Ethics Summary

1. Responsibilities and how to deal with them

Engineers carry responsibilities. The creations of engineers can save or kill many people. To make sure that engineers do the right thing, they need to be aware of their responsibilities and handle them in ethically correct ways. In this chapter we will examine what kind of responsibilities there are. Also, several types of ethical codes on how to deal with responsibilities are discussed.

1.1 Responsibilities of engineers

1.1.1 What is responsibility?

Whenever something goes wrong, people always start asking who is responsible. So, let's discuss **responsibility**. In fact, the main issue that we will discuss is **moral responsibility**. Moral responsibility concerns the rightness/goodness of actions and their effects. In fact, we define **morality** as all the views, decisions and actions that people use to express what they find right/justifiable/good. It must be noted that different cultures/different groups of people adhere to different kinds of morals.

Responsibility is often linked to the role a person has. (For example, the responsibilities of an airplane pilot are different from the responsibilities of the passengers.) And, since a person often has different roles in life, he has responsibilities to different individuals/instances. Sometimes these responsibilities may be inconsistent.

1.1.2 Active and passive responsibility

We can distinguish two kinds of responsibility.

- **Active responsibility** is responsibility before something has happened. A person that is actively responsible is expected to act such that undesired consequences are avoided as much as possible. The chance for positive consequences must be as big as possible. When discussing active responsibility, the ideals of engineers are often important. Let's take a look at the ideals which some engineers might have.
  - Often, engineers have **technological enthusiasm**: they want to develop new technological possibilites and take up technological challenges. Technological enthusiasm is not necessarily bad. However, it can be dangerous when possible negative effects/consequences of technology are overlooked.
  - Engineers tend to strive for **effectiveness** and **efficiency**. (Effectiveness is the extent to which an established goal is achieved. Efficiency concerns the ratio between the goal achieved and the effort required.) Again, striving for effectiveness and efficiency is not necessarily bad. But it does need to be done in a morally acceptable way.
  - Finally, engineers often wish to contribute to **human well-being**. However, human well-being depends on many factors, like safety, health, welfare and sustainability. And often a choice needs to be made between these parameters: a moral optimum needs to be found. Finding this optimum isn't as easy as it may seem.

- **Passive responsibility** is applicable after something undesirable has happened. So, if you're passively responsible, you need to be able to justify your actions. To hold someone passively responsible, four conditions usually need to apply.
  - **Wrong-doing** – The individual (or institution) has violated a norm or did something wrong.
  - **Causal contribution** – The individual must have made a causal contribution to the consequences for which he is held responsible. Although often multiple causal contributions have to be present: events rarely have only one cause.
  - **Foreseeability** – The individual must have been able to anticipate the consequences of his actions. Although we do expect people to do as much as reasonably possible to know the consequences of one's actions. Important here is also the precautionary principle. (The **precautionary principle** states that if an action or policy has suspected risk of causing harm to the public or to the environment, in the absence of a scientific consensus that harm would not ensue, the burden of proof falls on those who would advocate taking the action.)
  - **Freedom of action** – The individual must have been given the opportunity to choose for himself.

1.1.3 The role of engineers

Engineers are often salaried employees. They are thus hierarchically below managers. This can lead to situations of conflict. On one hand, engineers have a responsibility to their managers/their company. But on the other hand, they have a responsibility to society: the technologies that are developed should not be harmful towards the society.

A view that is often employed is the **tripartite model**. In this model, the responsibility of engineers is only confined to the technical choices that they make. So, engineers only have responsibilities towards their employers, customers and colleagues. All the decision making is done by managers, who carry the responsibilities towards society. The engineers thus separate their selves from the effects that their technologies might have on society. This is called **separatism**.

Sadly, managers don't always know the effects of technology well enough. It is therefore sometimes proposed to have engineers fulfill the role of managers. These **technocrats** use technological insight to decide what is best for the company/for society. However, **technocracy** is morally problematic, because it is **paternalistic**. (Paternalism exists when a group of people thinks that it knows better what is good for others than those others themselves do.) In a way, it denies people the right to shape their own lives.

A better way to deal with technology is to perform **technology assessments**. A technology assessment (TA) is directed at assessing the effects of technology. A **constructive technology assessment** (CTA) goes even a step further. It is directed at influencing and expanding the technological design processes. This can be done by involving the people that are effected by the technology into the design process.

1.2 Codes of ethics

1.2.1 Types of codes

Codes of conduct are codes in which organizations lay down guidelines for responsible behaviour. They are intended as an addition to the requirements of the law. For engineers, two types of codes of conduct are especially important. First, there are **professional codes** that are formulated by professional associations of engineers. Second, there are **corporate codes** that are formulated by (engineering) companies. We will go more into depth on these two types of code later in this part.

We can also split up types of codes of conduct, according to their objective. An **aspirational code** expresses the moral values of a profession/company. An **advisory code** advices professionals/employees

on how to exercise moral judgments. (Most of the codes for engineers are advisory codes.) Finally, a **disciplinary code** tries to make sure that the behaviour of professionals/employees meets certain values and norms.

1.2.2 Professional codes

Professional codes of conduct are guidelines made by a professional society. They instruct on the exercising of a particular profession. The use of professional codes mainly started after world war 2. During the war, the image of technology was tainted. By implementing professional codes, societies of engineers hoped to restore the social image of science and technology.

Professional codes for engineers mainly express the responsibilities of engineers. This is done in three domains. First of all, engineers need to conduct their profession with integrity and honesty. Second, they have certain obligations towards employers and clients which need to be fulfilled. And finally, engineers have responsibilities towards the public and the society.

1.2.3 Corporate codes

Corporate codes are voluntary commitments made by (groups of) corporations. These codes of conduct set certain values, standards and principles for the conduct of the corporations. Corporate codes often consist of several main elements.

- A **mission statement** concisely formulates the strategic objectives of the company. It answers the question what the organization stands for.
- The **stakeholder statutes** state the responsibility of a company towards its stakeholders. Stakeholders include consumers, employees, investors, society and the environment.
- The **value statements** contain the core values of a company: the qualities which the company finds desirable. Often mentioned values include teamwork, responsibility, open communication and creativity.
- The **codes of conduct** contain detailed rules and norms for the behaviour of individual employees. These mainly consist of guidelines on how to act in specific situations. For example, it explains how one should deal with fraud, theft, bribery, discrimation, etcetera.

Companies often draft a corporate code to improve one's image. However, if this is the only goal of the code, then we are dealing with **window-dressing**. The danger of window-dressing is especially present in aspirational codes.

1.2.4 Limitations of codes

Codes of ethics have several limitations. For example, it is very hard to precisely describe what one should do in every situation. For this reason, ethical codes are often rather vague. Inconsistencies and contradictions often appear in ethical codes as well. Also, ethical codes try to describe universal moral rules. But moral rules are generally not universal.

Sometimes ethical codes are very hard to follow. This is often the case when an employee discovers certain abuses in a company. He then needs to blow the whistle. We say that **whistle blowing** is used when an employee discloses information about abuses without the consent of his superiors. When this is done within the company (but outside the usual communication channels), we speak of **internal whistle blowing**. When the information is made known to someone outside of the company, then we are dealing with **external whistle blowing**.

Whistle blowers are usually in a weak position from a legal point of view, as they disclosed confidential information of the company. However, there often are legal requirements to make certain information public. Also, engineers can argue that they have freedom of speech. Nevertheless, whistle blowers almost always do lose their jobs. For this reason, some companies have formulated policies and procedures concerning whistle blowing.

A downside of ethical codes is that it is very hard to enforce them. This is especially the case for professional codes. These codes are often only advisory, and do not have a legal status. Enforcing corporate codes is a bit easier, since corporations can dismiss engineers if they breach the code of conduct. Codes of conduct can also be enforced by external organizations or by branch organizations. This increases the credibility of the ethical code.

1.2.5 International codes of conduct

Companies are often spread out over several countries worldwide. These multinationals employ engineers from different cultural backgrounds. Engineering has therefore become a global activity. A global code of ethics would thus be benificial. However, developing a global code of ethics for such companies can be very difficult. The main challenge is to create consistency, in spite of cultural differences.

The **United Nations Global Compact** (UNCG) is the world's largest global code of ethics. It is made for companies that are comitted to align their operations with the ten principles of human rights, labour, environment and anti-corruption. Following these ten principles can in many ways build trust and contribute to sustainable markets.

Next to this, the United States have been a world leader in promoting engineering ethics code development. Companies from other countries are often adopting American codes of ethics. But it remains to be seen whether this will be successful, since cultural differences are now neglected.

1.3 Distribution of responsibility

1.3.1 The problem of many hands

Previously, we have considered how individuals should act. Now let's look at a group of individuals. (For example, consider a group of people designing an airplane.) Let's suppose that something goes wrong, for which the group is responsible. (For example, the airplane crashes.) Of course it is always difficult to determine in a large group/organization who did what. Pointing out a single responsible person can thus very well be nearly impossible.

But, it can also occur that every person in the group has acted in a morally justifiable way. In other words, nobody is morally responsible. This is known as the **problem of many hands**: a collective is morally responsible for some outcome, while none of the individuals can be held responsible.

The problem of many hands is often caused by an imperfect distribution of information. For example, person A knows some piece of data, which person B does not know. If person B would have known this data, the accident could have been prevented. But of course it is impossible for everyone to know everything. So, person A could not be expected to know he had to present the data to person B. As such, neither person A nor person B is responsible. But, an accident still occurred.

To solve the problem of many hands, responsibility has to be distributed among the members of the collective. An ideal distribution is both morally fair and effective. However, meeting these two requirements simultaneously is difficult. For this reason, we will examine several methods to distribute responsibility, and see how well they work.

1.3.2 Distributing responsibility by law

Ethics discusses moral responsibilities. The law discusses legal responsibilities. To make a distinction, we call the latter **liabilities**. One could try to make moral responsibilities and liabilities as similar as is feasible. However, it is impossible that moral responsibilities and liabilities coincide.

There are several important differences between moral responsibilities and liabilities. Whether someone is liable depends on the law. Liability is decided upon in court. Finally, being liable usually means you will have to pay some kind of fine to repay the damage that is done.

In the case of the problem of many hands, it can help to hold people liable, even if they are not morally responsible. This may make them more cautious, preventing negative effects. This is thus an effective way to solve the problem of many hands. But it is not always very fair.

According to the law, there are several ways in which a person can be liable. Let's look at a few ways.

- **Regulations** – Regulations can forbid the development/production/use of certain technological products. Although more often, regulations are used to set the boundary conditions for technologies. When a person breaches regulations, he is liable.

  The downside of using regulations is that they are based on the current knowledge of a technology. So, when new technologies are developed, regulations always lag behind.
- **Negligence** – A person can be claimed to be negligent if four conditions apply. The person must have a duty, he breaches that duty, an injury is then caused, and there is a causal connection between the breach and the injury. If this is the case, then the defendant is liable.
- **Strict liability** – In contrast to negligence, strict liability does not require the defendant to be negligent. For example, a manufacturer is liable for defects in his products, even if he did not act negligently. However, often exemptions are made for special circumstances, such as when the defects could not have been foreseen, given the state of scientific and technical knowledge.

  The advantage of strict liability is that it motivates people involved in innovation to be careful. However, strict liability can also slow down the pace of innovation significantly.
- **Corporate liability** – Just like normal persons, also corporations can be liable. The law then treats corporations as a legal person. An advantage is that you don't need to find out which individual in the company is responsible. However, corporations are often characterized by limited liability. (For example, shareholders can only be held responsible until the values of their shares.)

1.3.3 Responsibility in organizations

There are several models to determine who is responsible in an organization. Let's discuss the three most important ones.

- In the **hierarchical model**, those highest in the organization's hierarchy are held responsible. In practice, it can be very difficult for the executives to get hold of the right information in time. Also, it can be hard to effectively steer the behaviour of lower organisational units. So, this model is not always fair.
- In the **collective model**, every member of the organization is responsible for the actions of the whole organization. People can thus be held responsible, whether they contributed to the actions or not. This seems morally unfair. Collective responsibility is therefore only applicable in a number of exceptional cases, like in very small groups.
- In the **individual responsibility model**, each individual is held responsible for his own actions. Although this is a morally fair problem, it can lead to the problem of the many hands.

So, none of the models discussed is ideal in terms of moral fairness and effectiveness. Which model to use mostly depends on how the organization in question is organized.

Next to laws and organizations, also technology can influence responsibilities. If a person is given a task, the technology must be available such that this person can carry out this task. If not, he cannot be held responsible. For example, if an autopilot prevents pilots from intervening during cruise flight, the pilots can't be held responsible if something goes wrong during the cruise phase.

2. Ethical theories

To be able to deal with responsibilities in an ethical way, we need to know more about ethics. What is ethics? And what ethical theories are around? That's what we'll discuss in this chapter.

2.1 Ethical definitions

2.1.1 What is ethics?

The word **ethics** comes from the Greek ethos, meaning something like 'morals'. In fact, ethics is defined as the systematic reflection on what is moral. In this definition, **morality** is the whole of opinions, decisions and actions with which people express what they think is good or right. So, in short, to think ethically, you need to systematically reflect on what people think is good or right. Ethics is not a manual with answers on how to act. It is only a search for the right kind of morality.

We can distinguish two kinds of ethics. The **descriptive ethics** is involved with the description of existing morality. It is about facts. Descriptive judgments are therefore true or false. On the other hand, there is the **prescriptive ethics**, also known as the **normative ethics**. This branch of ethics actually judges morality. Normative judgments are therefore value judgments: they indicate whether something is good or bad. We will mainly consider ourselves with normative ethics.

2.1.2 Norms, values and virtues

The most important parts of normative ethical theories are values, norms and virtues. It is important to know the distinction between these three terms.

- Moral **values** are matters/convictions that are worth striving for in general. Examples include justice, happiness, charity and such. A distinction can be made between intrinsic values and instrumental values. An **intrinsic value** is a value in itself: something that is worth striving for. An **instrumental value** is a value that only contributes to an intrinsic value. For example, if you want to get money to help people, then getting money is the instrumental value, while helping people is the intrinsic value.
- Moral **norms** are rules that prescribe what actions are required, permitted or forbidden. In fact, some norms are so important and so prescriptive, that they have been turned into laws. Norms can often be deduced from values. But, whereas values are ideals which people want to achieve, norms are the means to realize these ideals.
- Moral **virtues** are character traits that make someone a good person and allow him to lead a good life. Examples of virtues are honesty, courage, loyalty, creativity, humor, and so on. Virtues seem to be similar to values. But whereas values are things you strive for, virtues are character properties that are good to have.

2.2 Ethical theories

2.2.1 The extremes of ethical theories: relativism and absolutism

There are several ethical theories around. But, before we are going to discuss them, we first look at two extremes of the normative ethical theories. On one hand is **normative relativism**. It states that all moral points of view are relative. The morals of one person are not necessarily equal to the morals of another person. Next to this, it is also impossible to say that certain norms and values are better than

other norms and values. The problem with this theory is that it is now impossible to discuss normative ethics: all norms and values are allowed.

On the other hand is **absolutism**, also known as **universalism**. It states that there is a system of norms and values that is universally applicable to everyone, everywhere at every time. Absolutism makes no exceptions: a rule is a rule. However, there is no set of norms and values that never contradicts itself. So, absolutism in general doesn't work either.

We know that both relativism and absolutism don't work. Any choice/judgment based on one of these theories is ethically suspect. But we do know something important now: more useful ethical theories need to be somewhere between relativism and absolutism.

2.2.2 Duty ethics and the Kantian theory

Ethics is all about choosing the right actions. An **action** is carried out by a certain **actor** with a certain **intention**. This action then leads to certain **consequences**. In ethical theories, we can focus on the action, the actor, the intention or the consequences. If we mainly focus on the action itself, then we use **deontological ethics** (also known as **deontology** or **duty ethics**).

In duty ethics, the point of departure is the norms. An action is morally right if it is in agreement with moral rules/norms. Some theories within duty ethics depart from one main principle/rule from which all moral norms are derived. This is the so-called **monistic duty ethics**. On the other hand, **pluralistic theories** are based on several principles that apply as norms.

Immanual Kant has developed the most well known system of duty ethics: the **Kantian theory**. A core notion here is **autonomy**. A man should place a moral norm upon himself and obey it. This is his duty. He should then, on his own, be able to determine through reasoning what is morally correct.

The Kantian theory is part of monistic duty ethics: there is one universal principle. This principle is called the **categorical imperative**. It is formulated in different ways. The first formulation is the **universality principle**: 'Act only on that maxim which you can at the same time will that it should become a universal law.' The second formulation is the **reciprocity principle**: 'Act as to treat humanity, whether in your own person or in that of any other, in every case as an end, never as means only.'

There are several downsides to the Kantian theory. In Kant's theory, rules can not be bent. This reminds us of absolutism. So, the question arises whether all the moral laws form a consistent system of norms. Another downside is that Kantian theory prescribes to rigidly adhere to the rules, irrespective of the consequences. But in real life, following a rule can of course have very negative consequences. Kant's theory does not deal with these exceptions.

2.2.3 Utilitarianism

We don't always have to focus on actions. We can also focus on consequences. If we do this, we wind up with **consequentialism**. One type of consequentialism is **utilitarianism**, founded by **Jeremy Bentham**. The name of utilitarianism is derived from the Latin 'utilis', meaning 'useful'. In utilitarianism, the consequences of actions are measured against one value. This 'useful' value can be something like happiness, welfare or pleasure. It should be maximized.

Utilitarianism is based on the **utility principle**: we simply need to give the greatest happiness to the greatest number of people. (Do note that we have silently made the assumption that 'pleasure' is the only goal in life, and that everything else is just a means to get pleasure. This idea/assumption is called **hedonism**.) An action is morally right if it results in pleasure, whereas it is wrong if it gives rise to pain. The **freedom principle** is also based on this. This principle states that you can do whatever you want, as long as you don't cause anyone any pain/harm.

There are several downsides to utilitarianism. Of course it is very hard to determine how much pleasure

an action will actually give. Also, to find the total amount of pleasure, we need to consider all individuals that are involved and add up their pleasures. But how do we quantify pleasure? And has the pleasure of one person the same value as the pleasure of another? Also, how do we decide whether one action gives more pleasure than another? Answering these questions is difficult. Even the clever **John Stuart Mill** did not have an answer, although he did have an opinion. He stated that certain pleasures (like intellectual fulfillment) are by nature more valuable than other pleasures (like physical desires).

Another downside is that utilitarianism doesn't always divide happiness in a fair way. For example, a very talented entertainer can make a lot of people happy. But does this mean that he needs to spend every waking moment entertaining people, until he burns out? However, most utilitarians argue that this isn't a downside of the theory. In fact, they state that after a while, a small moment of spare time will give the entertainer more happiness than all the people he could have entertained in that time. Thus, utilitarianism automatically compensates for this 'flaw'.

In utilitarianism, an engineer could also be asked to bend or break a fundamental rule, because this will result in the greatest happiness for the greatest number of people. For example, the engineer has the opportunity to save 10 million euros on a design. But he knows that this will later cause an accident killing 5 people. He argues that 10 million euros can cause more happiness than 5 lifes. To compensate for this, **rule utilitarianism** has been created. This kind of utilitarianism recognizes and uses moral rules. It is thus also similar to duty ethics.

2.2.4 Virtue ethics and care ethics

Virtue ethics focuses on the nature of the acting person. This actor should base his actions on the right virtues. So, the central theme in virtue ethics is shaping people into morally good and responsible creatures. Virtue ethics is rather similar to duty ethics. But, whereas duty ethics is based on certain rules/norms, virtue ethics is based on certain virtues.

Virtue ethics is strongly influenced by **Aristotle**. He stated that every moral virtue is positioned somewhere between two extremes. In fact, the correct moral virtue equals the optimal balance between these two extremes. For example, to be courageous, you need to find an optimal balance between the two extremes of cowardice and recklessness. Sadly, there are downsides to this idea. The optimal balance often depends on the situation which a person is in. Also, moral virtues are subjective: you cannot generally say that the courageousness of one person is better than the courageousness of the other.

Care ethics is a rather new ethical theory. It emphasizes that the development of morals is not caused by learning moral principles. Instead, people should learn norms and values in specific contexts. Other people are of fundamental importance here. By contacting other people, and by placing yourself in their shoes, you learn what is good or bad at a particular time. The solution of moral problems must always be focused on maintaining the relationships between people. So, the connectedness of people is the key.

2.2.5 Caveats of ethical theories

Some people believe that applying ethics is just a matter of applying ethical principles to situations. But this is not true. One reason for this is the fact that there is no generally accepted ethical theory. And, different ethical theories might very well result in different judgments. So what should we do if we run into a new case? Well, we can apply our ethical theories to it. But we should be open to the possibility that the new case might reveal a flaw in our theory. Therefore, you should never blindly apply an ethical theory and rely on the outcome.

Now you may wonder, what are ethical theories good for anyway? Ethical theories may function as instruments in discovering the ethical aspects of a problem/situation. (For example, applying consequentalism is a good way to explore the consequences of actions.) Similarly, ethical theories may suggest certain arguments/reasons that can play a role in moral judgments.

3. Ethical argumentation

We now have ethical theories. But before we can actually form/justify moral judgments with them, we need to be able to construct arguments. This chapter is all about **ethical argumentation**: determining whether acts are right or wrong. First, we look at some basics of argumentation. Second, we examine how we can combine argumentation with our ethical theories.

3.1 Types of arguments

3.1.1 What is an argument?

An **argument** is a set of statements. One of these statements is the **conclusion**. The other statements are the **premises** of the argument. The premises are assumed to be true. The argument now states that the conclusion is true as well. Let's denote the premises as $P_1, P_2, \ldots, P_n$ and the conclusion as C. In general, an argument now takes the form of

$$P_1, P_2, \ldots, P_n, \text{ so } C. \tag{3.1.1}$$

Arguments can be judged on their effectivity. If the argument is always valid, we have a **logical analysis**. If the argument is sufficiently persuasive to convince the audience, then we have a **rhetoric analysis**.

Let's ask ourselves, when is an argument valid? We have a **valid argument** if the conclusion always must follow from the premises. Examples of valid arguments are

$$\text{If } p\text{, then } q, \qquad p, \qquad \text{so, } q. \qquad (\textbf{Modus ponens}) \tag{3.1.2}$$

$$\text{If } p\text{, then } q, \qquad \text{not } q, \qquad \text{so, not } p. \qquad (\textbf{Modus tollens}) \tag{3.1.3}$$

It is clear that, when the two premises are true, the conclusion also must hold.

3.1.2 Fallacies

An error or deficiency in an argument is called a **fallacy** (or **specious argument**). We can distinguish two types of fallacies: formal fallacies and informal fallacies. First, let's discuss formal fallacies. A **formal fallacy** is only determined by the form/structure of an argument. Any invalid argument is thus a formal fallacy. An example of a formal fallacy in an argument is

$$\text{If } p\text{, then } q, \qquad q, \qquad \text{so, } p. \tag{3.1.4}$$

A very powerful method to show the invalidity of an argument is to provide a counterexample. For the above fallacy, the situation 'q, not p' is a counterexample. All the premises hold, but the conclusion does not hold. Thus, the argument can not be valid.

In general, there are two ways to challenge an argument. One option is to show that the argument itself is invalid (as we have just done). The second possibility is showing that a premise is false. If the premises P_i of an argument don't hold, then the conclusion C isn't necessarily true either.

Now let's examine informal fallacies. An **informal fallacy** is based on considerations of the context/content of the arguments. We will examine a couple of examples now.

- In an **attack on the person** (**Ad Hominem**), we try to question (in some negative way) the presenter of the argument, instead of the argument itself. If we can make the presenter of the argument look unconvincing, then the argument will look unconvincing as well.

- We can **confuse law and ethics**. If we do this, we apply reasoning like 'if it isn't illegal, then it must be ethical'. But of course, there is still a big difference between law and ethics.
- In a **straw person** fallacy, we try to misstate the argument of a person. We then conclude that the original argument is bad as well.
- **Wishful thinking** occurs when we interpret facts according to how we would like them to be, instead of how they actually are.
- We have a **naturalistic fallacy** when we derive normative statements (what people ought to do) from descriptive statements (what people already do). So, we derive 'ought' from 'is'.
- Sometimes, we may use phrases/words that are unclear. This may cause the argument to have more than one meaning (**ambiguity**) or no distinct meaning at all (**vagueness**).

Next to this, there are also several fallacies related to risk. We'll examine the most important ones here too.

- In the **sheer size fallacy**, we justify an action X just because it has a smaller risk than a (possibly unrelated) action Y.
- The **fallacy of naturalness** is similar to the naturalistic fallacy: anything that is unnatural/not normal is said to be wrong. (We derive 'ought not' from 'is not'.)
- In the ostrich's fallacy, one argues that just because there are no detectable risks to an action X, there will be no unacceptable risks either. However, risks can of course always be hidden. (Also remember the precautionary principle.)
- In the **delay fallacy**, we say that is we wait, we will know more about an action X. We can then reduce the risks better. So, we should wait. The error here is that the assumption (that by waiting, you will know more) is virtually always true. So, you will wait indefinitely, while the problem may grow.
- The **technocratic fallacy** states that when a decision X is an engineering issue, engineers should decide whether or not X is dangerous. However, when discussing the 'dangerousness' of X, you often don't only need engineering skills, but also political/social/ethical skills. And engineers don't often have all that.
- In the **fallacy of pricing**, you try to weigh risks against each other by putting a price on everything. But the question is, can you put a price on everything? (What is the price of a human life?)

3.1.3 Non-deductive arguments

Valid arguments are of a **deductive** nature: the conclusion is fully enclosed in the premises. These arguments are thus **monotonic**. However, many arguments in daily practice are **non-deductive arguments** (also known as **non-monotonic arguments**). The premises (if true) now only give a limited support to the conclusion, but they do not guarantee that the conclusion is true. Accepting the conclusion is now solely based on considerations.

A frequently occuring form of non-deductive argumentation is the **inductive argumentation**. On the basis of a limited number of cases, we conclude that a law must hold for all cases. Non-deductive argumentations can never be called 'valid'. Instead, if a non-deductive argumentation makes sense, then we call it a **sound argumentation**.

To find out whether a non-deductive argumentation is sound, we should consider several **assessment questions**. An example of an assessment question is: 'are there sufficient cases to conclude that the law must hold for all cases?' If all the assessment questions can be answered positively, then the argumentation is sound.

3.2 Application of argumentation to ethical theories

3.2.1 Argumentation by analogy

When applying **argumentation by analogy**, we compare our situation to another analogous situation. If the other situation is morally correct, then our situation must be morally correct as well, and vice versa. For example, is it morally bad to digitally enter someone's computer uninvited? We could say that it is, because it is analogous to entering someone's house uninvited, and that is morally bad too.

There are a few important assessment questions corresponding to this kind of argumentation. Are the two situations comparable? And are the assumptions about the analogous situation true? (That is, is it really morally bad to enter someone's house uninvited?) If these question are answered positively, then we have a sound argumentation. Do note that argumentation by analogy is non-deductive. We can never be entirely certain that the two situations are comparable.

3.2.2 Argumentation in utilitarianism

In utilitarianism, an action is morally acceptable if and only if that action can be reasonably expected to produce the greatest happiness for the greatest number of people. In **utilitarian pleas**, the **means-ends argumentation** is of fundamental importance. The means-ends argumentation states that, if you wish to achieve an end x, you have to carry out action y.

There are several assessment questions concerning the means-ends argumentation. Can we exectute action y? Isn't there a better action than y to reach x? Aren't there any bad side-effects to y? And most importantly, does y indeed realize x? The latter question is related to the **causality argumentation**. The causality argumentation states that a certain consequence q (or x) can be derived from a certain situation/action p (or y).

3.2.3 Argumentation in Kantian reasoning

In the Kantian theory, an action is morally acceptable if and only if it meets the categorical imperative. The argumentation that we can use does depend on which formulation of the categorical imperative we take.

First, let's examine the first formulation: the universality principle. 'Act only on that maxim which you can at the same time will that it should become a universal law.' To defend that an action h is morally acceptable, we now use **reductio ad absurdum** (or **proof from the absurd**). We take the action 'not h' and make a universal law of it. Now we show that this will lead to morally unacceptable situations. Thus, there is a contradiction and h must be morally acceptable.

The just described method often works. But there are some problems attached to it. It can be very hard to find 'not h'. And this is because, in real life, things are virtually never a matter of yes/no and true/false. For example, is the opposite of 'I like you' perhaps 'I'm not that fond of you' or is it 'I really hate you'? There is no obvious answer, because there are simply several degrees of 'liking someone'.

Now let's examine the second formulation: the reciprocity principle. 'Always act as to treat humanity, whether in your own person or in that of any other, in every case as an end, never as means only.' Let's suppose we want to apply this principle to an action. When doing this, we must ask whether the persons effected by the action would agree to the means and the end of the action. If they do, then the action is morally acceptable.

3.2.4 Argumentation in virtue ethics

In virtue ethics, an action is morally acceptable if and only if that action is what a virtuous agent would do in the circumstances. A **virtuous agent/person** is someone who acts virtuously: he exercises the virtues. But how do we decide what a virtuous person is like? To find this out, we can use **characteristic-judgment argumentation**. It states that, if some person X displays certain characteristics $s_1, \ldots, s_n$, then an action A is justified for person X.

The characteristic-judgment argumentation has several important assessment questions. Does X really have the characteristics $s_1, \ldots, s_n$? And does having $s_1, \ldots, s_n$ really mean that action A is justified? Is it true that no more/less characteristics are required to justify A? Only when all these assessment questions can be answered positively, will the characteristic-judgment argumentation be a sound argumentation.

4. The ethical cycle

Ethics problems are difficult to solve. It is very hard to come up with a general strategy to tackle ethics problem. But there is one such strategy: the ethical cycle. We'll discuss it in this chapter.

4.1 The ethical cycle

4.1.1 Ill-structured problems

Mainstream ethics has been dominated by **rational foundationalist approaches**. They try to search for one, or a limited number, of basic moral principles that can solve every ethical problem. However, they fail to see that solving ethical problems is really rather complex. This is because moral problems are **ill-structured problems**.

You may wonder, what characterizes ill-structured problems? Well, ill-structured problems have no definitive formulation of the problem, they may embody an inconsistent problem formulation, and they can only be defined during the process of solving the problem. Also, ill-structured problems don't have just one perfect solution. Instead, they may have several alternative satisfactory solutions. Thus, solving ill-structured problems is not only about analyzing the problem and choosing/defending a certain solution. Instead, it is also about finding new solutions. (This is called **synthetic reasoning**.)

4.1.2 The ethical cycle

Although solving ethical problems is complex, we do need a systematic approach to solve them. This prevents the application of mere gut-feeling and other shortcuts. And luckily, there is such a systematic approach: the **ethical cycle**. The ethical cycle is displayed in figure 4.1. It consists of five important steps, which will now be discussed.

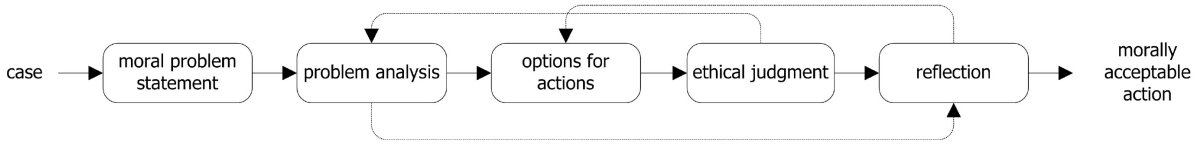

Figure 4.1: The ethical cycle.

1. The start of the ethical cycle is the **formulation of a moral problem**. A special case of a moral problem is the **moral dilemma**. In this case, there are two positive moral values/norms that cannot be fully realized at the same time. Instead, one action only realizes one moral value, while another action realizes the other moral value. But in real life, there are often more options for actions. So, in the ethical cycle we will mainly just consider basic moral problems.

   A good moral question/problem statement must meet three conditions. It must clearly state what the problem is, it must state for whom it is a problem, and it must be clear why/how it is a moral problem. However, it will often not be possible to fully formulate the moral problem precisely when the ethical cycle is started. In this case, we can start with a relatively vague formulation, and try to make it clearer as we solve the problem.

2. Secondly, there is the **problem analysis**. During this step, the relevant elements of the moral problem are described. There are three important elements: the interests of the stakeholders, the relevant moral values and the relevant facts. Sadly, facts aren't always entirely clear. If this is the

case, then we can formulate things in a hypothetical form. 'If x is the case, then choose action A. If y is the case, choose B.'

3. Next, we need to **generate possible options for actions**. During this step creativity is of major importance. Also, the **strategy of cooperation** can be useful to find alternatives. In this strategy, stakeholders are consulted for possible actions to solve the problem. This may often lead to win-win situations. And, next to the standard options, the option of whistle-blowing should also be kept in mind as a last resort.

4. During the **ethical evaluation** step, the moral acceptability of the various options for action is evaluated. This can be done on the basis of **formal frameworks** and **informal frameworks**. Formal frameworks include codes of conduct and ethical theories like utilitarianism, duty ethics, etcetera. Examples of informal frameworks are **intuition** and **common sense**. When using intuition, you choose the action that is intuitively most acceptable. When using common sense, you weigh the options for the possible actions, in the light of the relevant values. You then choose the best action.

5. Different ethical frameworks don't always lead to the same conclusion. Therefore, a **reflection** on the outcome of the previous step is necessary. The result of this step should be a choice for one of the possible actions. One approach for reflection is the **wide reflective equilibrium**. The basic idea of this method is that different ethical judgments are weighed against each other and brought into equilibrium.

   Central to reflection is argumentation. Arguments for/against ethical frameworks can be positioned at two levels. On the **first level**, you can criticize the ethical frameworks themselves in general. On the **second level**, you can argue about the concrete situation in which certain frameworks have been applied.

It must be noted that the ethical cycle is a cycle. So, it's no shame to go back a few steps to, for example, adjust the problem formulation. Instead, that is the goal of the ethical cycle! (Why else would they call it a cycle?)

4.1.3 Moral deliberation

The ethical cycle is often performed by an individual. But in real life, the chosen action will often affect other individuals as well. One may wonder whether it is justified that one person's choices affect other person's lifes.

One way to solve this problem, is by engaging in a **moral deliberation** with the people involved. By discussing the ethical cycle with other involved people, you will be able to make a more educated choice. And, you will not have to choose about other people's lifes without them being able to at least give their opinions.

5. Ethics in engineering and research

Applying ethics in fields like engineering and research poses new challenges. In this chapter, we'll take a look at what specific challenges this actually poses, and how they can be solved.

5.1 Ethics in engineering practice

Although some people may believe otherwise, technological developments raise a whole range of ethical issues. (Think, for example, of the cloning of people, and privacy issues related to surveillance systems.) Therefore, engineers need to be able to make ethically responsible decisions. And, no matter what some people might say, engineers will always be (at least partly) responsible for what is done with technologies that they have developed.

5.1.1 Ways for engineers to influence effects of technology

Some engineers think that they are relatively powerless in influencing the eventual effects of the things they develop. But the truth is that engineers make a lot of smaller choices that do matter from an ethical point of view. Let's take a look in what ways engineers can influence the effects of technology.

The first way in which engineers can influence the effects of technology, is through **requirements**. This is because requirements form the foundation of the design of a system. By setting the right requirements, engineers will be able to influence the effects of the developed product/technology. Important requirements related to moral issues concern safety, human well-being, animal well-being, welfare, privacy, justice, sustainability, environmental care, and so on.

A second way to apply influence is through engineering design. **Engineering design** is defined as the process in which certain goals/functions/requirements are translated into a blueprint/artefact/system/service that can fulfill these functions. A design often has several (partially) conflicting requirements. During the design process, decisions are made about the relative importance of these requirements. (For example, do we add extra mass to a car to increase safety, thus reducing its sustainability?) Again, the engineer will be able to influence the effects of the developed technologies.

The third topic we will look at is the **trade-off**. Engineers usually have to choose between different alternatives that fulfil the same or similar functions. In engineering practice, there are several ways to choose between alternatives. Let's look at a few options.

- The **cost-benefit analysis** is a utilitarian method. The social costs and benefits of all options are compared, and the option with the largest net social benefit is chosen.
- When using a **multi-criteria analysis** we give scores to all alternatives on a set of criteria. These criteria theirselves also may have different weights. Eventually, the option with the highest overall (weighted) score is chosen.
- We could **set a threshold** (or a minimum value) for every criteria. Each design that meets all the thresholds is considered satisfactory. Although no trade-offs have to be made, it may now occur that the analysis will result in multiple options, or no options at all.
- An alternative to the above three options is to simply **look for new alternatives** that perform better on all design criteria. This method does require a lot of creativity though.

Which of the above method is best suited depends on the situation.

5.1.2 Risks

Technologies often have unintended and undesirable side-effects. If such a hazard is known beforehand, we usually speak of a **risk**. In fact, risk is usually defined as the product of the probability of an undesired event and the effect of that event. Making safe technologies, by reducing hazards/risks, is an important ethical duty of engineers. So how can we reduce risks?

- We can make an **inherently safe design** that avoids dangers. Sadly, this is not always possible.
- We can apply **safety factors**.
- We can use **negative feedback**. When a device fails or an operator loses control, a negative feedback mechanism can make sure that the system is shut down, thus preventing it from doing serious damage.
- We can install **multiple independent safety barriers**.

In general, risks should be as small as possible. But, reducing risks is not always feasible or desirable. If the cost of a small risk reduction is, for example, very high, then it may not be worth while.

It must also be kept in mind that risks are hard to compare. First of all, not all risk assessments are equally reliable. Secondly, risks are often multidimensional. (Although a risk can be expressed in a one-dimensional number, the consequences may concern several fields, like human fatalities, property damage, environmental damage, etcetera.) Thirdly, the question is whether people voluntarily take risks. Next to this, also the benefit of taking the risk matters. Finally, it is important to check whether there are any available alternatives.

5.1.3 Scripts

Scripts are certain prescriptions that are built into technical products. These prescriptions influence how people behave and/or how they perceive the world. Some scripts may **exclude** groups of people from using the product. This is often the case when certain presuppositions about the users of the product have been made. (For example, in the case of a can opener, a presupposition about the strength of the user is made. Elderly people might not satisfy this presupposition and can thus not use the product.) This actually may become problematic when people are excluded from a certain vital service/product for which no affordable alternatives are available.

Scripts can also be used to **moralize users**. (An example here are automatic seatbelts. A car will not start, until the automatic seatbelts are used.) Such scripts have a positive effect: they may improve, for example, the safety of a product. However, they also limit the freedom of the user. When choosing to apply a script, the engineer has to wonder whether the advantages outweigh the disadvantages.

5.2 Responsibilities for research integrity

5.2.1 Responsible scientific research

To improve our technologies, we have to do research. Performing research in an integer way is very important. In fact, every researcher has the responsibility of **research integrity**. Research integrity encompasses several things: deal fairly with others, be honest about your methods and results, protect the welfare of research subjects, ensure laboratory safety, protect the health/safety of the public, and so on.

Still, things occasionally tend to go wrong in research. Only in very rare cases is this caused by **deliberate wrongdoing**. Instead, **honest mistakes** are much more common. To prevent such mistakes, often peer

reviews are held before scientific work is published. Also, some researchers like to replicate their results, to make sure no errors have been made. However, this is of course not always possible.

5.2.2 Research misconduct and fraud

Let's suppose that we are dealing with **research misconduct**: research has been done in a non-integer way. First, we have to ask ourselves, what actually counts as research misconduct? Research misconduct only covers wrongdoing related to scientific research. Three main acts can now be distinguished.

- **Fabrication** is the making up of data or experiments. This is often done by people who believe to know what the outcome of experiments will be, but (for some reason) can't wait for the results. Only in very rare cases does one use fabrication to support a conclusion which he himself doesn't believe to be true.
- **Falsification** is the changing or misrepresenting of data or experiments. This is often caused by **data selection**. In scientific research, certain experiments often need to be discarded. (For example, when measurement inaccuracies have occurred.) This data selection should be done legitimately: the method of selection should be clear and objective. If, on the other hand, the researcher only takes the measurements that support his hypothesis, he is **'cooking the data'**. The goal of this generally is to improve the strength of the evidence of the researcher.
- **Plagiarism** is the representing of the work or ideas of another person as one's own.

There are often discussions whether other serious deviations from accepted practices should also be considered as research misconduct. However, if this would be the case, then any novel/unorthodox research would be considered as research misconduct. Thus, innovation is suppressed. And this is undesirable. As such, research misconduct generally only consists of the above three acts.

Next to research misconduct, there is also **fraud**. Although fraud is often used to describe research misconduct, there is a difference. For fraud to be present, there should first be a person that intends to deceive others. Next to this, damage also has to be caused by this deception. Only when there is both deception and damage, do we speak of fraud.

Another method of deception is a **hoax**. The goal of a hoax is to deceive others only for the sake of deceiving them. However, hoaxes are rare in engineering and science.