 2010) or community websites. Figure 3.a illustrates the common structure of a wiki. In the left part of the website, a table of contents lists the pages included in the wiki. The page can be edited, all the changes performed can be tracked and opinions can be added using the navigation bar placed on the top of the page. Wikis have a user-friendly structure and an embedded editing tool to help non-technical people to edit the content. Wikis also allow the adding of multimedia resources (i.e.: images, audio, and video) and some newer wikis also allow users to add *widgets*. A widget embeds some functionality, i.e. opinion poll, online documents and slide presentation, among others. There are also Semantic Wikis associated with an ontology that could be also used to store a collection of ethical cases similar to (Bratsas *et al.*, 2009).

The wiki will be used in the second and third exercises for the teamwork activity. The main objective is to develop the social skills of the students when a study case is discussed and how effective is building knowledge through investigating a topic and presenting their findings in a shared work space. We need to look beyond the mere content of the messages, to see how the pupils engage in knowledge construction by means of interaction and effective communication that we pursue. Interaction and the building of knowledge will be increased as the level of contributions goes up throughout the inquiry process. So the second exercise involves each team posting its initial argumentation on the wiki page forcing the students to discern the underlying moral value related to the expounded arguments. A group can use the editing tool to add its defence. Multimedia resources

and widget components could help to improve its conclusions. The third exercise is focused on starting a deliberation about the arguments. The discussion panel in the wiki page is perfect for this exercise (Figures 3.(b-c)). Its structure, similar to the forum, can help students practice written dialogue. The build-up of trust which emerges from regular high quality social discourse means that the students are prepared to criticise each other's work constructively or engage in difficult issues related to the topic under study. From this communicative maturity, the final objective is to refine the arguments of each group using deliberation to reach a consensus. At this point, essential requirements of moral reasoning should be requested to complete and polish up the training of the ethical communication about ethical contents.

Figure 3. Example of a Wiki produced with Wikispace [Wikispace, 2010] (a) Wiki page to add content (b) Discussion frame. (c) List of posts in one thread



When managing ethical issues, students need to know that it is essential to control the meaning of their words because, in every subject they face, a set of pervasive and subjective elements (i.e.: opinions, reflections, assessments) are at stake. For instance, avoiding some forms of intense language will have favourable

effects on communication. Therefore, when making a deliberation among students, the teacher will require the use of careful language when analysing moral conflicts to improve communication competences and to carry out an effective communication. In this way, some language strategies (section 1 of this present chapter) that we consider appropriate should be enforced in the wiki. The linguistic strategies are necessary to accomplish desirable ethical communication. Moreover, the ethical responsibilities (section 1 of this present chapter) inherent to these linguistic strategies are required to reach an understandable and constructive reasoning.

In addition, good quality of written speech should be founded on respectful communication with the avoidance of irresponsible speech such as: defamation, harassment, flaming and abusive language. Students have to learn that communication has to minimize the use of damaging tools, like judgemental language, and to emphasize others' qualities when making an ethical decision. For this reason taking care of asynchronous communication through a set of linguistic strategies is needed because in this kind of communication it is very easy to create misunderstandings between interlocutors. Complementing written speech with attentive listening is a way to create empathy among the interlocutors through the inquiring process. Consequently, paying attention within a deliberation allows to the interlocutors to think about the different opinions based on a structured and consistent speech, to recognize differences and analogies, construct new arguments and ideas, or simply, promote an appropriate atmosphere for the reflection, mutual understanding and the reinforcement of the sense of collaboration and teamwork amongst pupils. In many ways, the wiki promotes all these features.

Furthermore, when a deliberation is in practice a mix of different cultures and disciplines can be achieved. Within this diversity it is inevitable that some students cannot escape their prejudgements. For this reason, it is essential to set in context all the involved par-

ticipants to understand the varied catalogue of points of view. One way through which the students can make themselves aware of their own prejudgements is to implement a deliberation by means of a reflective dialogue, based on moral reasoning. This tool allows them to engage with and to understand others' opinions, answers, behaviours and attitudes while taking into account all the elements (environment, participants, constraints, consequences, etc.) of the circumstances where they are placed.

As a final remark, we utilize web-based technology to improve students' awareness of ethical issues within online courses and further develop their decision making skills. Technology provides substantial benefits such as: it increases sociability which depends on collaboration and, consequently, on interaction; it promotes empathic skills by enabling students to see other's point of view; it mediates interactions that depend not only on the explicit exchange of information but also rely on implicit, effective and appropriate modes of communication; and it provides flexible and simple access to repositories of information. For this reason, all these features mean that web-based technology has a fundamental capacity to produce appropriate communicative tools for text-based communication while extending their meaning. In other words, in the context of collaborative learning, web-based technology involves displaying the correct values through the appropriate communicative resources, using craft knowledge to turn ideas into realistic classroom practice and engaging in the kind of reflective dialogue and critical thinking which can get the best out of unpredictable technology.

In this light, as a future work, we need to define the assessment criteria of the course. A good possibility is to use would be a method based on Audience Response System (Konstantinidis, Bamidis and Kaldoudi, 2009). Different measurements, such as speech quality or didactics quality could be specified to return useful feedback to the students. Finally, we propose to implement the designed course and analyze the behaviour of the

students. The obtained results combined with the assessment criteria will be used to refine the pedagogical aspects of the course.

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Epilogue

As a teacher at two engineering schools, the Universitat Autònoma de Barcelona (UAB) and the Universitat Oberta de Catalunya (UOC) I recognize the prevailing definition of the teaching of engineering which is strictly addressed to a training of operative nature in which any components that are not purely technical are omitted. This means, training oriented to the application of knowledge rather than a critical deliberation about it. It seems that technical training, and humanities studies are seen as two dissociated realities which involve not distinguishing between or identifying those values that are implicit in acquiring certain knowledge, and technical skills. Hence, teaching in engineering schools is described as being devoid of values. However, this axiological asepsis is not entirely true and does not reflect what is really happening in the core of engineering's curricula. Currently, there is an evolution of the common direction that these two realities are taking. In the teaching of engineering not only is there a predominance of values of an instrumental nature concerning effectiveness and viability and encouraging competitiveness, profitability and productivity in the service of the labor market and the employments patterns, but also values like commitment and responsibility to society and the environment become patently clear within the training of an eminently social profession.

In this light, an important consideration to bring up with teachers and students of engineering schools is whether the

wider trend of the engineering curricula towards a professional life oriented fundamentally to an instrumental conception of the work has any sense in the long run. It is very well known from the academic context that students with a degree in engineering will develop her profession above all in the business framework and there she will: work with other people, make decisions about her responsibility and others responsibilities, dissent from decisions of others, deal with customers, and so on. Technical competences and knowledge won't be enough if she lacks, for instance, the skills to communicate and to work within a team. From this point we can gather, as we have pointed out throughout the present study, that the engineering profile requires more than instrumental and technical knowledge, it requires taking into account the social perspective that its professional roots (Chapter 5) have acquired in the course of its development through the ages. It involves knowing how to negotiate with the customers, how to lead a teamwork, how to establish relationships of diverse nature with the stakeholders, and in general, how to achieve management tasks fittingly. The engineering profile needs a complete catalogue of knowledge (i.e.: theoretical and practical; operational and social), and interpersonal relationship and communication methods in order to coordinate and to know how to treat people, because people are its reason d'être.

At this point the ethical component plays an important role because it is when others are introduced into our world that we are confronted with ethics (Levinas, 1998). According to him, our self-defined limit of responsibility is breached by the presence of the other who stands in contradistinction to us. If we live or work isolated in the world, we would generally have no reason to consider whether we need to take an ethical stance or not. Generally engineers work in teams, in large and small groups. Whatever the team size, different participants bring different expertise to a task. Everyone has their own disciplinary perspective; their own ways of abstracting and modelling; different methods for finding

solutions to problems within their specialty. Each participant, with different competencies, responsibilities, and interests, sees the task differently, and consequently, participants' analyses, proposals and claims have a high likelihood to come into conflict with the others. Here lies the source of the complexity of today's engineering task for there is no over-arching, instrumental way to reconcile all these diverse ways of doing and thinking. Hence, the frame of ethical professional practice of ICT professionals is surrounded by people, and the encounter of the engineer with others (i.e.: suppliers, clients, managers, colleagues and stakeholders) calls for such responsibility (Chapter 4) and it cannot be avoided because as a professional she is called to respond. Moreover, this relationship with others demands social skills and communicative competences (Chapter 6) in order to fulfill an important goal of ICT professionals, making available the service that an engineer has to provide to society in order to attain recognition for the work done and the quality achieved.

For this reason, the training of the engineering profession cannot be exercised outside of ethical issues when it is about individuals who will act *from* and *for* a concrete social, cultural, political, economical and historical context (Chapter 6), responding to its needs and problems. Thus the education of the students should have as a goal not only the preparation of competent ICT professionals, but also the integral training of them, this means, the advisability and necessity to train engineers for life and not only for the market and the demands of contemporary society. Therefore, the ethical component that we defend for the engineering profession is not simply a set of qualities such as teamwork, leadership, team spirit, and so on, which are also needed. This view is oriented towards optimal development of human relationships, personal identities and skills on the management plane which are very important from a professional viewpoint and where the ethical concept is used as a complementary resource to technical preparation. What we really pursue within these human

relationships is an ethical training that allows the individuals to interpret, to reflect and to dialogue (Chapter 5) with others about the professional labor and the needs of the society and the environment. This involves values oriented above all to the development of critical, committed and transformative social attitudes which endure and which should be transmitted to the coming generations of engineering professionals. The whole thing in order to integrate into the ICT profession questions such as social justice, cooperation in development, environmental protection, human welfare and political decisions which are at stake during the exercise, at the workplace, of engineering and which require being performed in deep thought because occupational hazards exist and as professionals they should come up with the goods.

As a result of this ethical and social responsiveness of engineers in the ICT environment, explored in the course of this research work, we are of the opinion that the university and the whole of its community comes into play in order to carry out our educative proposal. For this reason, and thanks to the maturation process given by this study, we openly express a set of actions and tasks that from this privileged position should be fulfilled to achieve our educational goal. So the university as the place where the future ICT professionals are conceived and its educators with their daily interaction with the students are the relevant means in the transmission of the values pursued. Even though other means, for instance, professional associations and international organizations (i.e.: ACM, IEEE and UNESCO) (Chapter 3) should collaborate in and influence the cultivation of such values or professional ethics. Additionally, it seems advisable to reform the engineering programs following the spirit of the teaching of distinguished figures (Chapter 3) and some aspects of their lines of thought, in order to enable students' (and the university's) understanding of the social as well as instrumental challenges of contemporary professional practice and what this might entail for the profession's "social responsibility" (ethical

behaviour of the practicing engineer). All of these, and more concretely the university, are involved in promoting the real values (not only those declared in its statutes) of the institution and its community, because the society has legitimized their role as the main figures responsible for this transmission after the initiated educative and socialization process of the family, the school and the relevant social context. Indeed, its continuation function within the construction process of values is of relevant importance. Therefore, the university should show its values because insofar as the understanding of them is clearer, more intense their effect on the community will be. In that sense, University Social Responsibility (USR) (Chapter 4) has an important role to play to achieve this goal.

Consequently, the university has as an important mission with regard to the generation of beings that are "themselves", meaning, autonomous beings that strive to become good professionals in the service of the society. Because of this, the university counts on the fulfillment of the student's moral education as autonomous individuals putting into practice the performance of the post conventional level (Chapter 6). From our point of view, this is an essential task which is the responsibility of the university and the teacher with regard to the pupil. Another, and no less important, task is with respect to the future professional morals of the pupil, because the university should educate the pupil professionally too. As educators, we are obligated to know how to train the pupil within a tradition that belongs to a regulated community (codes of ethics and professional associations) (Chapter 2), which looks after the correct exercise of the profession, and to renew it. It demands of the students an attitude of an unquenchable thirst for knowledge, open-mindedness and gratitude towards a respectable and reputable profession, and in a desire for innovation for the maintenance of both.

Continuing with the enumeration of the university's functions, it should be able to train new ICT professionals, and to

carry out this the university should know how to transmit a proactive responsibility. In others words generating professionals, integrated with ever-changing communities, with the ability to solve new problems and face new challenges and to find new ways and alternatives to analyze and explore new conflicts and situations (i.e.: the dynamic relationship between technology and society and its consequences, the ethical issues involved within the Internet and ICT technologies and the shaping role of technology within engineer's profile) (Chapter 1), in a creative and innovative way.

In this light, the training of ICT professionals based on committed and transformative socials attitudes require a context through which to cultivate them. For this reason, virtue ethics (Chapter 1) appears as a fundamental learning resource. The virtues such as prudence, justice, fortitude and temperance are revealed here as essential parts of the engineer's profile because these virtues, also called cardinal virtues, combine intellectual elements with affective elements, and they are interconnected depending on one another. Its exercise demands the student look for a compromise adding this difficulty to the moral conscience of the individual. It is clear that the specific corporative moral training of the professional is the responsibility of the organization through its CSR (Chapter 2), but the general basic education (academic training) of the subject, the common denominator of all the corporations, belongs to the university. As such it is a duty for us, as educators, to integrate all these sets of morals harmoniously to avoid having schizophrenic students (Basart, 2008), and in order to prevent their different morals being held in different watertight compartments.

Hence if we aspire to reach such moral aims in the ICT professional profile (i.e.: post conventional morals, individual, professional, organizational and civil), it is necessary to assume the ethical perspective in each subject of the syllabus. In others words, it is not enough to have only one module of ethics within

the whole degree. Ethics should be transverse within the engineering's curricula and each subject should consider this ethical perspective. Taking into account this ethical approach means wondering if a certain activity, a certain action, a certain decision considered in a set type of subject belonging to a specific knowledge area (a concrete context of contents), is compatible with the principles of justice and solidarity, with the principles of non malfeasance, with transparency, with publicity and veracity, all of them ethical principles that go from a minimalist ethics towards some personal ethics (Chapter 1).

Completing the relevant and varied functions that the university has to takes on, this is the moment to allude to the social affect of the ICT professional. From this point of view, the university has the responsibility to guarantee the personal and professional development of the members of this society, and to create the suitable conditions to achieve it, from which the principal is to encourage a dialogical (Chapter 5) environment in the community on which the whole learning process is based, and social coexistence and understanding. Thus the university is contributing to the progress of society in the search of the truth and all those issues that a variable social context requires through quality teaching. For this reason, from an educational perspective, it is very important to know what the society needs and what the university should give to society to achieve this progress in the right direction. Owing to the fact that the university has a lot to say in regard to this social progress, this progress involves talking about the teaching quality and directly talking about the ethical criteria, too. So within the educational context certain considerations deserve to be mentioned in order to become aware of what we do (or not) in the university when educating ICT professionals:

- The university should be the engine of progress and the teaching staff is an essential piece of this. This progress is

materialized in knowing how to adapt to surroundings and it involves offering a response to the new challenges that the ever-changing society raises. It involves an all-round educational program for technical degrees.

- Ongoing criticism of the university is required in regard to its legitimacy. Hence a continuous reflection should pervade the institution, the teaching staff and the students in order to develop the appropriate requirements from teaching which are claimed by society. For instance, reflections such as: what should the mission of the university be? Is the university allowing the development of the autonomy of the students? Is there coherence between the academic life and the contemporaneous social conflicts? Which model of student should be shaped by the university depending on the competences and the knowledge taught there? For what kind of society does the university work? For which kind of labor market does the university work?
- Is the equilibrium between the political, the economical, the business sector and the social scope taken into account when the syllabus is changed by the university? This means, does the university and its whole community (i.e.: teachers, students, administrative personal and maintenance service) realize the context that the society lives when modifying the syllabus to adapt to that which is in constant evolution? Maybe, from the university, stagnation and resistance to change are two ways to resign us, but should overcome because they denote, for instance, on one hand, indications that we are well-off, that we are ignorant or that we are not empathetic with the students' reality and social changes. On the other hand, budget problems for the university have repercussions on the recruitment of staff and their training, the purchase of resources and the improvement of infrastructure to carry out the university's mission. Any change demands making

an effort of different nature, economical, personal and structural.

A commitment to professional practice by academia, professional associations and organizations and the business sector should help to define the engineering profession, and prepare a new generation of ICT professionals, for the benefit of society and the communities they serve.

Further work

Once one acknowledges that the engineering challenges faced at the workplace are not wholly responsive to an instrumental resolution and that social exchange and action is part and parcel of an engineer's work, engineering practice appears as a much richer experience. Thus what is needed is to open up the engineering classroom to new perspectives, other than those which see every engineering task and challenge as a "problem" to be solved, as an individual, alone. These perspectives are addressed to the exploration and analyses of ethical conflicts in order to become aware that something more than an improved technology might be required to deal with a concrete situation. There is something more to doing engineering and dealing with ethical issues than finding answers to well posed problems, but, again, that is precisely what is required in order to teach ethics (and engineering) an integral all-round educational program for engineers such as the Bolonya criteria indicates within its new global educational guidelines.

From our view point, a mixed syllabus in engineering made up of operational or instrumental engineering and humanities should be the core of future courses. We suggest implementing the kind of courses that promote inquiry and reflection on practice, as well as problem solving. This openness should pervade and dominate

the whole of the student's experience throughout all their years of undergraduate study, and what is more, during the training in the course of their whole life, lifelong learning. For this reason, during the present work, we insist on opening up the engineering classroom to dialogue and deliberation, allowing students to open the door to an infusion of questions of an ethical nature as an integral part of developing a concrete task. In this sense, a schooling of engineers rooted in a more "liberal", general engagement with studies, still with science and technology as their focus, but approached with an air of critical reflection is desirable.

Based on these previous assumptions, together with the present research work, our main future goals are as follows:

1. Designing a course of engineering, ethics and social responsibility based on the methodological and pedagogical guidelines developed throughout the research work. The subject should have the aim of helping students to reflect about the social and environmental aspects of technology by using a highly-participative methodology as we have shown within the present study.
2. Implementing the preceding subject within a virtual educational environment. A pilot study will be carried out by means of an optional subject belonging to the Telecommunication syllabus of the UOC.
3. Taking into account the previous point, in this case we will need to carry out deep research with regard to what the implications when training ethical issues within virtual context are. In this present work we only have pointed out some of the singular connotations that this context has. It is desirable that the ethical field is done through in-depth investigation with regard to the virtual educational environment. This new learning context requires a painstaking study in order to identify its own connotations, but they are not only hindrances, neither solely advantages. It is a

matter of making the most of its features. For instance, the technological resources available.

Another factor to keep in mind is the current students. They are the reason to use the technological resources within the learning process because our students have changed radically. Today's students are no longer the people our educational system was designed to teach. Our students represent the first generations to grow up with technology. They have spent their entire lives surrounded by and using computers, videogames, video cameras, cell phones, and all the other toys and tools of the digital age. E-mail, the Internet, cell phones and instant messaging are integral parts of their lives. They are digital natives. Because of this, there is no sense in not suggesting the new educational possibilities that the technological resources offer to the training of ethics.

4. As a result of the new profile of our students, who are "native speakers" of the digital language of computers, video games and the Internet, new ways of education are required. This means, implementing the methodological and pedagogical basis proposed in this research work, within a virtual context and with digital native students, will involve designing a course that bears in mind the meaning of open learning. This open learning based on the ability to effectively and efficiently make sense out of the enormous amounts of data continuously exchanged and published throughout online forums and web technologies including data streams, blogs, digital archives, and so on is a crucial ingredient for the learning process of these digital native. So to further enhance the usefulness of data exchanged among students by means of the previous pedagogical and methodological resources, tools and strategies, and the technological resources, we will need to define indicators of evaluation to capture the quality of

their posing of questions, their decision-making and moral reasoning when analyzing ethical issues in order to establish a reliable criterion when evaluating students.

5. Once the implementation of the future subject of ethical contents is fulfilled within a virtual context, taking into account all the elements mentioned previously and based on the conclusions drawn from the research work, the moment to think about the continuous learning through master's degree which includes this kind of content in all its magnitude arises. This means our additional future work is to implement a master's degree, developed between different technical universities or engineering schools, which include a wide range of subjects in order to deal with the diverse areas where ethics plays an important role and where its influence or presence is required. For instance, the contents to consider could include: science, technology and society; computers, society and ethics; business, ethics and law; environmental law and ethics; professional and sustainability issues; ethics, politics and justice; ethics and human rights; professional ethics; and management and organizational ethics.

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