Ethics in Engineering

Sam Fenster

Engineering 101

Safety - Honesty - Competence - Fairness - Faithfulness

“Ethics”

What actions are morally right and wrong:
How to avoid doing harm.

In engineering, typical principles are:

- Public safety and well-being
- Honesty
- Competence
- Fairness
- Faithfulness

- Public safety and well-being

– above all other considerations
(faithfulness to employer / client; trade secrets; …)

– now and in the future
(nuclear vs. CO_2?)

– what you make, what you approve

– when to violate secrecy, or orders

(who is being harmed?)

• Honesty

- not allow public or client to misunderstand effects
- not claim others' work
- admit error

(who is being harmed?)

• Competence

- not misrepresent your expertise
- not do work you're unqualified for
- accurately represent work done
- require / allow **professional development**

(who is being harmed?)

- Fairness

  - comply with **patent, copyright**

(who is being harmed?)

(Intellectual Property

- Using other people's / organizations' work
  - giving credit
  - patent, copyright, trade secret
    - a policy choice: reward ideas,
      but don't deny society their use forever.

)

(who is being harmed?)

- Fairness

  - comply with **patent, copyright**
  - avoid **conflicts of interest**

(who is being harmed?)

(Conflict of interest:

when you can't serve two masters

- between clients
- being paid for a favorable judgment
- asking for / being asked for **kickbacks**

)

(who is being harmed?)

• Fairness

- comply with **patent, copyright**
- avoid **conflicts of interest**
- don't misrepresent the competition
- don't discriminate based on race, sex, ethnicity, religion

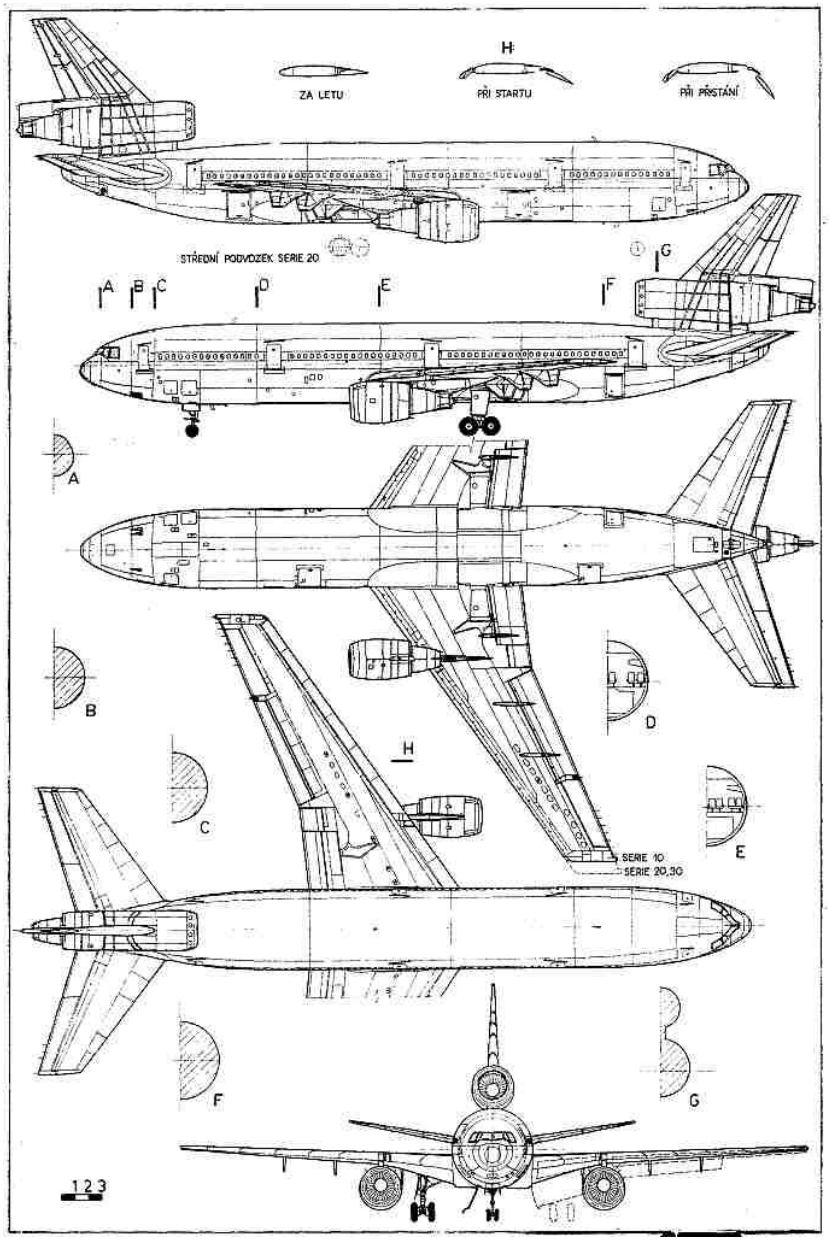
(who is being harmed?)

• Faithfulness

To whom is your duty?
Who are you looking out for?

- honor agreements with client, employer
- keep them informed of status and choices
- avoid *conflicts of interest* with others

Example case:
DC-10


H
ZA LETU
PŘI STARTU
PŘI PŘISTÁNÍ
STŘEDNÍ PODVOZEK SÉRIE 20
A
B
C
D
E
F
G
SÉRIE 10
SÉRIE 20,30
123

Safety - Honesty - Competence - Fairness - Faithfulness

DC-10 engineer:

- *Did* raise the problem to management;
- *Didn't* object when ignored.

- Ethics: safety vs. faithfulness (time & money)

- Mech.E., but planes have electrical & software too.

(More recent: Boeing 737 Max

- Crashes in Oct 2018 & March 2019
- Also 346 deaths.

)

(More recent: Boeing 737 Max

U.S. House of Representatives report:

- Pressures to update the 737's design swiftly and inexpensively
- Faulty assumptions about the design and performance of pilots
- What the report called a "culture of concealment" by Boeing
- Inherent conflicts of interest in the system that deputizes Boeing employees to act on behalf of the government
- The company's sway over top FAA managers

)

(who is being harmed?)

(Regulatory capture:

- When ethics enforcers protect companies they are supposed to regulate,

  rather than the public.

)

Example case: BART

Credit: Thomas Hawk

Example case: BART

- San Francisco area commuter train
- 3 EE's complain of negligent design and testing of control signaling,
- go over management's heads,
- get fired.

Example case: BART

- Events confirm signaling problems.
- Professional society supports the engineers.
- They're out of work 8–14 months.
- BART settles out of court.
- They get a public service award.

Software Engineering

- Badly under-regulated:
  - Privacy
  - Safety
    - voting!
  - Discrimination by A.I.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谷歌
高级搜索
使用偏好
语言工具
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CNET News News Blog, February 6, 2006 7:21 PM PST by Elinor Mills

More students protest Google's China policy

“Students protested Google's China policy at University of California at Berkeley and Stanford University this weekend….

“The students were demonstrating at talks given by Google China President Kai-Fu Lee, who spoke in Chinese about his background and recruitment for Google. In response to questions, he said Google did the right thing in censoring its search site in China.

“Students for a Free Tibet and others protested outside Google's headquarters within days after Google launched its China Web site.”

Other cases

- **Competence:** Emergency dispatch broken by prosecutor case system on same server
- **Faithfulness, honesty:**
  Air Force waste & retribution
- **Job loss, lives saved:**
  Bad nuclear reactor welds
- **Faithful to whom?**
  Refusing work on destructive machinery

[from Unger]

More “Swallowed whistle” cases

- Love Canal toxic waste dumping;
- Ford Pinto’s vulnerable gas tank;
- Space shuttle Challenger disaster and the O-ring.

School

- Why do you submit work?
  - to get feedback
  - to learn to do it right
- Why is it graded?
  - to force you to do it
  - to prove **TO OTHERS** that you know the material
    … with your course grade
    … as part of a degree in engineering

School

- Why is it graded?
  - to prove **TO OTHERS** that you know the material
    … as part of a degree in engineering

- What if the person who built your house
  who taught your class
  who wrote your software
  who you employed
  who you paid for a service
  lied about what they could do?

  (who is being harmed?)

School

What if the person who built your house

lied about what they could **do**?

- So: When you submit something that isn't your work for a grade,
  - (who is being harmed?)
- When others in your class do it,
  - (who is being harmed?)
- When employers see that graduates of <school X> *with good grades* can't **do things** well,
  - **(who is being harmed?)**

1986: Space Shuttle Challenger explodes 73 seconds after launch, killing all 7 crew members. Memo to superiors 6 months earlier:

MORTON THIOKOL, INC. COMPANY PRIVATE

Wasatch Division

Interoffice Memo

31 July 1985
2870:FY86:073

TO: R. K. Lund
Vice President, Engineering

CC: B. C. Brinton, A. J. McDonald, L. H. Sayer, J. R. Kapp

FROM: R. M. Boisjoly
Applied Mechanics - Ext. 3525

SUBJECT: SRM O-Ring Erosion/Potential Failure Criticality

This letter is written to insure that management is fully aware of the seriousness of the current O-Ring erosion problem in the SRM joints from an engineering standpoint.

The mistakenly accepted position on the joint problem was to fly without fear of failure and to run a series of design evaluations which would ultimately lead to a solution or at least a significant reduction of the erosion problem. This position is now drastically changed as a result of the SRM 16A nozzle joint erosion which eroded a secondary O-Ring with the primary O-Ring never sealing.

If the same scenario should occur in a field joint (and it could), then it is a jump ball as to the success or failure of the joint because the secondary O-Ring cannot respond to the clevis opening rate and may not be capable of pressurization. The result would be a catastrophe of the highest order - loss of human life.

An unofficial team (a memo defining the team and its purpose was never published) with leader was formed on 19 July 1985 and was tasked with solving the problem for both the short and long term. This unofficial team is essentially nonexistent at this time. In my opinion, the team must be officially given the responsibility and the authority to execute the work that needs to be done on a non-interference basis (full time assignment until completed).

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could), then it is a jump ball as to the success or failure
of the joint because the secondary O-ring cannot respond to
the clevis opening rate and may not be capable of
pressurization. The result would be a catastrophe of the
highest order - loss of human life.
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@mattblaze writes: "@EdwardTufte's take…

— this was partly a failure of **clear technical communication** (among many other things).

Why **writing (and graphical communication) is an essential part of engineering education.**"

Not always easy to keep in mind: Engineers' obligations to

- Society (including those in the future)
- Employers
- Clients
- Professional associates
  (colleagues, co-workers, subordinates)
- "The profession"

[Unger]

Social policy

- Ethics are not just an individual “everyone for him/herself” responsibility.

- Support from:
  - law
  - engineering societies
  - established procedures within employer

Social policy

- Help from social structures:
  - Protect whistleblowers & intellectual property
  - Establish safety & business standards
  - Professional societies investigate, testify, & legislate

Social policy

Safety - Honesty - Competence - Fairness - Faithfulness

Ethical issues

- Go beyond standards, or merely conform?
- Self-monitoring (individual, organizational)
- Conflicts of interest: who pays for testing?

- **Externalities** — costs you don't see or pay.

- Can an employer constrain your speech or employment?

Professional Codes

Safety - Honesty - Competence - Fairness - Faithfulness

NSPE Fundamental Canons:

Engineers, in the fulfillment of their professional duties, shall

1. Hold paramount the safety, health, and welfare of the public.
2. Perform services only in areas of their competence.
3. Issue public statements only in an objective and truthful manner.
4. Act for each employer or client as faithful agents or trustees.
5. Avoid deceptive acts.
6. Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

Details:

1. **Engineers shall hold paramount the safety, health, and welfare of the public.**
   a. If engineers' judgment is overruled under circumstances that endanger life or property, they shall notify their employer or client and such other authority as may be appropriate.

   b. Engineers shall approve only those engineering documents that are in conformity with applicable standards.

   c. Engineers shall not reveal facts, data, or information without the prior consent of the client or employer except as authorized or required by law or this Code.

. . .

1. **Engineers shall hold paramount the safety, health, and welfare of the public.**

   . . .

   d. Engineers shall not permit the use of their name or associate in business ventures with any person or firm that they believe is engaged in fraudulent or dishonest enterprise.

   e. Engineers shall not aid or abet the unlawful practice of engineering by a person or firm.

   f. Engineers having knowledge of any alleged violation of this Code shall report thereon to appropriate professional bodies and, when relevant, also to public authorities, and cooperate with the proper authorities in furnishing such information or assistance as may be required.

IEEE's code

1. to accept responsibility in making decisions consistent with the safety, health and welfare of the public, and to disclose promptly factors that might endanger the public or the environment;
2. to avoid real or perceived conflicts of interest whenever possible, and to disclose them to affected parties when they do exist;
3. to be honest and realistic in stating claims or estimates based on available data;

IEEE's code

4. to reject bribery in all its forms;
5. to improve the understanding of technology, its appropriate application, and potential consequences;
6. to maintain and improve our technical competence and to undertake technological tasks for others only if qualified by training or experience, or after full disclosure of pertinent limitations;

IEEE's code

7. to seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, and to credit properly the contributions of others;
8. to treat fairly all persons regardless of such factors as race, religion, gender, disability, age, or national origin;
9. to avoid injuring others, their property, reputation, or employment by false or malicious action;

IEEE's code

10. to assist colleagues and co-workers in their professional development and to support them in following this code of ethics.

Professional organizations

- IEEE
- ACM
- ASME
- ASCE
- AIChE
- NSPE

In our curriculum

- Senior Design
- Engineering Economics
- Management Concepts in Engineering

Society depends on the good judgment of engineers.