Chapter 7: Ethical codes in Life Sciences Research and Engineering

Abstract: We have seen that, while the four principles approach to bioethics can help to provide useful insights, the principles need to be specified, balanced and justified in each situation. This can be time consuming and unpredictable. For this reason, both institutions and professions have worked to specify how these principles translate into the ethical behaviour they expect of their members. In institutions this can mean a code of practice or an institutional ethical charter. EPFL has an aspirational Oath taken by students on graduation, and an enforced directive on Research Integrity (Lex 3.3.2) which identifies the institution's expectations of students and staff. Institutional like the Lex rules often have enforceable sanctions. At a wider level, professional societies also have codes such as the Biomedical Engineering Society Code of Conduct & Policies.

Case Study Applying an Ethical Code

The US National Society of Professional Engineers has a Board of Ethics which provides advice on ethical issues for practicing engineers. In 2022 they published a decision based on the following case (the details have been shortened here).

A company is building a medical facility. The access to the new building requires upgrading work to a stream and bridge on the approach road. The existing legislation requires that this upgrade take into account the types of extreme flooding which might take place, on average, once every 25 years.

An engineer contracted by the company to work on the access road has seen, as a conference, some evidence that there may in the future be an increase in extreme flooding events linked to climate change. He is concerned that, given these potential climactic changes, the existing legislative requirement would not be sufficient to meet the actual future needs. He is concerned that if the standards required are insufficient, this could, in turn, potentially lead to flood damage to twenty homes in a nearby neighbourhood. He therefore proposes to the company that they undertake a more complete and costly analysis to assess the risk to nearby homes. However, the company directs the engineer to proceed without this costly analysis unless it is requested by the regulatory authorities.

The US National Society of Professional Engineers has a code of ethics which includes the following rules of practice:

1. Engineers shall hold paramount the safety, health, and welfare of the public.
2. Engineers shall perform services only in the areas of their competence.
3. Engineers shall issue public statements only in an objective and truthful manner.
4. Engineers shall act for each employer or client as faithful agents or trustees.
5. Engineers shall avoid deceptive acts.

The Board of Ethics considered two questions:

A. Does the engineer have an obligation to the wider public to consider potential changes in the environmental conditions due to climate-change which have not yet occurred?
B. What ethical courses of action are open to this engineer?

Questions:

1. In the last chapter you met the principles of non-maleficence, beneficence, autonomy and justice. Can you identify which principle/principles are linked to each statement in the 'rules of practice' from the Code of Ethics?
2. Looking at the 'rules of practice' from the Code of Ethics, is there one (or are there some) that seem particularly relevant in this case?
3. How would you answer Questions A and B that the Board of Ethics considered?

The board of ethics identified that:

(a) The requirement to hold paramount the safety, health, and welfare of the public (rule of practice 1) implies that, engineers should adhere to the principles of sustainable development in order to protect the environment for future generations. It also implies that if an engineers' judgment is overruled under circumstances that endanger life or property, they should notify their employer or client and any other authority that may be appropriate.
(b) The requirement to issue statements in an objective and truthful manner (rule of practice 3) implies that they should include all relevant and pertinent information in such reports (i.e., they should not omit relevant content).

They concluded that, if the engineer is reasonably certain that the project will result in adverse impacts to public health, safety, and welfare, and if the company does not carry out the proposed additional evaluation, the engineer should include their concerns in a report for the regulatory agencies and the public.

Questions:
4. The Board of Ethics here has said that the engineer has an ethical obligation to go beyond what is legally necessary in terms of the studies they should carry out. Should engineers be obliged to go beyond what is legally necessary like this?

Introduction

In the last chapter you saw that many of the practices central to modern life science engineering (such as the design of human trials, or the need for informed consent in research that involves people) grew out of a principles-based, deontological approach to bioethics. We also saw that whether or not an action is ethical cannot be simply read off from a principle, but the specifics of a situation (specification) and the balance between different principles needs to be taken into account (balancing), and any decision needs to be checked to ensure it is logically consistent, and in line with the facts of the situation (justification). In practice, such a method can work well for ethical decisions which an individual or a small group needs to take in a context in which they are solely responsible for the whole of the decision and

where the question is totally new. But, as we saw in chapter 4, ethical decisions are normally taken by engineers and scientists who work in organisations – not only as individuals. And these organisations – and the countries in which they work – also have a stake in the decision which is taken. These organisations may include the company for which the engineer works, the client that they are working on behalf of, and, often, the professional association of which they are a member. Each of these play a role in the setting within which ethical principles need to be applied.

To increase the chance of efficient and consistent decisions which are in line with ethical principles as they are adapted to the specifics of a given context, ethical principles are often rearticulated in the form of codes. In this chapter we will look at codes of ethics that apply in life sciences engineering.

Oaths and Codes: Aspirations or Rules/Laws?

There are many different codes or 'oaths' that apply to engineering in general and life sciences engineering and research in particular. These can be organised in terms of two different dimensions:

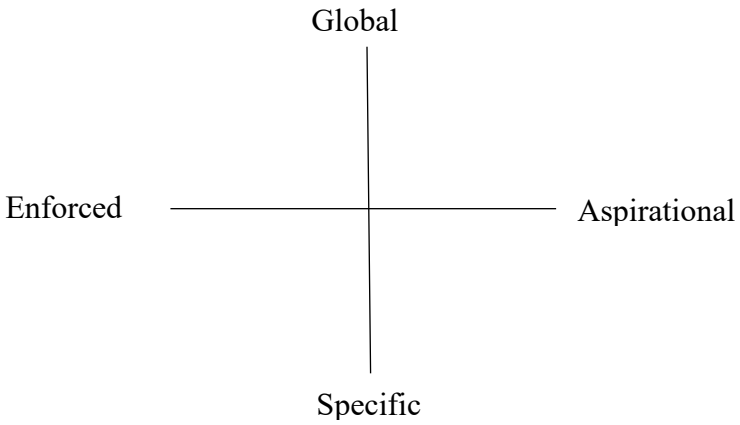
- Generality - Specificity
- Enforcement - Aspiration

At the most general level, as we saw in the last chapter, ethical principles have been reframed by the United Nations in the form of a Universal Declaration of Human Rights (1948). This was followed by a range of other Declarations by United Nations bodies in more specific domains such at the 'Universal Declaration on the Human Genome and Human Rights' (1997), and the 'International Declaration on Human Genetic Data' (2003). In 2005 the

United Nations Scientific and Cultural Organisation (UNESCO) agreed a 'Universal Declaration on Bioethics and Human Rights'. At the other extreme on the continuum of 'Generality – Specificity', individual organisations may have their own codes of ethics. For example, EPFL has an Honor Code of students (Lex 2.31), and a directive on Research Integrity (Lex 3.3.2) which identifies the institution's expectations for students and staff. Students in EPFL in the early 1990s also wrote an ethical oath which many students have taken upon graduation; the Archimedean Oath. These are all highly specific versions of codes. Between these two extremes of 'the entire globe' and 'the company I work in' there are a range of different intermediate bodies which all have a stake in ethical behaviour. Perhaps the two most evident of these are (a) the state, and (b) professional bodies. In the case of the state, Switzerland has, for example, laws on the treatment of animals, on the use of people in medical research and on the protection and management of people's data. Examples of codes from professional bodies include the Helsinki Declaration on medical research involving human subjects (from the World Medical Association) (which was mentioned in chapter 6) or Code of Conduct and Policies of the Biomedical Engineering Society.

The second dimensions on which codes can be distinguished is the dimension of 'Enforcement – Aspiration'. Some codes are intended to stipulate the (minimum) standard that everyone should expect. These minimum standards generally have some mechanisms for enforcement – those who break these codes can usually expect to punished in some way. In EPFL this is the case with the directive on Research Integrity (Lex 3.3.2), for example. Perhaps the most obvious examples of 'enforced codes' are laws: a researcher in Switzerland who is found to have violated the laws on human or animal research or on data protection, may expect to be punished by the state as well as by their employer. At the other end of this spectrum are codes which are not enforceable as such. These can sometimes articulate a

higher standard of ethical behaviour than is found in legal statements of minimum standards. This provides a more aspirational target to which people could aim. Their power is often a kind of soft power that operates though embarrassment, guilt, pride and awe, rather than through punishments and sanctions.



Two dimensions of organisation of ethical codes

In this chapter we will not look too much at relevant laws – these will be addressed in a later chapter. We will focus more on codes and how they may help ethical decision making.

Global Codes

The UNESCO Universal Declaration on Bioethics and Human Rights was adopted by the General Conference of UNESCO in October 2005. It was intended as a document that would specify how the general principles of Human rights, as articulated thorough multiple UN declarations, should be understood in the context of bioethics. The Declaration identified a

number of principles that should be respected in any decision of practice in bioethics. These were:

1. Human dignity and human rights: human dignity should be respected and the interests and welfare of the individual should have priority over the sole interest of science or society.
2. Maximisation of benefit and reduction of harm: this applies to direct and indirect benefits, both to research participants and to other affected people.
3. Autonomy and individual responsibility: The autonomy of people to make their own decisions should be respected.
    a. Consent: Any preventative, diagnostic or therapeutic medical intervention, and any scientific research, should only be carried out with prior, free and informed consent based on adequate information. Exceptions to this principle should be in accordance with legal standards and related to public safety, detection of criminal offences, protection of public health and protection of the rights of others.
    b. Special protection for those who do not have the capacity to give consent: Where people cannot give consent then the research should only be authorised if it is in the best interests of the person concerned, and where there is no comparably effective alternative.
4. Human vulnerability: Some groups are more vulnerable than others in society as they have less social power. Individuals and groups of special vulnerability should be protected.
5. Privacy and confidentiality: privacy of the persons concerned and the confidentiality of their personal information should be respected.
6. Equality, Justice and equity: The fundamental equality of all human beings in dignity and rights is to be respected so that they are treated justly and equitably.
7. Non-discrimination and non-stigmatization: No individual or group should be discriminated against or stigmatized on any grounds
8. Respect for cultural diversity and pluralism: The importance of cultural diversity and pluralism should be given due regard. However, such considerations are not to be invoked to infringe upon human dignity, human rights and fundamental freedoms,
9. Solidarity and cooperation: Solidarity among human beings and international cooperation towards that end are to be encouraged.
10. Social responsibility and health: Promotion of health is fundamental and should include access to quality healthcare for everyone, access to water and nutrition, improvement of living conditions, reduction of marginalization and reduction of poverty and illiteracy.
11. Sharing of benefits: Benefits resulting from any scientific research and its applications should be shared with society as a whole and within the international community, in particular with developing countries.
12. Protecting future generations: The impact of life sciences on future generations, including on their genetic constitution, should be given due regard.
13. Protection of the environment, the biosphere and biodiversity: Due regard is to be given to the interconnection between human beings and other forms of life and to the

role of human beings in the protection of the environment, the biosphere and biodiversity.

Reflection Questions:

1. For each of the statements in the UNESCO Declaration, identify whether you would associate it with each of the principles of Justice, Non-maleficence, Beneficence and Autonomy? Are there any principles in the UNESCO Declaration that do not appear, to you, to be linked with any of these principles?
2. The five phases of an Ethics of Care process identified by Tronto are caring about (attentiveness), caring for (responsibility), care giving (competence), care receiving (responsiveness) and caring with (solidarity). For each of the statements in the UNESCO Declaration, identify whether you would associate it with one of the five phases in an Ethics of Care process
3. Are the aspects of the UNESCO Declaration that you particularly like? Are there any aspects you feel should not be included in a statement of ethical principles for life sciences?

Specific Codes

In medicine, students on graduation often swear an oath to practice their professional ethically. This is called the 'Hippocratic Oath', named after a Greek doctor from the classical age called Hippocrates. It applies principles such as non-maleficence, and justice in more specific terms applicable settings in which one is dealing directly with patients.

In 1990s four EPFL physics developed a similar oath for engineers to emphasise their commitment to ethically practice their profession. Historically this was read and signed at the

end of the masters studies at their diploma ceremony. Following the model of the name of a figure from Greek antiquity, they called their oath the Archimedean Oath, named after a Greek physicist, mathematician and inventor of the classical age. Archimedes himself was identified as an inventor of many devices, including a type of water pump as well as being an inventor of military machines. He was killed during the Roman siege on the city of Syracuse.

In the early 2020s the text was reformulated by the EPFL student Association AGEPoly to better reflect contemporary concerns. The text of the oath is below:

Archimedes Oath

Taking into account the life of Archimedes of Syracuse, who illustrated in Antiquity the ambivalent potential of technology,

Taking into account the growing responsibility of engineers and scientists in regards to Nature and Human Beings,

Taking into account the importance of ethical problems raised by Technology and its applications,

Today, I swear to the following engagements, and promise to strive to attain the ideal they represent:

- I will practice my profession with the good of all people in mind, respecting human rights* and environmental sanctity.
- I will take responsibility for my actions, having informed myself to the fullest extent, and will in no case discharge such responsibility on others.
- I will strive to perfect my professional abilities.

- In choosing and completing my projects, I will pay attention to their context and their consequences, particularly with respects to technical, economic, social, and ecological aspects, and will strive for the respect of the environment.
- I will be especially careful in regards to any military uses that my work could have.
- I will contribute to preserving the environmental and social integrity of our planet.
- I will contribute to the best of my abilities to the promotion of equity for all human beings, and will help construct a just society for all.
- I will rigorously and honestly transmit any information to carefully chosen persons, if such information represents a necessary knowledge or if holding it back puts anyone in danger. In the latter case, I will ensure that such information leads to concrete actions.
- I will not let my personal or professional interests take precedence over what I deem to be just.
- I will, to the best of my ability, strive to encourage those who surround me, in both my personal and professional life, to follow the ideals of the present oath.
- I will practice my profession in a context of intellectual honesty, with conscience and with dignity.
- I promise solemnly, freely, and on my honour.

Questions:

1. For each of the statements in the Archimedean Oath, identify whether you would associate it with each of the principles of Justice, Non-maleficence, Beneficence and Autonomy? Are there any principles in the Oath that do not appear, to you, to be linked with any of these principles?

2. For each of the statements in the Archimedean Oath, identify whether you would associate it with one of the five phases in an Ethics of Care process: attentiveness, responsibility, competence, responsiveness, and solidarity.
3. The name of the 'Archimedean Oath' refers to a classical Greek figure who was, himself, involved in the design of military machines. Some people have criticised this name. Do you feel the name is appropriate.
4. The Archimedean Oath statements begin with "I will…". Does this (individualistic) approach to ethics resonate more with a deontological or an Ethics of Care approach?
5. Are the aspects of the Oath that you particularly like? Are there any aspects you feel should not be included in a statement of ethical principles for life sciences engineers?
6. Are there any things missing that you would like to add or any edits you would suggest?

The 'Archimedean Oath' is a specific code (specific to students from a given institution) that is aspirational in nature. Other specific codes can be more enforced. An example of this type is the EPFL Rules on Research Integrity (Lex 3.3.2) and the rules on citation of written work (which is regarded as being an ethical issue as it involves ensuring that people get credit for their own work – Lex 1.3.3).

The EPFL rules are framed explicitly in terms of a person's obligation to scientific integrity and their responsibility for the good name of their colleagues:

> Concern for the truth, open-mindedness, self-discipline, self-criticism and rectitude are essential characteristics of ethical behaviour. They represent the basis of all scientific activity and are prerequisites for the credibility and acceptance of science. It is the responsibility of all EPFL researchers to uphold the good reputation of the institution, to respect its rules, policy and guidelines and undertake their activities accordingly (Lex 3.3.2 preamble).

EPFL Rules on Research Integrity

The EPFL rules on research integrity can be found here: www.epfl.ch/about/overview/wp-content/uploads/2019/09/3.3.2_principe_integrite_recherche_an.pdf

The rules include sections on:

- Role and responsibilities of senior and junior researchers
- Requirements regarding documenting of projects
- Management of data including tracking of data analysis and ensuring data security
- Specific rules regarding human research or humans
- Authorship rules
- Rules on citation, plagiarism, and recognition of the institution
- Rules on the obligation to contribute to peer review

Review Lex 3.3.2.

Questions:

1. The Archimedean Oath was notable for its focus on individualistic decision making ("I will…"). Is the Lex 3.3.2 similarly individualistic or are there places where it also addresses relationships or social context?
2. What (other) notable differences do you note between the Archimedean Oath and the Lex 3.3.2? What areas of similarity do you see?
3. Are there parts of the Lex that you would link to each of the principles of Justice, Non-maleficence, Beneficence and Autonomy? Are there other ethical principles which appear to be important in the Lex (noting that the preamble of the Lex refers to "Concern for the truth, open-mindedness, self-discipline, self-criticism and rectitude are essential characteristics of ethical behaviour")?
4. Are there parts of the Lex that you would link to each of the five phases in an Ethics of Care process: attentiveness, responsibility, competence, responsiveness, and solidarity.

Professional Codes

Although the term 'professional' is used in everyday speech ways that encompass everything from professional footballers to medicine, in this chapter the term is used to refer to occupations that have a high degree of specialised knowledge and skill which is acquired through long periods of study and which is typically used in complex and uncertain circumstances that require a high degree of judgement. This definition works for professions like medicine, dentistry, accountancy, teaching and, of course, engineering. The specialist nature of professional knowledge and judgement typically means that assessment of the quality of professional work can often only be undertaken by other members of the profession. One feature of this claim to control over certain knowledge and skills is that it can be hard for non-professionals to successfully question the judgement of professionals, except in extreme cases (i.e., it is hard for someone who is not an engineer to know if the engineer is doing a good job on not, unless there is a major and evident failing). Because it can be hard to hold professions and professionals accountable for their judgements, one of the features of professions and professional education in universities has been that professionals are generally expected to be guided in their actions by a concern for the wider good: as Aileen Pierce has noted: "At the core of professionalism is the claim to subordinate or, at least moderate, self-interest in service of the public interest" (2006, 7; see also O'Flaherty and Doyle, 2014).

In many professional codes the 'public interest' often meant, primarily, the interest of the person the professional was interacting with – often a client (in the case of an engineer) or a patient (in the case of a doctor), or both (in the case of a life sciences engineer). As van de Poel & Royakkers (2013: 67) noted: "The early codes comprised rules for engineers that

chiefly pertained to etiquette. The professional code regulated people's entry into the profession and the behaviour of members towards each other and in relation to employers and clients". As we have already seen in the previous chapter, this narrow focus on the interests of the client or employer was broadened out after the second world war to also include a focus on the general public and wider society. This can be seen, for example, in the NSPE code of ethics which featured in the case study at the start of this chapter. It includes as a first principle "Engineers shall hold paramount the safety, health, and welfare of the public". His focus on the wider public was built onto the existing focus on clients and employers, which remained important in professional codes, and, as a result, the focus of a lot of professional codes is often on potential conflicts of interest between engineers and their clients. Such conflicts may arise due to personal reasons (e.g. having stocks in a company that may be impacted by an engineer's actions) or for professional interests (e.g. working for two competing clients at the same time, or having intellectual property from one client that may be of benefit to another client). A feature of professional codes, then, is the idea that the engineer shall act in their client's interest, rather than their own. This can be seen, for example, in the NSPE code of ethics which includes as a principle: "Engineers shall act for each employer or client as faithful agents or trustees".

Professional codes are also intended to guard the reputation of the profession and so they focus on issues linked to reputation such as truthfulness and competence. For example, you will see in the NSPE Code of Conduct in the first case study the requirement that "Engineers shall perform services only in the areas of their competence", "Engineers shall issue public statements only in an objective and truthful manner", and "Engineers shall avoid deceptive acts."

A third important feature of professional codes of ethics is that they are often more specific a branch of engineering when compared to more generalist codes.

The Biomedical Engineering Society (BMES) Code of Ethics is an example of a professional code of ethics for life sciences engineers. It covers a number of areas:

- Responsible conduct of research
- Use and collection of computer code
- Respect and Protection of Human Subjects
- Respect for non-Human Animals
- Respect for common humanity and disparate needs in applications of biomedical technology
- Care in the use of autonomous technology
- Care with respect to identity in the development and deployment of biotechnology
- Care for the environment
- Responsibilities of mentors and mentees in professional and educational relationships
- Public Trust
- Dignity and Respect of Persons, including colleagues, employees and the wider public

The BMES Code of Ethics

You can access the BMES Code of Ethics here:

https://www.bmes.org/2025/cmbeconference/codeofconduct

Questions

1. In what ways does the BME code generate a sense of responsibility to fellow members of the profession?

2. In what ways is a code for biomedical engineering more specific than the codes for a whole school (Archimedean Oath and Lex 3.3.2)? Are there areas that are addressed that you are surprised to see in a code of ethics?
3. Are there parts of the code that you would link to each of the principles of Justice, Non-maleficence, Beneficence and Autonomy? Are there other ethical principles which appear to be important in the code (such as competence or truthfulness)?
4. Are there parts of the Lex that you would link to each of the five phases in an Ethics of Care process: attentiveness, responsibility, competence, responsiveness, and solidarity?

Case study: Mary in PharmaSci

Mary is a bioengineering student on a work placement ("stage") in PharmaSci, a medical/ pharmaceutical company, that is researching the development of new treatments for patients who have suffered burns. The research involves some intrusive and painful medical tests on people aged 18 to 24 who have previously suffered severe burns. The research is at an early stage and a new treatment will probably not be developed for years, if at all. One of Mary's tasks is to interview the research subjects to collect additional data. She can see that the young men and women she is interviewing have ongoing physical pain. There is a box of tissues kept in the interview room because some of the subjects cry when describing the pain caused by the testing.

As she interviews the subjects, Mary realizes that many of them have volunteered because they are hopeful that an effective treatment for their condition may be quickly developed. They have all volunteered to participate, and have signed consent forms which explained to them that a new treatment was not likely in the short term, however, despite having being informed about the research project, many of them still have a level of hope that is not justified by the nature of the research.

She tells her immediate supervisor in the lab that she thinks the research subjects may not have properly understood the research before giving consent. Her supervisor tells her that this kind of situation is totally normal and that she should not worry about it.

1. Try to identify the range of different people which are directly or indirectly involved in this case: (going beyond the people immediately present).
2. Who in this situation needs care and who gives care (pick the 3 most evident)?
3. How might each of these describe this situation from their perspective?
4. What emotions might they experience if made aware of this situation?
5. What are the thinking and acting tendencies associated with these emotions?
6. Are there particular technical or organisational competences that you expect professionals to bring to a situation like this? Are there particular principles or practices described in a relevant code of ethics that might be applied here (remembering that an ethical requirement may go beyond what is the legal minimum requirement)?
7. How could those involved (collectively) provide support to those who need care and those who give care in this situation?
8. What monitoring should be in place to see if the care actions are having the intended consequences or if they need to be adapted?

Conclusion

While the deontological principles of autonomy, non-malfeasance, beneficence and justice have been influential in the development of ethical practices in bioethics, they do need to be specified, balance and justified in relation to specific situations. Part of the context that needs to be specified is the organisation within which an engineer works, the professional group to which they belong, and the capabilities and risk of the type of technology they develop or

deploy. Professional codes provide some of this specification, justification and balancing and therefore can make it easier to see what an ethical decision might be in a specific context.

As we have seen, many ethical codes are 'voluntary', intended to describe what an engineer should aspire to rather than the minimum standards to which they are required to comply. But some (like the Lex 3.3.2) are enforced with sanctions for those who break it. One type of 'code' we have not looked at in this chapter is laws. Laws are similar to other codes in lots of ways in that they codify general ethical principles in specific ways that are to apply in a given place. The next chapter will look in more detail at laws which are relevant to life sciences engineering in Switzerland and, in particular, one aspect of those laws: their focus on peer review processes in ethical decision making.

References

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