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Ethics in Engineering in the Netherlands: The Role of Professional Associations, Universities, and Law*

MICHIEL BRUMSEN
Dept. of Philosophy, Faculty of Technology, Policy and Management, Delft University of Technology, The Netherlands. E-mail: m.brumsen@tbm.tudelft.nl

The paper starts with a sketch of engineering in the Netherlands. The different curricula in engineering (both 'vocational' and 'scientific') are described, their accreditation, and the membership and role of professional societies. The regulation of the engineering profession, and the role played by professional societies, is very different in the Netherlands than in the USA, mainly because there is no licensing of engineers. The situation in the Netherlands is also compared with the situation in other countries in Western Europe. The second part of the paper concentrates on engineering ethics education in the Netherlands. The history of such topics within the engineering curricula is described. Engineering ethics in the Netherlands is very much a discipline 'directed' by teaching staff in the Universities; with the occasional exception, the ethical awareness within the professional societies is not highly developed. This situation may however change, since interest in ethical issues is being shown by employers' organisations and trade unions, and awareness within professional societies appears to be on the rise. The paper closes with some suggestions for topics for research in ethics and engineering.

INTRODUCTION

THIS PAPER aims to describe the place of ethics in engineering in the Netherlands. An earlier paper[12] has described the ethics courses taught at the biggest technical university in the Netherlands; the current undertaking aims to zoom out a little and describe the societal force-field in which engineering ethics is located in the Netherlands. I start by giving a brief sketch of engineering in the Netherlands, the engineering curricula, and the relevant professional societies. I go on to discuss the role of codes of conduct and whistle-blowing legislation. By then, it will be clear that the current courses on ethics and engineering in universities have an important role to play, and the history, contents and goals, and the sources used for case material are described for the ethics courses in Delft. Finally, given that the universities play a dominant role in the ethics of engineering in the Netherlands, I will briefly elaborate on the research being set up in this area at Delft University of Technology.

A SKETCH OF ENGINEERING IN THE NETHERLANDS

Engineering curricula and degrees

In the Netherlands, the title of 'engineer' is essentially an academic title, not a professional one. It is meant to certify that someone has mastered a certain body of knowledge, the content of which is set by the various engineering faculties—rather than certifying that someone has acquired the skills and abilities necessary to work in the engineering profession, as determined by relevant practising professionals. Engineering degrees differ from other academic degrees only in the content of the body of knowledge one is supposed to master during one's course of studies. Once one has graduated, there are no further restrictions on practising as an engineer (see also the later section on 'Accreditation').

There are two types of institutions of higher education, leading to two different degrees. Firstly, there are the Schools for Higher Professional Education (*Hoger Beroeps Onderwijs*, HBO), that offer four-year curricula which lead to the title of *ing* (B.Eng.). Secondly, there are the technical universities, offering five-year curricula leading to the title of *ir* (M.Sc.). (In 1984, educational reform resulted in the so-called Two-Tier Structure, which limited university curricula to 4 years. The reduction from 5 to 4 years was however mostly cosmetic, and it took students on average about 5.5 years to complete their program, which constituted no reduction. In 1994 this was recognised by the Ministry of Education, and the formal duration of engineering programs was again set to be 5 years.) Three such universities exist, Delft being the oldest; the other two technical universities are in Eindhoven and Twente. There is one agricultural university, in Wageningen, which also

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educates to the degree of *ir*. In what follows, I will not include agricultural engineers and their professional associations.

Admission criteria for these two kinds of curricula differ. For HBO, as a minimum one needs to have completed five years of secondary education. The universities may be entered after six years of secondary education, or after the first year of HBO (HBO-propaedeuse). It is also not uncommon for an HBO graduate (*ing*) to enter university, receiving credits for the study program already followed.

The *ir* curriculum concludes with writing a dissertation, as a report of the final assignment. The nature of this assignment varies: for some curricula (such as applied physics), it is a piece of scientific research, usually done in a research group within the faculty. For other curricula (such as industrial design), it is a design assignment, usually done in co-operation with a partner from industry.

Opinions differ on how the two kinds of engineering degrees compare. Lintsen [10] argues that although the contents in terms of technical knowledge are very similar, the *ing* curriculum is geared more towards practical and applied technical knowledge, whereas the *ir* curriculum is geared to abstraction and independent scientific research. In general, somebody with an *ir* degree is likely to receive a higher salary, and to end up more often in positions of higher management, than the person with the *ing*, although the difference may be decreasing.

The role of work experience

One important aspect of the Dutch engineering curricula concerns the role of work experience and internships. The curriculum leading to the *ing* degree generally contains a substantial internship in industry. The same cannot be said of the *ir* curriculum at the universities: while not entirely uncommon, it is not compulsory to include an internship, and the time available is generally under pressure from other elements in the curriculum. However, *ir*s as well as *ing*s are considered full engineers, and after graduation they start their careers as professional engineers without the need for further accreditation. There is therefore an important sense in which Dutch engineers are trained-on-the-job, without their progress being subject to formal (external) review.

Professional associations

There are a number of professional associations of Dutch engineers. The two main associations were, until recently, the Royal Institute of Engineers (*Koninklijk Instituut van Ingenieurs*, KIvI), and the Dutch Association of Engineers (NIRIA), for university graduates (*ir*) and HBO graduates (*ing*), respectively. These associations have now formally merged into KIvI-NIRIA. KIvI was organising about 30% of *irs*, NIRIA 20% of *ings* [7, p. 123]. This differs from discipline to discipline; in some cases, the discipline-specific association has merged with KIvI-NIRIA, and in others they have not. Important discipline-specific associations are the Royal Dutch Association for Chemistry (*Koninklijke Nederlandse Chemische Vereniging*, KNCV), and the Dutch Association of Physicists (*Nederlandse Natuurkundige Vereniging*, NNV). Membership in both KNCV and NNV is open to graduates of the relevant non-engineering (scientific) curricula. About 70% of chemistry graduates are member of KNCV; NNV organizes about 40% of physicists. Several smaller discipline-specific organizations exist, such as those for information technologists, biotechnologists, and architects, which within their discipline may play important roles.

It is not evident how KIvI-NIRIA compares with, e.g., its American counterparts such as NSPE. On the one hand, they largely play a role as trade unions for engineers. For example, members get special rates on insurance, and they receive juridical support in professional matters. The association continually researches the labor market for engineers, and also give career advice. Moreover, of other trade unions, none really seems to cater to engineers. On the other hand, however, there is at least the perception that there are strong links between this professional association and industry, especially at management level; this does not necessarily fit easily with their role as a trade union.

The other important function of this association is that of organising study groups (sections), in which members can have contact with their peers and stay abreast of technical developments in their discipline. Within such study groups there are sometimes discussions about ethical matters. For example, when the government was discussing whether or not to close the nuclear power plant at Borssele, the issue was also debated in the section ‘Nuclear Technology’. This discussion was, however, couched in technical terms, and it centered on whether what we now know about brittleness of materials because of continued exposure to radiation justified the conclusion that the plant was now at the end of its life span.

Similarly, ethical issues will be implicit in discussions in other sections; however, generally discussions would be aimed at formulating expert opinion on issues, explicitly based on technical matters, but implicitly on normative points of view that are not questioned further. Perhaps a good indicator of priorities within KIvI is a page on its website [21], which gives ‘ten good reasons to become a member’, listing in the eighth position ‘monitoring the quality of engineering curricula and degrees’ and on the last ‘improving the image of engineering and technology.’

The activities of the discipline-specific associations, which are also called professional associations, are very similar to those described above, although there is perhaps less emphasis on the trade-union aspect. This is probably why KIvI-NIRIA attracts fewer members from disciplines with active discipline-specific associations. A difference between these associations and KIvI used to be that they have a code of conduct. More on this later.

Accreditation and licensing

Both the *ir* and *ing* titles are protected by law, since 1960 and 1972, respectively [10, p. 72]. Whereas curricula need to be registered by the Ministry of Education in order to receive funding and in order for students to qualify for grants, quality control of the curricula was until 2003 essentially by self-regulation performed by the institutions themselves. This took the form of an integral inspection by an external review committee once every five or six years, set up by the Association of Co-operating Dutch Universities (*Vereniging van Samenwerkende Nederlandse Universiteiten*, VSNU). These reviews are meant to assure accountability to society for the spending of public funds. The funding of curricula that receive consistently bad reviews may be reduced by the Ministry of Education. There was no accreditation process, as is common in countries that are signatories to the Washington Accords (Australia, Canada, Hong Kong, Ireland, New Zealand, South Africa, United Kingdom, United States).

In 2003, an accreditation organisation (*Nederlands-Vlaamse Accreditatie Organisatie*, NVAO [22]), was started after a change in the law on Higher Education because of the Bologna Declaration (see also the next section). This means that there is now a tighter integration of the registration of curricula as qualifying for funding and quality control. However, there is no licensing system such as in the USA. Therefore there can be no link between accreditation and licensing.

A European accreditation initiative comes from the European Federation of National Engineering Associations (*Federation Européenne d'Associations Nationales d'Ingenieurs*, FEANI*)*. It maintains a register of engineers who may carry the qualification *Eur Ing* [23], which requires having completed an accredited curriculum, plus a certain amount of work experience. This appears to be largely geared towards mutual recognition of engineering curricula between European countries, and again does not involve legal issues having to do with licensing.

Comparison with other countries

Comparison of engineering degrees (indeed, all university degrees) between European countries is somewhat confusing. Within the European Union, agreements exist as to which degrees are supposed to be equivalent; but despite extensive student exchange programs such as ERASMUS, this has—with some reason—not led to the broad mutual recognition that was hoped for. The Schools for Higher Professional Education (HBO) are thought to be comparable to British Polytechnics ('new universities') or German *Fachhochschulen*, and the Dipl.Ing (FH) degree is considered equivalent to a *B.Eng.* The degrees conferred by the technical universities (*ir*) are considered equivalent to *M.Sc.* or *Dipl.Ing.*

The Bologna Declaration on higher education, signed in 1999 by the Ministers of Education of 29 European countries, seems an important step towards making degrees more comparable. The objectives to be fulfilled are defined in this declaration as follows [15]:

1. Adoption of a system of easily readable and comparable degrees.
2. Adoption of a system essentially based on two main cycles.
3. Establishment of a system of credits.
4. Promotion of mobility for students, teachers, researchers, and administrative staff.
5. Promotion of European co-operation in quality assurance.
6. Promotion of the necessary European dimension in higher education.

The second objective is widely being interpreted as fashioning higher education after the Anglo-Saxon model (indeed, in Dutch higher education the curriculum changes being implemented in order to reach this objective are referred to as 'the bachelor/master structure'). A minimum duration of the first cycle is specified as three years, and the degree awarded after this first cycle should be 'relevant to the labour market'. However, in Dutch engineering universities there is considerable resistance to this idea, as most educators believe that a five-year curriculum is essential for a good engineering degree. (A reason for this may be the relatively recent discussion about study duration in the Dutch two-tier structure, mentioned above. The result of the Bologna declaration is effectively that the first tier as it came into being in the 1984 Higher Education reform, is now being divided into two cycles.) Therefore, the end of the first cycle is regarded by most as a 'pivot-point', promoting mobility of engineering students. Even though this falls short of reaching the objective as laid down in the declaration, there is some resistance to mutual recognition of the degree obtained after the first cycle as entry qualification for the second cycle without further conditions.

The status of the *ing*-degrees (and similarly, the *Ing.Grad.* degrees in Germany) after the current reforms is not very clear. To quote the discussion paper [14] by the European Society for Engineering Education (SEFI, *Société Européenne pour la Fondation des Ingenieurs*), 'how these should fit into the Bologna scheme and how these can survive side by side with the new intermediate 'bachelor's degree' is far from obvious.' Currently, the ing-degree is considered (by law) to be equivalent to B.Eng, whereas the first cycle of three years—the above-mentioned pivot point—of study at Technical Universities results in a B.Sc.

Another important issue put on the agenda by the Bologna declaration, objective 5 above, is accreditation. According to the SEFI discussion paper, things are really moving on in Europe on this issue. It warns that 'the creation of a European Agency similar to ABET is not realistic'. Instead, a European accreditation network, based on a cooperation of accrediting bodies, is thought to be the most realistic way forward. Again, the focus appears to be on mutual recognition rather than licensing. Hopefully, this will eventually improve comparability of European degrees.

In the current existing situation, it can reasonably be said that education and professional practice in engineering in the Netherlands are most similar to that in Germany [8], in that the engineer's title is an academic one, and also because of the existence of two kinds of titles alongside each other. It is also not dissimilar from that in France [3], although there the engineering curricula are less standardised and a greater variety of institutions confer engineering degrees. In Britain, on the other hand, 'training-on-the-job' and accreditation by professional societies plays an important role. The situation in Britain, with regard to the role of professional societies, accreditation and licensing, seems to be more like that in the US. For this reason one might even question, with Didier [3], whether engineering can be rightly called a profession in continental Europe, as opposed to engineering in the USA (at least, if one follows Davis [2] in defining the term 'profession').

NORMATIVE CONTEXT OF ENGINEERING IN THE NETHERLANDS

In addition to what was said in the previous section about engineering curricula and professional associations, more needs to be said to get a handle on the ethical standards of engineering practice in the Netherlands. Below, I zoom in on three issues that seem particularly relevant: legislation on whistleblowing, professional codes, and codes of conduct in industry. These are important parts of what could be called 'the normative context' [7] in which engineers work.

Legislation on whistle blowing

In April 2000, the Federation of Dutch Trade Unions (FNV, *Federatie Nederlandse Vakbeweging*) operated a telephone number for three days for (potential) whistleblowers. Employees in all types of organisation, who had encountered misconduct in their organisation and had reported it internally, externally, or both, were encouraged to phone in. Several thousand people attempted to phone in, constituting a response much bigger than expected, which resulted in severe undercapacity. In the end, 150 telephone calls revealed serious cases: 119 of these concerned matters of public (as opposed to personal) interest, and on the nature of these cases a report was published [5]. In summary, 61% of respondents were in civil service, while 39% were working in commercial enterprises. The most commonly reported (42% of respondents) types of misconduct concerned mismanagement and abuse of power (40.3%). Further down the list were concerns perhaps more typical to engineering practice, such as:

- failure to comply with rules and regulations (21.8%);
- non-disclosure or incorrect representation of information to politicians (10.8 %) and the general public (5%);
- a lack of openness about risks (8.4%);
- corruption (7.6%);
- pollution of the environment (2.5%).

90% of respondents had reported the misconduct internally, and about 60% had also reported externally (mostly to their trade union (24%) or a lawyer (20%). All the more remarkable is that 40% of respondents had lost their jobs, 9% had been suspended, and 35% were on sick leave: this meant that at least 23% of respondents got into severe trouble without even having reported externally. No data were published on how many of the respondents were engineers.

The legal position of whistleblowers in the Netherlands is precarious. Since January 2001, civil servants are protected against dismissal provided they report in good faith, only internally, and according to an explicit procedure. (They are thus not in any way legally protected against dismissal as a result of whistle blowing understood as reporting externally.) However, in general, the disclosure of details regarding the employer's organisation, which the employee should have kept secret, can result in immediate dismissal, sanctioned by civil law. Moreover, such an employee may be criminally prosecuted as well. Disclosure of details is however not punishable under criminal law if the employee could reasonably assume that such disclosure was necessary in order to protect the public interest; in civil law, no such exception exists. The only recourse for an employee would be to argue that his employer is not a 'good employer', in the sense of being reasonable (e.g. about which details are to be kept secret). However, breakdown of relations between employees, often a consequence of whistle blowing, can also be a legitimate reason for dismissal, although one is entitled to compensation if one can demonstrate not to have been at fault. In general, therefore, one could say that Dutch legislation does not protect whistleblowers, and some argue that this is in conflict with what the European Treaty on the Universal Rights of Man says about freedom of expression.

It would be a matter for further research as to whether for engineers this legal situation is relevantly different between the Netherlands and countries that have some kind of legal protection for whistleblowers such as the UK and the US. However, the legal situation regarding whistleblowers may well be a cause of the very cautious attitude of most professional associations regarding ethical issues, for example regarding professional codes, as will be shown in the next section. A related reason may be the strong links between the professional associations and industry mentioned earlier. If one constructs discussions about ethical issues in engineering exclusively as 'what counts as misconduct, and when should it be reported on?' (as many tend to do), then it is almost impossible not to burn one's fingers in the situation described. It is easy to give advice to members which will land them, and perhaps also the association itself, in severe legal trouble; moreover, the associations will not want to be seen acting against employers' interests. This cautious attitude manifests itself, among other things, in the situation regarding professional codes.

Professional codes

The biggest professional association, KIvI-NIRIA, has after several years of discussion and some failed attempts adopted a professional code in 2003. It has suffered fairly severe criticism, and is likely to evolve significantly in the near future. It is also member of the FEANI, which has a code of conduct. However, as this association has only institutional members, it is unclear what this code of conduct means for individual members of the member associations who are not registered as *Eur. Ing*. (Anyone who is so registered is supposed to abide by the code, and can presumably be struck from the register if found to be in violation.)

The Royal Dutch Association for Chemistry KNCV has a code of conduct, since 1997. Work on this code of conduct started after 75% of respondents to a questionnaire indicated that they thought it desirable to have a code of conduct. It is a fairly elaborate code, and most members know of its existence. There are however no activities to enforce the code. Support for members who seek to abide by the code is limited to an 'ethical expert' whose advice can be sought in full confidentiality. As far as is known, to date no member has made use of this service.

Another discipline-specific professional association that (since 1984) has had a code of conduct is the Association for Registered Information Technologists (VRI, *Vereniging Register Informatici*). This association is open to graduates of HBO or University (not only engineers) with at least four years' professional experience, or 7 years' experience at HBO-level. Members are bound by the code of conduct, and a register is kept of members. There is a disciplinary procedure; if a complaint against a member is upheld, a member can be struck from the register. VRI has approximately 2500 members.

A report on ethical codes and their possible role in the technological and scientific professions appeared in 1993, commissioned by the Ministry of Education [7]. Its central questions were: 'Is it desirable that scientists and engineers have codes of ethics, in order to institutionalise their moral responsibilities? If so: what should be the contents of such codes?' This well-researched piece of work concluded that advisory codes, helping engineers straighten out problem situations, might be useful and desirable in the Dutch context. However, it also concluded that the use of professional codes for the legal regulation of scientific and engineering professions are not desirable. Even though there is a growing interest in professional codes for engineers, it therefore seems unlikely that steps will be taken in the direction of a licensing system in the near future.

Codes of conduct

Interest in business ethics, and in particular responsible enterprising, has also been growing in recent years. This is of course not merely a local (Dutch) phenomenon. The Association of Dutch Enterprises (VNO-NCW, *Vereniging Nederlandse Ondernemingen/Nederlands Christelijk Werkgeversverbond*), together with KPMG Ethics & Integrity Consulting, have in 1999 organised a conference on codes of conduct of corporations, and published a booklet reporting on the state of affairs. Although codes of conduct, just like the legislation concerning whistleblowers, do not specifically or only address engineering issues, they seem relevant to the normative context of engineering.

Of the 100 largest companies in the Netherlands, 38 had a code, 52 did not have a code, 6 were developing one, and 4 did not respond to an inquiry about their code. 34 codes were further researched. Most codes (85%) mention responsibilities of the company toward their employees, and society at large. In 62% of codes, mention was made of the responsibility to offer employees chances to develop themselves professionally and personally; however, only 26% explicitly said something about offering a good career perspective, and only 18% about involvement of employees in decision-making. Almost all codes make explicit mention of the responsibilities of the employee towards the company. Issues mentioned were among other things, conflicts of interest (56%), corruption (38%), open and transparent communication (38%) and correct recording of data (50%), disclosure of secrets (35%).

Two significant facts deserve to be emphasised here. Firstly: enterprises are significantly more pro-active in adopting codes of conduct than professional associations of engineers are in adopting professional codes. Secondly: employers use these codes to set standards of conduct for their employees—including engineers. The profession therefore appears to have lost the initiative in setting standards of conduct in engineering practice; this may not be desirable, since there is the real possibility of conflicts between the two types of code, given the issues mentioned above.

TEACHING ETHICS AND ENGINEERING IN THE NETHERLANDS

In this section, I attempt to sketch the current state of engineering ethics education in the Netherlands. It is hoped that, together with the above, this will create an intelligible picture of local engineering ethics. I start by giving a brief history of teaching in this kind of topic. Then, I elaborate on the general outlook and contents of the teaching. I also describe what sources the educators use for their course material and cases.

Brief history and state of affairs

Towards the end of the seventies of the previous century, it was common to have a compulsory course on science, technology and society in engineering curricula. The focus of such courses was largely historical, aimed at giving students a feel for the dynamics of technological development in relation to societal developments. The growing attention for such topics in curricula in science and technology was a result of the awareness in society that science and technology create as well as solve problems. Especially the idea that technological developments would soon overstretch natural resources, and endanger the human environment because of polluting activities, was prominent at that time.

Unfortunately, a lasting integration of science, technology and society (STS) courses in the curricula was not achieved. This is perhaps due to two factors. Firstly, although STS subjects generated quite some interest among staff, it turned out to be difficult to convert this interest into commitments at institutional level to attract appropriate expertise. As a result a good deal of the teaching was done by staff for whom STS was only a side interest, and different faculties had their own decentralised initiatives. This did not contribute to establishing a lasting effort in which courses could be fed from dedicated research. Secondly, the focus of this type of course was not such that it could be easily identified what skills students would gain from it. Thus teaching was somewhat under pressure of the question: what does theorising about the interplay between technological developments and society contribute to educating engineers?

The eighties and nineties did however see some institutionalisation of the discipline of Technology Assessment. In 1986, the Dutch Organisation for Research in Technology Assessment (NOTA, *Nederlandse Organisatie voor Technologisch Aspectenonderzoek*) was established to instigate and conduct discussions on a societal level, in order to signal and prepare for collective and political decision-making ethical aspects of developments in science and technology. This organization was renamed the Rathenau Institute in 1994 [24]. It has been established by the Ministry of Education, and formulates research projects that are then usually carried out by researchers outside the institute. The formulated research projects are presented every two years to Parliament, as are the outcomes of previous projects. Currently, topics on the agenda of the Rathenau Institute include:

- Biotechnology
- Nanotechnology
- ICT and vulnerability
- Human–animal relationships
- Reproductive medicine
- Healthy eating
- Food genomics

The Rathenau Institute however is not involved in any educational efforts.

The situation regarding the teaching of ethical aspects of engineering described above received a new impulse in 1993, when the Higher Education Act came to include a formulation to the effect that 'the Universities and Polytechnics among other things should pay attention to personal development and the promotion of societal responsibility . . .'. This Higher Education Act, which was (among other things) the result of a discussion the result of a report 'Ethical Aspects of Science and Technology' by the NOTA (later Rathenau Institute), prompted Delft University of Technology to write in its 1994 Strategy Document: 'the engineer has to have insight in and a feeling for the ethical aspects of his professional practice.' In 1993, the DUT instituted an Advisory Committee on Ethics, which one year later advised to include in all curricula a compulsory course 'Societal and Ethical Aspects of Technology'. The report of this committee also formulated teaching goals, on which more below. The committee saw such a compulsory course as a first, but necessary, step towards integrating ethics throughout the engineering curricula. Teaching on the first pilot course started at Delft University of Technology in 1996; our experiences are described in more detail elsewhere [12, 25]. Now most curricula at DUT have a compulsory ethics course.

The previous paragraph describes the recent developments at DUT. DUT has been serving as a pioneer in developing courses in ethics and engineering in the Netherlands, and indeed, in Europe. (Another important pioneering group in Europe is in Lille, France; see Didier [3].) In other Technical Universities a similar process has taken place. At Eindhoven University of Technology, a similar advisory committee on ethics was appointed, which resulted in the appointment of a Professor in Ethics of Technology in 2000. Twente University appointed a person in 2001 to set up ethics teaching. Although introducing ethics teaching varies with the institution, there is close co-operation between the Technical Universities. In the summer of 2000, the philosophy department of DUT organized a workshop on teaching engineering ethics, to exchange ideas and information both between the Universities and between philosophy staff and staff from engineering faculties.

This workshop was considered by all participants to be so useful that it is now a yearly returning event.

From the side of HBO's (Polytechnics) as well there is interest in ethics courses for engineering students. With several such institutions agreement exists to enable them to use parts of the teaching materials developed at DUT. Due to the nature of these institutions fewer resources are available to develop their own teaching material. The ethics teaching at DUT has also attracted the attention of KIvI, the Royal Institute of Engineers. Staff from DUT has conducted evening workshops in ethics, for the section ethics of technology of KIvI. There were about forty participants to these workshops.

The renewed interest for ethics in engineering comes at a time when engineers are, in some sense, under siege. One indicator of this fact is that student numbers for engineering programs have been on a steady decline in the last decade or so. The image of engineering, in Dutch society at least, is not such that it exerts an obvious attraction on prospective students. And those who do choose to study engineering tend to be defensive when it comes to discuss matters of ethics. It can only be hoped that teaching ethics in the engineering curricula contributes to a situation in which there is no need for this defensive tune, and engineers have regained some confidence in ethical matters.

Course outlook and contents

What are the courses in ethics and engineering like at DUT? I will give a brief overview here For a fuller description, see van de Poel *et al.* [12]. The two main teaching goals, conforming to the advice of the Advisory Committee on Ethics mentioned above, are as follows:

1. Transfer of knowledge and skills which will enable engineering students to recognise and analyse the ethical aspects and problems of their future professional practice, and to enable them to conduct a solution-oriented debate about such problems. (This term turned out to be interpretable in many ways. We interpret it not as meaning that debates should always lead to clear solutions, but that they should not be pieces of armchair philosophy and should deal with real-life ethical aspects of engineering.)
2. To increase the students' insight into the complex decision-making processes and procedures in which engineers may become involved, surrounding the use of technology and into the ethical aspects of such processes and procedures.

On average, about 120 student-hours (3 credits) are available. In this time we try to reach the teaching goals through lectures, group discussions, and essay writing.

The lectures are based on the teaching material that we have developed in the Department of Philosophy, and are delivered mostly by philosophers. The aim here is to provide a theoretical backdrop to the small group discussions (with 12–16 students). Three groups of subjects are covered in the lectures. The first group is concerned with issues such as the history and development of the engineering profession, ethical codes, and hazards and risks of technology. These topics are also found in many other textbooks. However, the role played by ethical codes is, as mentioned earlier, different in the Netherlands than in the US. Most Dutch engineers did not even, until recently, have a code of ethics; and now that KIvI-NIRIA does have one, it is not connected with a licensing system or any other kind of sanctions. This of course is reflected in the teaching and material used: central questions are, 'what functions could a code of ethics have?' and 'what are relevant similarities and differences between engineering and professions which do have codes of ethics such as medicine and law?' rather than 'what do codes of ethics say?' and 'what would actual formulations in codes imply in this or that concrete case?'

The second group of subjects deals with argumentation theory and philosophical ethics. 'How could one actually go about determining what is the right thing to do in a given situation?' is the central question here. Some theory of argumentation and reasoning has proved desirable, since many students tend to overestimate their skills, hardly having been exposed to systematic argumentation about normative and societal issues. Insight in the difference between inductive and deductive reasoning, and a number of fallacies (such as the naturalistic fallacy, in which a normative conclusion is based only on factual premises, but also statistical fallacies) is very useful for the rest of the course. The students are exposed to traditional ethical theories such as Kantian ethics and classical utilitarianism, but there is also ample discussion of (the problems of) ethical relativism, and the use that ethical theories might be put to, and how they are supposed to relate to one's ethical intuitions.

The third group of subjects deals with the context in which engineers work. Attention is paid to the allocation of responsibilities within organisations; the role of legislation in encouraging or even forcing corporations to behave responsibly; and theory and practice of collective decision-making. The need for paying attention to such topics is felt all the more in an environment where professional associations and ethical codes play a minor role. A guiding question in this group of subjects is: how could and should engineers influence this context in such a way that it becomes more conducive to engineers behaving ethically? The guiding thought is that engineers often get caught in ethical dilemmas caused by matters of legislation and organisation, matters which require a heroic behaviour of engineers if they are to behave ethically.

In the discussion groups, a casebook is used in which texts are collected together with questions that generally function as a frame for the discussion. A lecture is usually accompanied by a meeting of the discussion group, and the topics therefore are chosen to illustrate and clarify the possibilities of making use of the 'theoretical' background knowledge from the lectures. For example, a lecture on ethical relativism could be accompanied by a group discussion about a case in which engineers working for a multinational company are confronted with ethical norms and legislation conflicting with their own, or a lecture on risks and hazards may be illustrated by a discussion on the health hazards of mobile telephones.

If, however, the normative context in the Netherlands is so different from that in the country where most teaching material has been developed (namely the USA), what case-material is used for the case-book and essays? To this question the next section is devoted.

Sources for case-material

As may have become clear, engineering ethics in the Netherlands is not driven by a demand from professional associations. Even if there is a clear interest in ethics, such as in the KNCV (*Royal Dutch Association of Chemists*), there is no demand, but at most encouragement for ethics teaching to engineering students. Moreover, lacking a body like the US National Society of Professional Engineers' *Board of Ethical Review*, engineering ethics educators in the Netherlands have not been able to draw on any collection of engineering cases from Dutch engineering practice developed by the professional associations The previously mentioned evening workshops for KIvI deserve some reference here though; the evenings were set up in such a way that they were introduced by a practising engineer, telling about his work experience. There is however still some difference between telling about ethical choices one has had to confront within a closed meeting, and having things spelt out in teaching material that is essentially public. Given the ease with which most actors would then be identifiable, most engineers are reluctant to take such a step. Neither, of course, were those cases all readily usable in a teaching context, given pedagogical considerations.

The outlook chosen for teaching ethics at DUT needs to be mentioned here as well. Although the individual engineer with his ethical choices is an important point of reference, there is an important sense in which the perspective is a collective one, which seeks to diminish or avoid ethical and societal problems of technology. Engineers organised in a profession are just one of the actors from such a perspective. Therefore, whereas, the focus from within a professional association is more on supporting member-engineers that have to confront individual ethical decision-problems, and also (but perhaps to a lesser extent) on improving the image and standing of engineering and technology, the perspective chosen at DUT is aimed at maximising (in an intuitive sense) the good that technology brings to society. One might say, therefore, that there is a slight mismatch between both the aims and the prioritised problems that engineering ethics educators and the professional associations respectively have. (*In extremis*, the interests of society at large might be opposed to those of engineers or their associations.) This mismatch should however not be exaggerated: it seems plausible that improving the image of engineering implies taking the interests of society at large seriously as a profession.

Some case-material from American textbooks [6, 11, 18, 20] was of course used, and also the case material available at e.g. the Online Ethics Centre and Texas A&M [26, 27]. However, this is less desirable for a couple of reasons. Firstly, by and large case-material is related to the role played by codes of conduct in the American context, or at least a dominant role is played by the codes. However, as explained, the situation is very different in the Netherlands. Secondly, but of course significantly, for students the (perceived) distance between their own professional practice and that described in American case-material is quite large. Therefore it is preferable to use European cases.

A practical advantage of the emphasis in our courses on reducing the problems that technology brings to society is that it does allow the use of cases that are, in another way, public. It enables us to use newspaper articles, court proceedings, parliamentary inquiries, and websites of various interest groups and also companies. A few examples:

- In the year 1986, the ferry 'Herald of Free Enterprise' capsized, just out of Zeebrugge port (Belgium), causing many deaths. In a British court case the causes leading to the accident were researched. In the final judgement, no single person was blamed, and the company was acquitted on the charge of corporate manslaughter. Several relevant insights may be gained from the case. Firstly, it is a typical example of an organisation in which the organisation of responsibilities was such that a disaster could easily take place. It illustrates what one might call 'the problem of many hands', which is relevant to many technological actions. Secondly, if one analyses the design of such roll-on roll-off ferries, it becomes clear that the large car decks have the potential to make the ship meta-stable in case water enters. (Another example of an accident that could be related to the same design aspect is that of the Estonia, which capsized a few years later between Sweden and Finland in mid-sea.) What, one may ask, was the responsibility of the engineers in designing a safe but also economical ship?
- In the year 1999, an employee of the Dutch State Institute for Public Health and Environment (RIVM, *Rijks Instituut voor Volksgezondheid en*

Milieu), sent a piece to a major newspaper. In his view, the reports made by the institute, which form the basis of decision-making in Parliament on environmental issues, were based on models with insufficient empirical vindication. Also, data were often presented pretending to be more accurate and with more significant numbers than actually could be the case. This revelation eventually spurred a public debate on how experts are supposed to communicate their results to politicians and decision-makers. The engineer in question was treated as a whistle-blower and lost his job.

- In May 2000, a major explosion took place in a company manufacturing fireworks. It reduced an entire neighbourhood of the Dutch town of Enschede to rubble, leaving several dead. A public inquiry was conducted in order to try to understand, among other things, how an explosion of ornamental fireworks could have had such devastating effects, and how it was possible that such a company was located in a residential area. Several licensing issues emerged, and questions raised about public decision-making concerning risky activities. The case is useful for discussions about issues of legal liability, and of risk communication by experts. The investigation committee also wrote that they think a 'cultural change in our thinking and decision-making about risks' is in order. What role should engineers play in that discussion?
- For many years, the future of Amsterdam Airport Schiphol has been under discussion. What limits should be enforced on the growth of the number of flights and the noise connected with them? How should public decision-making be conducted? An advisory committee was appointed to advise on the norms for noise upon which to base legislation. The chairman of the committee was the professor of acoustics in the Faculty of Physics at DUT. As the committee proceeded, it found that the subject was extremely complex, and the assignment given by the Minister of Transport unworkable. In their (public) report they propose a different type of norm, based however on normative assumptions that were not clearly part of their expertise.

The last case also serves to illustrate that contacts within the University can be a good source for case-material. One reason for this is that DUT staff are regularly called on, because of their expertise, to take part in research or consultancy of obvious societal relevance. Also, most of the ethics courses are jointly taught by staff members of the philosophy department and the relevant engineering faculty. In practice this means that about half of the total number of discussion groups are led by lecturers from the engineering faculty, and also that engineering staff bring in cases from within their faculty or, more broadly, their discipline, to be included in the case-book used. Co-teaching arrangements prove rather fruitful in this respect, since staff from the engineering faculty are generally more aware of what is going on in their faculty and discipline than philosophers. More generally, reports on research and research programs within the University, in diverse university publications, can be a source of case-material which is very directly relevant to students: they might, after all, end up doing their graduation project in one of these research programs.

The public material on cases such as the ones mentioned above does of course need some work to turn it into teaching material. In general, for a subject to be turned into teaching material it suffices to select a relevant topic in the public debate, and find a piece of text from the press or the Internet to use as a frame for asking some critical questions. An example is the conference on climate change in the Hague (COP6). On the assumption that there is a role to be played here by engineers, an overview of the history and the main problems, actors and their interests can serve as a starting point for a discussion. (We used a leaflet from the Climate Action Network [28]). The discussion is then on questions such as: what is the role of uncertainty here? What might application of the precautionary principle imply in this case, and is that desirable? Why is it so difficult for the main actors to come to agreement? How would you propose to reach agreement? What are the responsibilities of engineers in this matter? The ability of students to formulate such questions is usually not well-developed to start with, but as they get confronted with teaching material that demonstrates which questions are ethically relevant, this improves.

RESEARCH IN ETHICS AND ENGINEERING

In the sense that the impulse for it comes largely from within the universities, it is no exaggeration to say that ethics and engineering is an academic subject in the Netherlands. This means that for two (albeit related) reasons it is necessary, in order to give a picture of ethics in engineering in the Netherlands, to say something about the academic research being done on this subject. Firstly, the research topics give an indication of how ethics in engineering is going to develop, given that research results will eventually influence the ethics teaching that future engineers receive. Publication of research results should of course also contribute to the ethics in engineering practice. Secondly, the direction of research arises out of reflection on what is relevant to current engineering practice, and on the gaps in our understanding—a kind of mirror on the ethical lacunae of engineering practice.

At the Department of Philosophy at DUT, we have formulated a research program in the conviction that the teaching effort can only become and remain integrated in the curricula and be taken seriously academically if there is research to support it (cf. the experiences with STS teaching). We have identified three main themes central to the research program. They are as follows [29]:

1. *Responsibility for technological actions.* (Our working definition of 'technological action' is: all actions involving the development, implementation and use of technology.) The engineer often works as part of a team. What are the implications of this fact for the moral responsibility for the consequences of the projects that he contributes to? What are the implications of the ways in which technology is implemented in society (including decision procedures regarding such implementation) for the responsibility of the engineer, and of the engineering profession? In what ways does and should the law steer technological developments, and allocate responsibilities?
2. *Dealing with risks and hazards.* Risks and hazards constitute an important element of engineering practice. How do engineers, e.g. in design teams, deal with and decide about them? What methodological problems are inherent in current risk analysis practices? On the basis of which considerations should norms of acceptable risk be decided, and who should be involved in such decisions? What ethical principles are to be applied when deciding under incomplete or unreliable knowledge?
3. The specific nature of ethical problems in technology and engineering. Which aspects of technology and engineering generate ethical problems that traditional ethics is badly equipped to handle? What is the nature of these ethical problems, and how should they be dealt with?

Our research program on Ethics and Engineering has seen an inaugural conference in Delft in April 2002, which has resulted in a selection of papers in a special issue of *Technè*, dealing with the above topics in a further attempt to set the agenda for research in Ethics and Engineering.

In order to ensure a maximum of integration with local research programs at DUT and recognition among engineers of relevance of our research, we have decided to focus our research on the ethical aspects of risks. Projects that have already started or will soon start include:

- *Ethical aspects of design processes*. In what ways do moral problems crop up or manifest themselves during design processes? How do engineers/designers deal with the moral aspects of design? And in what way could their dealing with such aspects be improved? (This PhD project started in 2000.)
- *Risk norms* in the USA and Europe. What are the differences in regulation and legislation regarding norms for risk between the USA and Europe? What does this mean for the relative risk levels of comparable activities? How and by whom should it be decided what risk levels are acceptable? An international network, RISKREG, has been started to research these questions;
- *Informed consent.* How is this notion being used in medical ethics? What are the problems (practical, juridical and moral) with it in medical ethics? What are the relevant differences between medical and engineering practice, and what does this imply for how exactly the notion could and should be employed in ethics of engineering? (This Ph.D. project started in 2002.)
- *Apportioning responsibility* in design and management of critical infrastructures. When several organisations have to ensure together the proper functioning of an infrastructure, in what way can we assign responsibilities to these organisations which is both morally just to the organisations involved, and effective in ensuring reliability and generally reduction of risks to an acceptable standard?

CONCLUSIONS

A number of factors relevant to the ethics in engineering in the Netherlands have been elaborated on in this paper. Engineering curricula are of an academic rather than professional character; the model followed is German rather than Anglo-Saxon. As a result of the Bologna declaration, there have been some moves towards accreditation. However, any initiatives toward accreditation of degrees are intended for mutual recognition of European degrees, and legal regulation in the form of a licensing system is not to be expected in the near future. Professional associations of engineers in general take a very cautious attitude towards ethical issues; it remains a matter for (comparative) research whether this is to be explained in terms of the character of these associations and the legal situation regarding whistleblowers. In any case, it has led to a situation in which ethics in engineering is mostly an initiative of the technical universities. Compulsory ethics courses in engineering are a relatively recent effort, which is gaining ground; their set-up reflects the local normative context, especially in the way attention is paid to professional codes. Research projects on ethics in engineering are now being set up, and it is hoped that this will further raise the profile of ethics in engineering in the Netherlands.

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Michiel Brumsen received his Ph.D. from the University of St. Andrews, Scotland, writing his dissertation on the role of causality in the philosophy of mind. He has been an assistant professor in the Department of Philosophy of the Faculty of Technology, Policy and Management of Delft University of Technology since 1998, in ethics and engineering. He has recently (co-)authored several papers on teaching and research in engineering ethics, and co-edited a special issue of the journal *Technè* on research in engineering ethics. Currently his main research interest is the ethics of technological risks, with a special interest in risk communication and informed consent. Among others, he is involved in a Dutch Science Foundation-funded project researching the ethics of risks of upscaling in biotechnology.