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Engineering Ethics Beyond Engineers' Ethics

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Abstract 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 certain model of the ideal engineer: someone both quite individualistic and strong enough to deal with all the moral challenges that could 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 now we 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.

Keywords Engineering ethics · Professional responsibility · Responsible engineer · Engineering education

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Engineering Ethics or Engineers' Ethics?

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, 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 1991; Martin and 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 some 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 engage the members of the 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: Whom 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.

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 taken a role in the outcome (Lynch and 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 single-mindedly, by using his or her own means and resources; here, the result is close to the paradigm of the *heroic engineer*. Broome and 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; 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 for 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 instance, discipline, courage, and tenacity. Moreover, there are heroic engineers who, in special circumstances, sacrifice themselves, putting at serious risk their job or their career, and sometimes even their life. These attitudes deserve much admiration and respect, but heroism is far from what can 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.

Ethics, Rights, and Corporate Social Responsibility

It has been argued (Stohl et al. 2009) that, at least inside the Western tradition, it is possible to identify three stages or 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. 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 we are now going to summarize these three processes according to Stohl's et al. (2009) description.

Ethics

First generation ethics is personal ethics. It comes vertically from God and is fixed for ever. This ethics is kept alive by faith and religion. 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 17th and 18th centuries a new stage of ethics arose. Now 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. That 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.

A Broader Concept of Responsibility

Following 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 far from those third generational features. Day by day, we transform the planet in which we live. Engineering is one of the activities that 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 into careful consideration its influence on the life of all human and non-human beings. A more 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 which 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.

Just 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.

Even so, 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, as regards to sophisticated technological products—such as those produced by engineering—, there are a great number of factors and relations to be taken into account. But that is not all. Some factors and relations, 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?"

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). 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 bad—not just nature but also our other environments: politic, 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 very 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 also it is 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 to, and secondly to act in accordance with this understanding.

We experience, day in and day out, how 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. To make 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. With 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, something 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 the 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 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. Finally, they 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 fair/unfair.

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.

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