Professional Ethics

HS-219

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RISK, SAFETY, AND ACCIDENTS

DEFINITIONS

Risk: The possibility of suffering harm or loss.

Safety: Freedom from damage, injury, or risk.

Safety and risk are essentially subjective and depend on many factors:

SIX FACTORS

1. Voluntary vs. involuntary risk

Many people consider something safer if they knowingly take on the risk, but would find it unsafe if forced to do so.

If you buy a house near a plant that emits low levels of a toxic waste into the air, you are willing to assume the risk for the benefit of inexpensive housing. However, if you are already living near a plant which you did not know emits toxic fumes and are only now informed about it, the risk will appear to be larger. Because this risk is not voluntarily assumed or taken. Voluntarily assumed risk mostly seems to be smaller.

2. Short-term vs. long-term consequences

Something that might cause an illness or handicap/disability that will not last long appears to be safer than something that will cause permanent handicap/disability.

An activity/sport that might result in a fractured limb seems safer or less risky than an activity/sport that might be the cause of a spinal fracture that will result in lifelong handicap/disability. The former is painful but short-lived. The latter is permanent.

3. Expected probability

Most people consider a rare chance of a severe injury to be an acceptable risk whereas a 50:50 chance of a minor injury might be unacceptable.

A beach with a low risk of a shark attack is, for most people, less dangerous or unacceptable than one with a much greater probability of a jellyfish sting since it is known to have plenty of the creatures. Even though the former may be fatal (result in death) or cause lifelong disability through dismemberment while the latter would only be temporarily painful and cause no permanent damage.

4. Reversible effects

Something will seem safer or less risky if the negative effects are ultimately reversible.

An injury such as a fracture or an illness such as a fever are mostly healed or cured and thus are not permanent or irreversible. On the other hand, lung cancer, that may be caused by toxicity in the air, can be ultimately incurable and fatal.

5. Threshold levels for risk

Something that is risky only at fairly high exposures will seem safer than something with a uniform exposure to risk.

Driving a car entails uniform exposure to risk. An accident can be caused any of the times that you drive. But high levels of exposure to nuclear radiation can cause severe health problems, disability, or death. But if the levels of nuclear radiation are low or controlled, the radiation would seem to most people to be less risky than driving a car.

6. Delayed vs. immediate risk

An activity or experience whose harmful effects will be delayed for many years will appear to be less risky than an activity that may result in immediate harm or injury.

The negative impacts (such as diabetes or heart failure) for health of a high-fat diet are mostly unavoidable, and even fatal, but they are not immediate. So people are less careful in their eating habits. The risk is somewhere in the distant future. The same people might find activities such as bungee-jumping and skydiving to be unacceptably risky. Even though if the latter may cause death, the former may also do the same.

Thus whether an activity or experience is safe or risky depends on who is asked. Risk and safety are matters of individual perception. A person may find diving into a pool from substantial height to be a fun-filled activity whereas another person may consider it to be risky in terms of being life-threatening. Hence, risk and safety are subjective matters.

In the profession of engineering it is ultimately the decision or judgment of the engineer or the company management as to whether a project or assignment is safe or risky to undertake.

SAFETY FOR ENGINEERS

How can an engineer be confident that his/her designs or products are safe?

There are **four criteria** for this:

1. Compliance with laws

This is the minimum requirement. Your design or product must meet the safety standards outlined and required by applicable laws. (Legal standards for product safety are usually available in published form and are well known.)

2. Compliance with the standard of "accepted engineering practice"

You cannot create a design or make a product that is less safe than what every engineer understands and agrees to be acceptably safe.

Even if safety laws do not require a certain safety standard to be applied, an engineer must pay heed to the standards that are considered a given in their profession.

In order to keep up with the continually upgrading "accepted engineering practice", a responsible and conscientious engineer will keep upgrading their knowledge and skills through attending conferences, seminars, workshops, and courses, through discussing issues with other engineers, and through perusing trade magazines and journals for information on the currently applied standards in the field of engineering for design or product safety.

3. Alternative designs or products

These must be potentially safer. This requirement is not easy to meet as a good amount of creativity is needed to explore and find alternative ideas or solutions. It goes without saying that such a good amount of creativity can be developed through constant upgradation of knowledge and skill.

4. Foreseeing potential misuses of the product

An engineer must design a product in such a way that even if someone is so insensible (or even foolhardy enough) not to be careful in the use of the product, the probability of harm or injury is minimal. Placing a warning label on a product is not sufficient.

A Final Word

Every product must be rigorously tested in order to assess its safety level. No product must be put into actual use or sent into the market without having been thoroughly tested.

DESIGNING FOR SAFETY

A basic process found in Wilcox (1990) for executing engineering designs includes the following steps:

1. Determine the needs and requirements as well as the constraints.
2. Generate several alternative designs or solutions.
3. Analyze each design or solution to determine its pros and cons.
4. Test all the designs or solutions.
5. Select the best design or solution.
6. Implement the chosen design or solution.

RISK-BENEFIT ANALYSIS

In such an analysis the risks and benefits of a project are assigned dollar amounts, and the most favorable ratio between risks and benefits is sought.

In doing a risk-benefit analysis, the engineer must consider who takes the risks and who reaps the benefits. One must ensure that those who are taking the risks are also the ones who are benefitting. For instance, a hazardous waste site near a population must also benefit the same population.

ACCIDENTS

Categories of accidents

1. Procedural accidents

These are the result of someone not following established regulations and procedures. For example, a pilot flying an airplane at an altitude technically considered to be too low may cause an accident.

2. Engineered accidents

These are caused by flaws in the design. These are failures of materials or devices that don't perform as expected.

3. Systemic accidents

These are characteristic of very complex technologies and the complex organizations that are required to operate them. Example: the airline industry. Running it properly requires the work of many individuals such as baggage handlers, mechanics, flight attendants, pilots, government inspectors, and air traffic controllers. An engineer must understand the complexity of such a system and make an effort to create a design to avert as many mistakes made by the people using the technology as possible.

Source:

Engineering Ethics by Charles Fleddermann