



University of
Nottingham

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**Department of Mechanical, Materials
and Manufacturing Engineering**

Ethics for engineers

*“What do engineers need to know about
ethics?”*

Ethics for engineers

Objectives – students should be able to

- Understand and be able to apply in context principles of ethics appropriate for engineers.
- Apply the duties and responsibilities of engineers and be aware of the consequences of failing to consider ethics.
- Understand the application of principles of some methods that can be used to help to resolve ethical dilemmas
- Demonstrate knowledge of examples of events or situations in which there are ethical issues to consider.
- Be familiar with codes of ethics and conduct for engineers

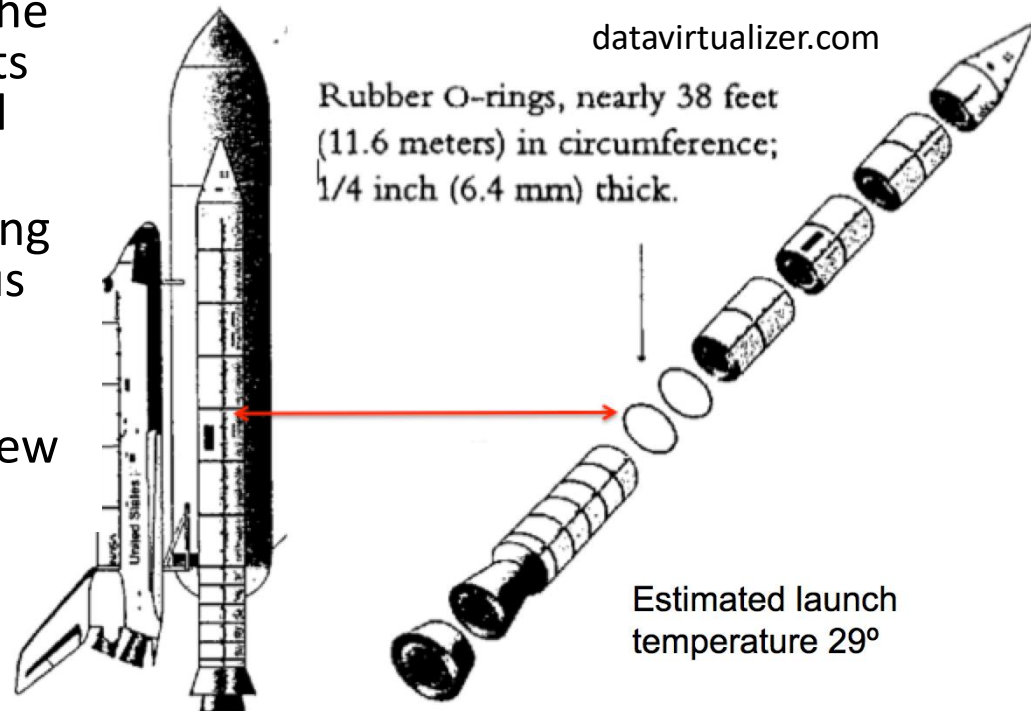
Challenger Space Shuttle

<https://www.youtube.com/watch?v=fSTrmJtHL>
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Challenger Space Shuttle

- 1977 – engineers discover that joints in the booster casing expanded rather than tightening as they were designed to do and O-ring seals (backup seal for the joints) frequently became unseated
- 1981 – a revised design was used for new lightweight versions of the booster but the unmodified joints continued to be used in the steel versions
- 1981-1985 - evidence of scorching and failure of the seals on various flights
- 1985 – decision to “close out” (ignore) the O-ring problem as new designs were being prepared



Challenger – some points to consider

- Jan 27 1986 – the Chief Engineer tried to stop the launch (because of the predicted cold weather and the knowledge that the seals performed poorly in cold weather). This was not successful (pressure from other organisations involved, delayed launches as a result of earlier poor weather)



- What roles did engineers play in this incident? How could they have done things better?
- What made it difficult for the engineers to prevent this incident?

We will come back to this later.

Some questions

- You find some money on the street ...

LOOK, YOU HAVE
CROSSED THE LINE



BUT WE BOTH STARTED
ON THIS SIDE...



You find some money on the street ...

England | Regions

What do you do if you find £20 - is it finders keepers, losers weepers?

By Alex Homer
BBC News

1 March 2017 | [England](#)



A woman who kept a £20 note she found in a shop has been convicted of theft in a case that has prompted a combination of surprise and alarm for some people who think they might have done the same. But what rights do people have if they find something that belongs to someone else?

"Finders keepers, losers weepers" is an old adage that will be familiar to anyone who has lost something and seen it fall into someone else's hands.

But does that principle - effectively saying "tough luck, it's theirs now" - actually stand up to legal scrutiny?

A flurry of reaction to the case on social media saw protagonist [REDACTED] dubbed either "morally wrong" for trousering the £20 note or the victim of harsh treatment for being hauled through the courts.

[REDACTED], from Blurton in Stoke-on-Trent, **was ordered to pay out a total sum more than eight times as much as she pocketed** - £20 in compensation, a £20 victim surcharge and £135 in court costs.

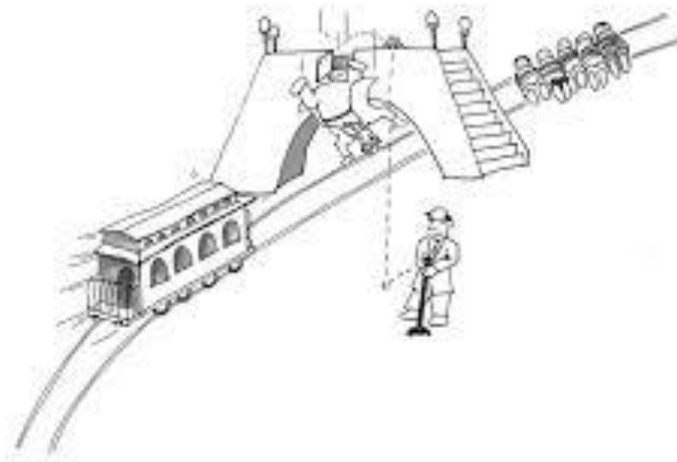
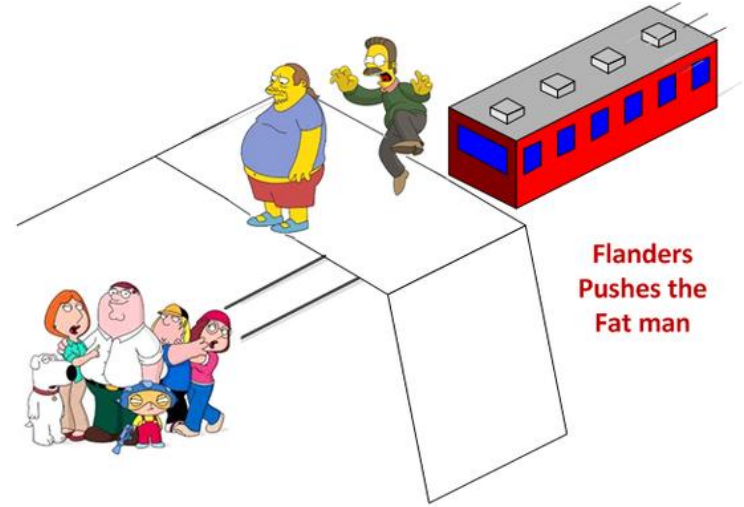
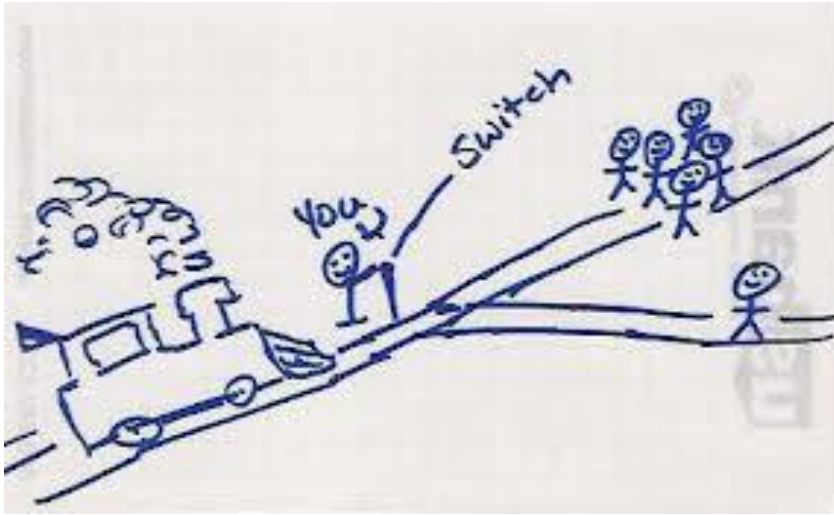
Prof Robert Chambers, an expert in private law at King's College London, said finders did have a right to keep something they discovered, but the "person who lost it still had a right to have it returned".

And the loser had a bigger right in law than the finder, he said.



CartoonChurch.com

The trolley problem



Some findings on these problems

- More people are usually willing to sacrifice the man on the branch line / spur than push the man
- One is killed to save many others in each – what is the distinction?
- You may be able to perform an act with bad consequences if on balance the act is good and the bad effects are unintended
- Utilitarian approach

Utilitarian approach

Greatest benefit for the greatest number of people (see Patankar et al, 2016 or Beabout and Wennemann)

“an action is right if it tends to promote happiness and wrong if it tends to produce the reverse of happiness— not just the happiness of the performer of the action but also that of everyone affected by it”

<http://www.britannica.com>

The consequences of an action are of importance, rather than the motive of the action

<https://www.youtube.com/watch?v=Xa6c30Tr6yA> Mr Spock

Utilitarian approach

- Where do we see the Utilitarian approach being used today?

Another look at driverless cars

- Do you think autonomous vehicles should be designed on utilitarian principles?
- Would you buy a car designed using Utilitarian principles of ethics?



Another look at driverless cars

- Would you buy a car that might kill the single occupant (e.g. you) to save several other people?
- Would vehicles have different moral settings? Who would take responsibility in the event of a fatality (designer, buyer?)

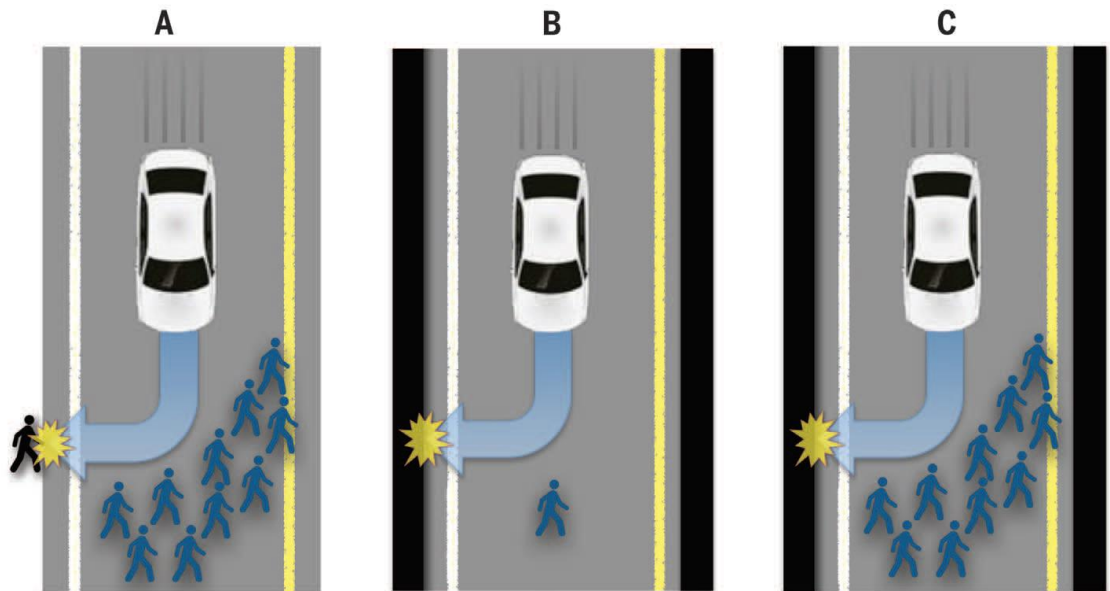


Fig. 1. Three traffic situations involving imminent unavoidable harm. The car must decide between (A) killing several pedestrians or one passerby, (B) killing one pedestrian or its own passenger, and (C) killing several pedestrians or its own passenger. See Bonnefon et al (2006)

Are there alternatives?

- Utilitarian approaches are not the only way. What else could we do to look at these problems?
- Look at the work sheet Exercise 1 after this session.

Exercise 1 – Theories of ethics

Five common theories of ethics are explained briefly below.

1. Match the label with the correct explanation.
2. Think about the theory and search for some details in a quick internet search and then write down some of the common strengths and weaknesses of the theory.

Utilitarianism *Conventional morality* *Egoism* *Duty ethics* *Virtue ethics*

Judging actions on the basis of their effect on the individual performing the action –

Advantages and disadvantages

.....

Morality based on the conventions of society –

Advantages and disadvantages

.....

What are we actually trying to teach here?

What is ethics?

What is professional ethics?

Some definitions?

- Ethics – relates to “ethos” or character ... sometimes considered to be a customary way to behave in a society. ... “how to live well (Beabout and Wennemann 1994, see also Patankar et al 1013)
- Professional ethics – “Special ... standards of conduct governing members of a particular profession because they are members of that profession ... are more than mere ordinary morality or common sense” (Davis, 1993)
- substitute the following engineering ... business ... medical .. research
- <http://www.theguardian.com/world/ethics>

What are we actually trying to teach here?

- *“.... cultivating a student’s capacity to deliberate meaningfully and responsibly about ethics” rather than ... “teaching a single decision procedure or recommending a particular set of values, principles or norms”.*

(Matchett, 2008)

What skills and knowledge do you need to be able to do this?
What principles can you apply? e.g. moral principles?

Skills and knowledge areas

Teaching ethics to professional engineers (Loui et al 2003)

- Topics in an ethics course
 - Professionalism,
 - responsibility,
 - confidentiality,
 - conflict of interest,
 - risk and safety,
 - relationships between engineers and managers,
 - loyalty,
 - whistle-blowing,
 - codes of ethics,
 - licensing,
 - choosing a vocation

Duties / responsibilities of engineers

(Johnson, 1992)

Multiple duties

- Duties to society
- Duties to employers
- Duties to clients
- Duties to co-professionals and professional organisations

Factors affecting these duties

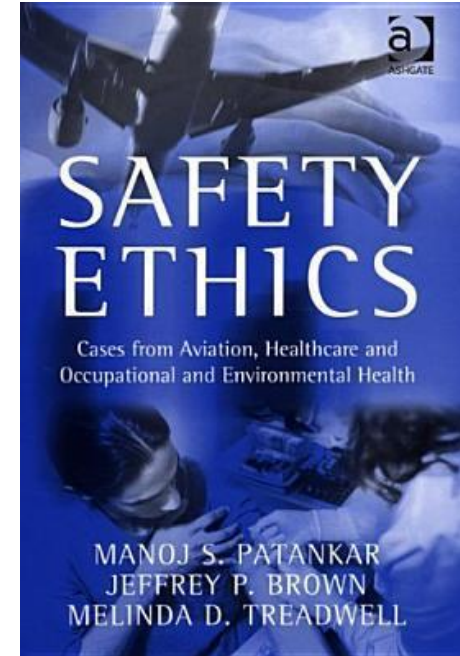
- Conflicts between the duties.
- What is an acceptable degree of risk? Who decides?
- Visibility of the effects of your work
- Limits to what engineers (you) can do (e.g. autonomy, loyalty, whistleblowing, personal and professional risks, things we do not know)

Please think about some examples from each

Moral principles and corresponding duties

Patankar et al refer to the Principles of

- **Respect** – treat yourself and others with respect befitting the dignity and worth of a person
- **Non-malevolence** – avoid harming people
- **Benevolence** – promote well-being of others
- **Integrity** – maintain personal standards worthy of a professional
- **Justice** – be fair and treat people equally in similar circumstances
- **Utility** – choose the action that produces greatest benefit for the greatest number
- **Double effect** – make sure there are no foreseeable side effects that are disproportionate to the good of the main effect.



Engineering Council and the Royal Academy of Engineering- Statement of Ethical Principles

<http://www.engc.org.uk/professional-ethics.aspx> – you should use this link to access more ethical principles for engineers

Four fundamental principles to guide engineers and technicians in achieving the high ideals of professional life:

- Honesty and integrity
- Respect for life, law, the environment and public good
- Accuracy and rigour
- Leadership and communication

Putting this into practice

- How can you put this all together in making decisions?
- Imagine you are a maintenance engineer and your supervisor wants you to sign off on some work that you have not checked. What do you do and why?

From Patankar et al, 2015

Moral decision-making process (Beabout and Wennemann, 1994)

If the **intention** is good, the **motive** is good and the **circumstances** warrant a specific action, an **action** can be ethically permissible, but sometimes the **effect or outcome** may not be desirable

- **Intent** – *what* was the intention (often purposely or knowingly)
- **Motive** – *why* was something done (reason behind the intent, was this morally good)
- **Circumstance** – did the circumstances warrant the action, were there alternatives?
- **Decision** – who made the decision and how and were they prepared to accept the consequences of the decision
- **Action** – are various courses of action considered, do those involved accept the responsibility for their actions?
- **Outcome** – there are often multiple effects and side effects (consequences of side effects should be minimised and these should not be disproportionate with the intended good of the main effect)

Try to apply this to the previous example

Imagine you are a maintenance engineer and your supervisor wants you to sign off on some work that you have not checked. What do you do and why?

Challenger – revisited

What are the main issues to consider?

After the session, work through the questions on the worksheet Exercise 2 part 1, applying the decision-making process from Patankar.

Think about the Moral decision-making process discussed in content for this session on ethics (Beabout and Wennemann, 1994)? What are some of the important things to think about here and were the actions likely to be ethical?

Intent – what was the intention (often purposely or knowingly)

.....

Motive – why was something done (reason behind the intent)

.....

Circumstance – did the circumstances warrant the action, were there alternatives?

.....

During this session we will look in more detail about the circumstances around the important decision of whether to launch.



Challenger – revisited

What are the main issues to consider?

Many reports on this incident also refer to a teleconference on the evening before the launch

- The engineering contractor (Morton Thiokol) was reportedly reluctant to not launch, but it is arguable that there was insufficient consideration of this.
- NASA were “not happy” and expressed opinion in a teleconference that the data were inconclusive
- (offline) Managers from Morton Thiokol looked for evidence to launch and took a vote that excluded the engineers. Apparently there was insufficient deliberation on ethical and safety issues.
- (back online) The Morton Thiokol managers read a list of the rationale that supported the launch
- NASA accepted this with no discussion
- NASA put pressure on Morton Thiokol to prove that it was not safe to launch, rather than prove that it was safe to launch.

See the opening section of the publication by Lynch and Kline (2000) for some salient points about the decision to launch the Challenger Shuttle.



Challenger – revisited

What are the main issues to consider?

Now think about the different meetings and communications that were part of this “decision to launch”.

- Internal at Morton Thiokol – engineers
- Morton Thiokol managers to NASA
- Morton Thiokol managers consulting again with engineers
- Morton Thiokol managers
- Morton Thiokol managers reporting again to NASA
- Internal at NASA

Think in particular about:

- nature of those meetings and type of discussions
- who was involved, their roles?
- what would have been discussed?
- what pressures were people facing?
- what could have influenced their decisions?



Main ethical issues from the Shuttle examples

- Situations are complex leading up to and during decision-making.
- These are not simple situations and decisions are rarely taken by an individual, with all of the information that is needed to hand.
- Insufficient deliberation of ethical and safety issues, over longer timescales of projects or immediately before an event
- Exclusion of experts in decision making / other competing interests
- Poor team / group dynamics, cultural influences
- Difficult decisions, uncertainty, incomplete information
- Poor organisational practices
- Normalisation of deviance – See Vaughan

- Problems with organisations, hierarchies, group dynamics

Otto R. Lerbinger, Professor of Communications at Boston University.

"In a group trying to move ahead with a decision, you find that those people that have anything negative to say are unpopular, so a manager deliberately has to encourage people taking the devil's advocate position. In a crisis situation, somebody has got to think about the possibility of something going wrong, and to use a worst case scenario approach".

Using case studies (like Challenger)

- Scenarios enable consideration of Individual decisions, though more likely as part of a group – team dynamics, organisational culture are important
- These can be broadened to consider implications of engineering for societal issues – e.g. impact of new technology on the community
- Focus on the ordinary rather than the extraordinary – realistic, engaging, provocative
- Enable discussion, taking different perspectives
- Real events, adapted from real events, developed by students

Summary

We have looked at

- Some **definitions** of ethics, **theories** and **moral principles**, including reasons why an engineer needs to have a good understanding of ethical principles
- Some ethical **decision-making / problem solving approaches**
- Ethical / social responsibilities as a person, responsibilities and practices of engineers as a professional group (professional responsibilities) – **multiple duties** and the **factors** that can affect these
- Examples of ethical issues from **major incidents** or other engineering scenarios
- **Codes of conduct / ethical principles**

Some questions to leave with you

- Is a technology safe and does it contribute to the welfare of society? What role does an engineer have in relation to the safety of a product that they are developing? Who has the final say on this?
- How do engineers solve problems associated with things that might happen in the future (i.e. the need for foresight)? Will engineering solve humanity's social problems?
- Should an engineer be involved in the design of weapons or an organisation where there is use of unfair labour?
- Engineers (as well as others) are sometimes in a position in which they can harm other people. How should they deal with this?

Any Questions?

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