



Engineering Responsibilities and Ethics

Study Skills

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Societies Expectations of Engineers

Society needs Engineers

What have engineers contributed to society:

Engineering is behind everything!

- **Cars**
- **Computers**
- **Aircraft**
- **Buildings**
- **Roads**
- **Facilities Infrastructure**
- **Communications Equipment**
- **The list is endless.....**

Society demands continual progress and evolution

What Society doesn't tolerate

Failure!



Professional Responsibilities

Engineers have a duty of care to ensure their work is ethical and safe

Society not only expects, but requires engineers to work to the highest standards

By upholding these standards and engineer will:

- **Protect members of the public**
 - **Protect themselves**
- **Protect and enhance the reputation of the profession**

This is expected by society, employers and professional bodies (IMechE)

Codes of Conduct

Professional bodies publish codes of conduct

Institute of Mechanical Engineers (IMechE) publish their Code of Conduct

[https://www.imeche.org/docs/default-source/governance-documents/code-of-conduct-regulations-\(5-12-18\).pdf?sfvrsn=2](https://www.imeche.org/docs/default-source/governance-documents/code-of-conduct-regulations-(5-12-18).pdf?sfvrsn=2)

Code of Conduct has 4 main expectations:

1. Practice competently & maintain up to date skills
2. Act with integrity & respect for others
3. Promote sustainability
4. Exercise engineering leadership

The ethical basis that engineers should work to



Practicing Competently

Engineers should recognise their limitations

Only conduct work in their specific areas of competence

Identify and limit risk involved in the work wherever possible

Actively pursue the best outcome for all concerned

Continually increase their knowledge and range of competencies (CPD)



Continual Professional Development

Moore's Law: Technology doubles every 2 years

Continued Education:

- Seminars
- In house training
- Conferences
- Write & Publish papers/journal articles
 - Postgraduate education

Become a member of a Professional Society:

- Institute of Mechanical Engineers (IMechE)
 - Incorporated Status
 - Chartered Status

Career opportunities & Salary benefits



Acting with Integrity & Respect

Engineer should never mislead others, or knowingly allow them to be misled

Respect confidentiality

Avoid deceptive or corrupt acts

Refuse any attempt at bribery

Declare conflicts of interest

Not to implicate others in matters they have no knowledge over





Promoting Sustainability

Engineers have an ethical responsibility to sustainability

Socioeconomic & Environmental factors

Never knowingly exploit environmental resources

Balance present and future requirements

Look to develop sustainable, alternative solutions





Exercise Engineering Leadership

Engineers should strive to continually improve the public perception of the profession

Actively participate in discussions on their area of competence

Use their expertise to contribute to discussions in a truthful and meaningful manner

Act when malpractice and risk is identified

Encourage diversity within the profession

Support the ethical position of the professional body, for the betterment of the profession



What Constitutes Risk and Managing Risk

Health & Safety Risks

Engineers do not just design products

Engineers commonly design processes used in manufacturing, testing and recycling products

Considerations for local risk factors must be given

Health & Safety in the Workplace



Health & Safety Risks

**Why should engineers care about health and safety
in the workplace?**

(2019/2020 HSE Statistics)

111 Workplace Deaths

65,427 Reported Workplace Injuries

38.8 Million Workdays Lost

£16.2 Billion Cost to industry

**1.6 Million people suffering from work related
illnesses**



HSE

**Health & Safety
Executive**

Understanding H&S Risk Areas

Employers and Employees are both responsible for health and safety at work

Very large topic area:

<https://www.hse.gov.uk/pubns/priced/hsg268.pdf>

Some of the main topic areas:

- **Employer & Worker Responsibilities**
 - **Electrical Safety**
- **Control of Substances Hazardous to Health (COSHH)**
 - **Machinery, Plant & Equipment**
 - **Personal Protective Equipment (PPE)**

Health and Safety in the workplace is ever evolving, but an engineer should always be aware of the latest requirements to mitigate risk



Managing H&S Risks

Assessment of the potential risk

First stage use Risk Matrix

Identify a potential risk

How likely is it to occur?

How severe will it be if it occurs?

What action should be taken:

- Care
- Caution
- Alert
- Stop

Risk Matrix		Likelihood of Occurrence			
		Very Unlikely Little or no chance of occurrence	Unlikely A rare combination of factors would be required for an incident to result.	Possible Not certain to happen but an additional factor may result in an accident	Probable More likely to occur than not
Hazard Severity	Minor No or minor injury (first aid)	CARE	CARE	CARE	CAUTION
	Moderate Off-site medical treatment or DAFW*	CARE	CARE	CAUTION	ALERT
	Serious More than one DAFW, long-term absence	CARE	CAUTION	ALERT	STOP!
	Major Permanent disability or harm, fatality	CAUTION	ALERT	STOP!	STOP!

*DAFW – Day Away From Work

CARE	Minor harm possible, serious harm very unlikely to occur; implement controls and ensure care is taken when performing activity.
CAUTION	Minor harm probable, major harm unlikely to occur; follow all control measures, increased level of competence required and ongoing self-assessment of risks identified.
ALERT	Moderate degree of harm probable but major harm unlikely; critically assess the risks and appropriate controls. Specific competence required and ongoing assessment of risks by individual and/or supervisor.
STOP!	Serious or major harm will probably occur; stop the activity and critically assess the risks, review safety aspects of activity and implement further, appropriate controls. Consider referencing HSE or other Best Practice, consider involving HSS.



Managing H&S Risks

Risk matrix can be expanded to a risk assessment

Identify all possible risk areas beyond just personal injury

Assess the criteria:

- Likelihood of Occurrence
 - Severity of Risk
 - Impact of Risk

Details who is responsible

What mitigating actions should be taken

Project name: Common project risks

ID	Date raised	Risk description	Likelihood of the risk occurring	Impact if the risk occurs	Severity <i>Rating based on impact & likelihood.</i>	Owner <i>Person who will manage the risk.</i>	Mitigating action <i>Actions to mitigate the risk e.g. reduce the likelihood.</i>
1	[enter date]	Project purpose and need is not well-defined.	Medium	High	High	Project Sponsor	Complete a business case if not already provided and ensure purpose is well defined on Project Charter and PID.
2	[enter date]	Project design and deliverable definition is incomplete.	Low	High	High	Project Sponsor	Define the scope in detail via design workshops with input from subject matter experts.
3	[enter date]	Project schedule is not clearly defined or understood	Low	Medium	Medium	Project Manager	Hold scheduling workshops with the project team so they understand the plan and likelihood fo missed tasks is reduced.

Managing Risk for Products & Processes

What is FMEA?

FMEA – Failure Mode Effect Analysis

This type of analysis can be applied to many aspects of the automotive industry:

- **Design**
- **Product Development/Improvement**
- **Logistics**
- **Manufacturing**

Any process where there may be safety critical considerations can have FMEA applied

FMEA allows assessment of a product/process to determine where a failure may occur and the severity of the potential failure

Can be applied in advance or retrospectively

6 Main Stages of FMEA

Identify a Failure Mode

Likelihood of Detection

Severity Number

Probability of Occurrence

Risk Priority Number

Recommended Actions



What each Stage Involves

Detect a Failure Mode:

Identifying what potential failures could occur in the process/component

This can be predicted at design stage or based on real world failures

Likelihood of Detection (D)

How likely is it that the failure will be detected before it causes a catastrophic issue, ranked 1-10, 10 worst.

What will the identifiers be prior to failure?

Severity Number (S)

Ranking the severity of the potential failure on a numeric scale 1-10, 10 worst.

This can be a business case (process) or risk to life/injury (component failure)

Probability of Occurrence (P)

How likely is it that this identified failure will occur, ranked on a numeric scale 1-10, 10 most likely.

Some serious failures may be extremely unlikely to occur

Risk Priority Number (RPN)

Mathematical formula applied to determine which potential failures require the most attention

$$RPN = S \times P \times D$$

The higher the RPN the more effort should be put into resolving the issue

Recommended Actions

What can be done to mitigate the potential impact of the failure, or stop the failure from occurring at all

Calculating RPN Values

Analysis conducted on assembly line process for automotive plant

Assessing potential failures/issues surrounding seat belt installation stage

RPN shows how the ranking system works to identify the most important failure to address

FAILURE MODE & EFFECTS ANALYSIS (FMEA)				Date:	1/1/2018
				Revision:	1.3
Process Name: Left Front Seat Belt Install		Process Number: SBT 445			
Failure Mode	A) Severity Rate 1-10 10=Most Severe	B) Probability of Occurrence Rate 1-10 10=Highest Probability	C) Probability of Detection Rate 1-10 10=Lowest Probability	Risk Preference Number (RPN) AxBxC	
1) Select Wrong Color Seat Belt	5	4	3	60	
2) Seat Belt Bolt Not Fully Tightened	9	2	8	144	
3) Trim Cover Clip Misaligned	2	3	4	24	

Important Considerations in FMEA

Murphy's Law:

"Anything that can go wrong, will go wrong"

Well structured FMEA should assess the possibility of ANYTHING happening, no matter how unlikely it may seem!

Using a consistent weighting system for ranking the different areas is important so as not to skew the RPN results

Consideration should always be given to both the immediate failure, but also the processes of detection and prevention. This will create a much more robust process that should eliminate the possibility of serious failures