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Foreword

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I have been observing engineers, engineering practice and engineering education for over twenty years now. I almost became an engineer myself. Indeed, after high school I first studied in a two-year science class where I prepared for the competitive exams required in order to enter engineering education. When I decided to change direction later on, I was already on the way to specializing at the electrochemistry engineering school of Grenoble. My first job was as a teacher in a *second chance school* for young people, many of them almost illiterate, despite having completed compulsory education. My following job was as a social worker with homeless people. I went back to university to study education. I then returned to the world of engineering earlier than expected. While studying alternative systems of education, an engineer who pioneered in France the inclusion of ethics in engineering education proposed that I do some research on an experimental course on engineering ethics. Two decades later I am now a social scientist and the focus of my research is mainly on engineering profession and education, ethical issues raised by engineering, and the promotion of ethical awareness among engineering students. It's clear that I was more drawn to debating with engineers, identifying the ethical issues their profession faces in our modern globalized world, discussing with students and writing papers about those questions, than to practising engineering myself.

Since discovering the academic field of engineering ethics, I have paid careful attention to the collaboration between engineers, philosophers and other Humanities scholars in tackling the ethical issues of engineering across many countries. I have witnessed scholars' efforts to develop philosophical and ethical reflection that is linked to practitioners' experiences. I have had the good fortune of meeting a great many practising engineers and academics from a variety of backgrounds who were eager to build bridges between their disciplines. I have met many Humanities researchers who had a real interest in engineering, not only as a theoretical issue, but also remembering that it involves human beings, and that engineering is a wonderful and critical challenge for humankind. As much as a critical approach is necessary when dealing with ethics, it is also essential to develop a better mutual understanding and for academics to remain close to the human experience of the central actors, the engineers. This is, to me, the only effective way to reach engineers and to promote, with them, the engineering profession's ethical concern.

I am very enthusiastic about Satya Sundar Sethy's efforts to contribute towards helping engineering educators find the best way to build bridges between engineering and society, develop students' ethical awareness, accompany the practitioners' effort to act more ethically, take their fair share of responsibility and participate in the ongoing ethical discussion surrounding their professional activity. This book, which is the result of an exciting and highly practical project, is one more brick laid in constructing this new field of interest at the crossroads of the Humanities and engineering, engineering ethics.

Engineering Ethics: a burgeoning academic discipline. Bioethics and business ethics have long had their international conferences, their academic networks, their international scientific journals, as well as their

schools of thought and their internal theoretical controversies. On the contrary, engineering ethics as an academic discipline is less well known and attracts occasional scepticism from academics as well as from practising engineers. In the USA, where there have already been many national conferences on this topic since the 1980s, academic discussions have developed after several decades of debate within the profession. When scholars from the USA began studying the ethical issues of engineering, several codes of ethics had already been published and even revised in the country. Although the first code of engineering ethics came from the UK, the genre had found highly fertile ground in the USA since the beginning of the 20th century, and many codes from various engineers' associations have long co-existed. The attempt to reach an agreement over a common text never really succeeded, but most professional associations came to an agreement in the middle of the 1970s on the code put forward by the Engineers' Council for Professional Development (today the Accreditation Board for Engineering and Technology, ABET).

Since the publication of the first codes of engineering ethics (by the American Association of Consulting Engineers, ASCE) the USA has had a long history of discussion by engineers on ethics. Engineering ethics as a field of teaching and research also has a long history in the USA, longer than anywhere else. Since the 1970s, the USA's National Science Foundation had started to promote collaborative research between engineers and philosophers in order to better analyse the issues of engineering ethics and develop appropriate teaching materials. These collaborations resulted in conferences, published manuals and articles, many codes of ethics put on line, as well as case studies for pedagogical use. Since the mid-1980s the ABET has increasingly required engineering programs to include the teaching of professional ethics. This culminated in the formulation of the Engineering Criteria 2000 released in 1997 and which makes it a requirement to include teachings about the ethical responsibilities of engineers.

Engineering: an international profession. The work environment of engineers covers the entire globe. Companies and engineering products cross borders easily, and move over vast regions of the world; international business and engineering have increased manifold. All over the planet, the majority of engineers work in large multinational companies. To increase their skills in working effectively with people from around the world and in order to gain an international engineering perspective, students most often study in an international context. They learn foreign languages, spend semesters abroad and gain experience in collaborative projects with foreign students in their own country. To embrace this reality, efforts have been made within various regions of the world – in America, Asia, Europe, and beyond – to harmonize technical and engineering education. Accreditation and professional guidelines have been set up to further the mutual recognition of diplomas and titles.

Engineering: a globally transformative potential. Risk and pollution, like engineers and engineering products, cross borders easily. Sometimes, the impacts of engineering on the environment are sudden and dramatic but more often they are indirect and subtle and may escape immediate notice and the reach of these impacts has increased over time. The side effects of engineering on society, the environment and safety of human beings and the ecosystem can be felt on a local scale but also on the global one. The consequences of engineering decisions can be felt long after they were made and far from where they were discussed. In order to meet such challenges, especially when engaged in global projects involving multinational jurisdictions, engineers need to equip themselves with a strong awareness of both moral responsibilities and the possible implications for the decisions made in the course of their professional duties. In this context, it may not be

surprising that efforts have been made to consider the possibilities of producing international codes of ethics for engineers. Indeed, since the end of the 20th, scholars from the USA have been calling for an international agreement on ethical standards for engineers, so far to not avail. Instead the World Federation of Engineering Organisations – an NGO in close relations with UNESCO – has designed a guideline to assist member organisations in guiding ethical behaviour by formulating their own code.

A variety of engineers' responses to the ethical questions: the comparative analysis I have made since my doctoral research published (*Penser l'éthique des ingénieurs*, 2008 ; *Les ingénieurs et l'éthique. Pour un regard sociologique*, 2008) has shown that the way engineers and engineering association tackle the ethical issues of their profession varies a great deal from one country to another. This doesn't mean that engineers do not have to respond to the same kind of issues, but that:

- Being an engineer (or a graduate engineer, a professional engineer or a civil engineer) doesn't mean the same thing depending on the national, regional and/or cultural context. There are different definitions for an engineer and also different ways of segmenting the larger definition, each of them entailing various types of social expectation;
- the feeling of belonging to a profession or a distinct group whether social, professional or occupational, holding specific responsibility varies from one place to another and is linked to the history of the group, how it started, as well as the challenges it may have to face;
- The type of answers given by human communities to ethical questions also varies from one place to another: some rely on codes of conduct or ethics or standards, others on the law, some rely on individual answers, others in collective ones.

For instance, codes of ethics have existed in the USA and Canada since the beginning of the XXth century, and in Norway since 1970; In Sweden a code of honor have existed since 1929 and in Finland since 1966; in a few other countries like Australia and New Zealand code of ethics have been published in the 1980s and in others like Japan only in recent years; in the province of Quebec the code of ethics published by the Order of the engineers has the force of law; in yet other countries – even very industrialized ones like Germany – there is no code of ethics for engineers. Actually, like any other outcome of engineering activity, whether technological products for the marketplace, or technical codes, or ethical codes – where these exist – the responses given to the ethical questions embody a variety of interests, tensions, and assumptions. They reflect a common morality, but they also reflect specific circumstances of the time and place where they were designed.

- In the USA, the early interest of professional associations in codes is linked to the professionalization movement of the beginning at the 20th century and can be understood as a means for engineers of obtaining the social recognition due to what is designated there as a profession, in opposition to the other types of occupations.
- In Germany, there is – strictly speaking – no code of ethics for engineers; however there is a document called “fundamental of engineering ethics” which differs in genre from the codes published in the USA. In Germany, debates about ethics rose out of the ashes of the Second World War and the collaboration of engineers in some of the third Reich atrocities. In a mission statement published in 1950 they included an explicit commitment to humanity as a whole which can be understood as a self-criticism by German engineers, who previously had understood themselves as advancing civilization by serving Germany.
- In Japan, engineering ethics was developed in the late 1990s as a result of nuclear accidents and out of the need to meet the requirements of foreign

accreditation bodies like the USA's ABET. At the same period, most Japanese engineering societies published codes of ethics to respond to the challenge of deep cultural transformation involving a weakening of loyalty to tradition and an increase in individual self-interest.

The reasons for the engineering profession to have - or not to have - a code of ethics depend on many factors. The relationship between ethical debate within the profession and discussion around the promotion of ethics within engineering education also varies from country to country: this relationship is tangible in the USA and in Japan, but is not in Germany or in France. Beyond the existence of a code of ethics, which is only the tip of the iceberg, the question "what do engineering ethics and engineers' social responsibility mean for engineers?" receives various answers which are historically and socially determined. One of the reasons for this is that these questions are linked to others - cultural and local factors - that cannot be ignored, such as:

- What does it mean in my country to be called an engineer and/or a professional engineer and /or a civil engineer? What does this calling say about what I know or am supposed to know and what others do not? What does it imply in terms of social expectation?
- Are some specific occupational activities in my country regulated by a professional order? Is it the case for engineers? Do engineers have to be found in specific types of organizations?
- How do people relate to ethics and values in my culture, in my social or professional group? Do people in my country look for answers in religion, in wisdom or being helped by personal coaches? Do they rely more on written laws or given word? Do they expect a code of ethics or a professional order to draw a line between what should be promoted and avoided? Are codes of ethics meaningful for engineers in the country where I have been trained to become an engineer?

Most American people, and engineers among them, believe that when it comes to ethics there are rules that can be applied to any situation. This is far from the case in most Asian countries where the common belief is that there are no unique rules that can apply to every situation. The way the concept of identity and responsibility is understood in Japan, has to be understood in relation to the establishment of the Japanese nation state under the Meiji Restoration where harmony is a key concept. In China, professional ethics has found its roots in the Confucian culture and the concept of social order. The concepts of Dao, and harmony are also very important. In Canada, engineering students learn that any breach of the code of ethics could lead to a court trial, or expulsion from his or her professional engineering association, and not being able to work as an engineer unless moving to another country, or at least another province of the country. In France, the majority of students are simply unable to imagine that there might exist somewhere in the world such a thing as a code of ethics for engineers. In the USA, academics find it hard to believe that there are countries where engineers do not belong to something called a "profession".

While we observe an increasing harmonization of engineering education all over the world, the environmental, social, and other ethical issues at stake within engineering require answers which are both global and local. We all know the famous saying "think global, act local". Engineers are for the most part acting globally and need, of course, to think globally in order to design projects that work in the global world. At the same time, I believe that finding answers to ethical questions needs to be informed by the culture from where the answers come and the questions are asked. An engineer can become more aware of the global ethical issues of engineering. She can learn

to think more globally about these issues. But, her reflection will be influenced by one or more cultural and professional frameworks: where she was brought up and her engineering education, where she actually studied to become one, and where she actually works as an engineer. Scholars of engineering ethics too often ignore these important questions and teachers may for granted that any engineering ethics textbook will be appropriate for their students.

Contextualising the teaching of engineering ethics. To enable students to familiarise themselves with a field of studies that is not their first choice and does not relate to experimental sciences, teachers need to build their courses around their students' background because their worldview is shaped by the symbolic references common to their particular culture. Thus, although the Challenger accident (1986) may be used as an engineering ethics case study with students from all over the world, it may require different approaches that take into account the students' cultural context. Looking for answers to an ethical dilemma in the code of ethics of the USA's National Society of Professional Engineers (NSPE), or studying the concept of Dao, may not be of much relevance to a French student. In another country, it may be more relevant to consult a code of professional ethics or any other kind of formal regulation, where that exists – and has meaning for the engineering community. It may also be efficacious to discuss the issues of engineering ethics as they relate to the particular philosophical framework with which the engineers and engineering students are already familiar.

To conclude, I should like to acknowledge Satya Sundar Sethy's remarkable energy and determination in completing this book, and his skilfulness in bringing together the main themes developed by the international community, including academics from the USA with their widely differing approaches. He has also given voice to Indian researchers, who are able to give global issues a new reading and another perspective, making the international community more aware of local situations and alternative frameworks for dealing with engineering ethics --- at the same time as helping Indian engineers also to think locally.

Christelle Didier