

University of Wales Trinity Saint David

Wales Institute of Science & Art



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Engineering Skills Technical Report

Academic Skills (ACHA4022A)

Owain Holgate

2404061

Date (12/2025)

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Introduction

This report will cover a range of topics that are of importance to an engineer and their team. It will begin with a chapter on Health & Safety followed by a risk matrix. This will be followed by a chapter on an engineer's role in society and a chapter on problem solving for an engineer. It will conclude with a chapter on team structure with a firsthand report of an experience of working with a team and finish with an overall conclusion of the report.

Health & Safety with Risk Assessments

Safety with The Lathe

When operating the lathe, it is important to ensure that the following safety procedures are followed. Remaining safe while using the lathe is of utmost importance to ensure that the operator of the lathe and any occupants around are not injured.

PPE and Clothing

Wearing PPE is of utmost importance while operating the lathe. It is required for the operator to wear both safety glasses and closed-toe shoes. Users must also ensure they are not wearing any loose-fitting jewellery or clothing and long hair must be tied back.

The Lathe

The lathe can be a very dangerous machine, this is why it is of utmost importance to ensure the whereabouts of the emergency stops on the machine are. Along with this it is important to check that there is no damage to the lathe itself as this can pose a large safety risk. Ensuring the area around the lathe is clear and tidy is also important while operating the machine.

Potential Hazards	Risk	Actions in place
Clothing/Jewellery/Hair getting caught in the lathe	Crushing or amputating limbs, death	Ensuring no loose-fitting items are being worn Having long hair tied back Ensuring lathe is only used while protection guard is down
Hands getting caught in lathe	Crushing or amputating limbs, death	Ensuring lathe is only used while protection guard is down Not putting hands near any moving parts while lathe is active
Flying debris	Burns, eye damage	Ensuring eye protection is worn at all times Maintaining a safe distance from the cutting tool while it is still active
Cutting tools and sharp edges	Cuts and lacerations	Maintain care while handling sharp cutting tools during attachment and dis-attachment Clean sharp edges and cutting tools with a brush and not hands

(Cornell University)

(Health and Safety Executive)

Security Risk Matrix

		Risk Assessment Matrix			
		Severity			
		Catastrophic - 4	Critical - 3	Marginal - 2	Negligible - 1
Probability	Frequent - 4	High (16)	High (12)	Serious (8)	Medium (4)
	Probable - 3	High (12)	Serious (9)	Serious (6)	Medium (3)
	Remote - 2	Serious (8)	Serious (6)	Medium (4)	Low (2)
	Improbable - 1	Medium (4)	Medium (3)	Low (2)	Low (1)

1. Sensors failing (risk 9)

Autonomous vehicles use a wide verity of sensors to detect hazards in the road whilst the car is driving itself to ensure the safety of the occupants. Unfortunately, these sensors can sometimes fail due to a variety of reasons. One of the most common issues across almost all the sensors is the fact that they struggle under certain weather conditions, primarily when it is extremely rainy or foggy. Another issue that a lot of sensors face is an issue with detecting against reflective surfaces causing potential false readings or not detecting at all.

(MDPI/ Francisco Matos, Jorge Bernardino, João Durães* and João Cunha (2024))

2. Cyber-Attack (risk 8)

A cyber-attack on autonomous vehicles can have small to large adverse effects on the autonomous vehicles industry. With the growing number of constantly online technology, the risk of a cyber-attack and its effects are growing. One of these issues is the remote hijacking of autonomous vehicles which can cause mass traffic jams and paralyze city roads in addition to making vehicle thefts easier. The hijacking of autonomous vehicles can also pose a large risk to human life of the people within the vehicle and pedestrians outside the vehicle. A hack on an autonomous vehicle would also negatively impact the vehicles manufacturer as it would lower the public trust while the fear of autonomous vehicles increases.

(Cyber-Expert (2024))

3. Lithium Batteries (risk 12)

Most if not all autonomous vehicles use lithium-ion batteries as a fuel source, however these batteries do pose quite a few risks. These batteries can be quite sensitive to heat, physical damage and manufacturing faults. One of the biggest issues is if the batteries go into a thermal runaway which will cause them to spontaneously combust. This is a large risk as these fires release a toxic gas that can cause another explosion.

Furthermore, with cars having a larger battery these fires can reignite again whilst simultaneously being more difficult to extinguish compared to conventional fires.

(British Safety Council/ Matt Humby (2024))

4. AI and Software failure (Risk 9)

Autonomous vehicles use AI to make decisions while in their self-driving mode. The issue with using AI for decision making is that it can encounter ethical dilemmas it cannot understand. Issues arise when AI might be unable to weigh up human life due to its algorithmic programming. These AI systems can cause difficult legal situations depending on their decision making. In addition to this, the software used in these autonomous vehicles can also malfunction. Slight errors in the systems code can lead to crashes and potential injury or death.

(TFLcar/ Grant Davis (2024))

Highest Risk (Lithium Batteries)

Lithium batteries have been given the highest risk from the risk matrix. Engineers and manufacturers should ensure they have designed a battery that has the lowest risk of malfunctioning and catching flames. In the event that these batteries combust it should be ensured they are in a location in the vehicle that causes the least amount of harm to the occupant and that a fire team may easily access the flames and extinguish the fire quickly.

Engineers Role in Society

Institute of Electrical and Electronics Engineers (IEEE)

The IEEE code of ethics is to ensure that its members are kept to the highest standards of integrity and behaviour. Their code of ethics highlights the importance of integrity and professional conduct through prioritising the health, safety and welfare of the public through multiple means. This includes a need to prioritise ethical design and sustainable development practices. This shows the need for the organisation to maintain a focus on reducing environmental harm. This also includes the need to avoid conflict of interests and avoid unlawful conduct. They also highlight the need for their members to avoid discrimination on all bases and treat their fellow members with respect. They are instructed to avoid any form of harassment and to refrain from committing any act that could cause harm to others, both physically and mentally.

(Institute of Electrical and Electronics Engineers [IEEE])

Institution of Mechanical Engineers (IMECHE)

The IMECHE code of conduct highlights four key areas. It begins by highlighting the need to act competently and with care. It explains how the members must quantify and limit the risk they may face during their work for both themselves and people they may be working with. It also says that they must only work in fields they are competent and disclose any work they may not have the knowledge or training to complete. The code of conduct goes on to say that the need for integrity and respect is of utmost importance. It goes on to say that you should go over work without bias and as accurately as possible. It highlights the need to avoid any acts that could be seen as deceptive or corrupt such as bribery. Its third main point is to focus on sustainability and responsibility for the environment. It explains the need to understand the importance of a diverse environment and to avoid exploiting the earth for natural resources and the needs of future generations. It also explains the need to comply with environmental protection need. Lastly it points out the need of a positive public perception. It explains the need of public discussion in a truthful environment with the advocacy of ethics and rights.

(Institution of Mechanical Engineers [IMECHE])

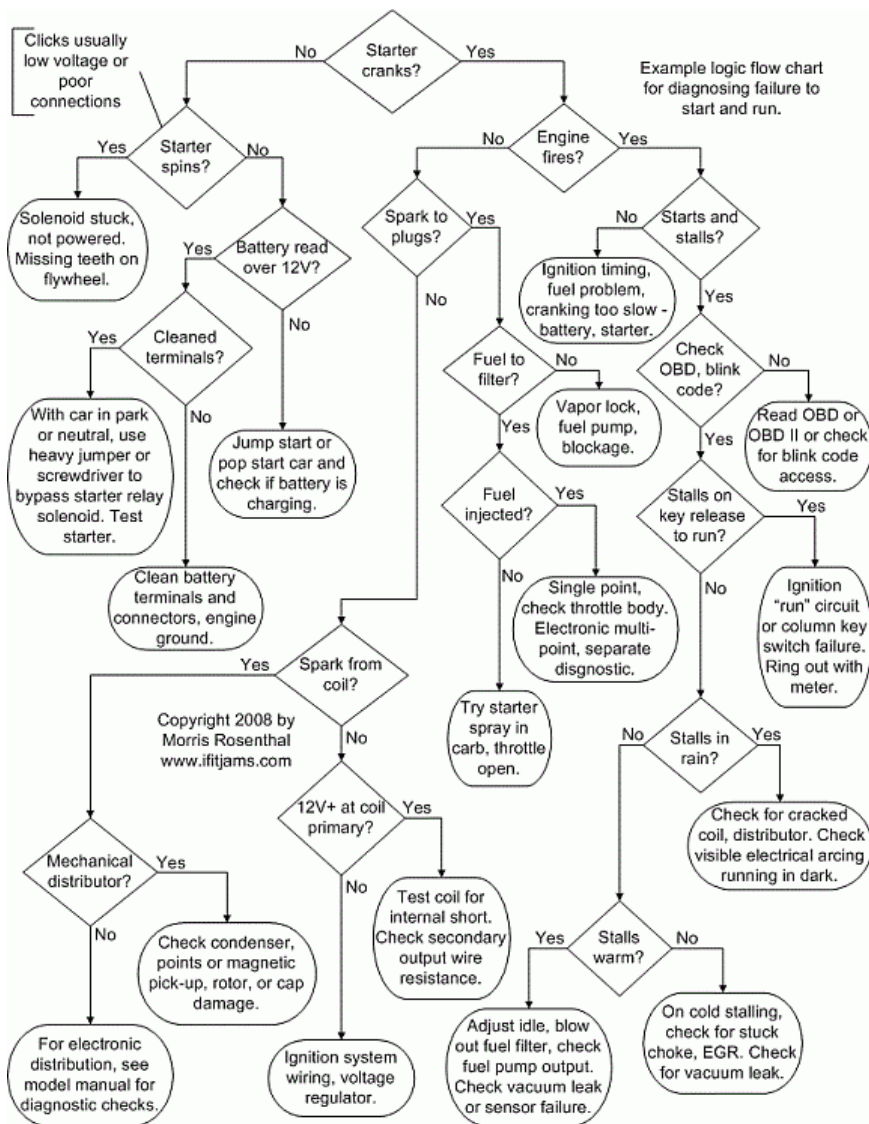
Problem Solving

Engineers use a variety of different measures to solve problems they may face while designing a product. A very common type of problem solving is to do a 10-step program to determine and fix the problem. Firstly, you must clearly identify what the problem is, then you must gather information on your issue and following this generate a wide variety of possible solutions to the issue. After brainstorming multiple ideas, you must evaluate which idea is the most suitable for the issue. Upon deciding on an idea, you begin to plan out the idea fully before beginning to test if the theory works. After creating prototypes of the solution you have created you may implement the solution into your design. Following the implementation, you must monitor your solution to ensure it works and doesn't create further problems. Lastly, upon completion of your monitoring you document the process and solution you have created and communicate it with other members of your team.

(University of Greater Manchester (2023))

One of the most popular ways for engineers to use a flow chart as seen below. Flow charts use different shapes and arrows to create paths to help troubleshoot problems. Typically flow charts use a yes or no format to streamline any problems that may or have occurred during the design process. This allows an engineer to quickly look at the chart and determine what their issue is so it may be resolved quickly. This way of problem solving is a more efficient and faster way of the one seen above.

(miro/ Mandy Bray (2024))

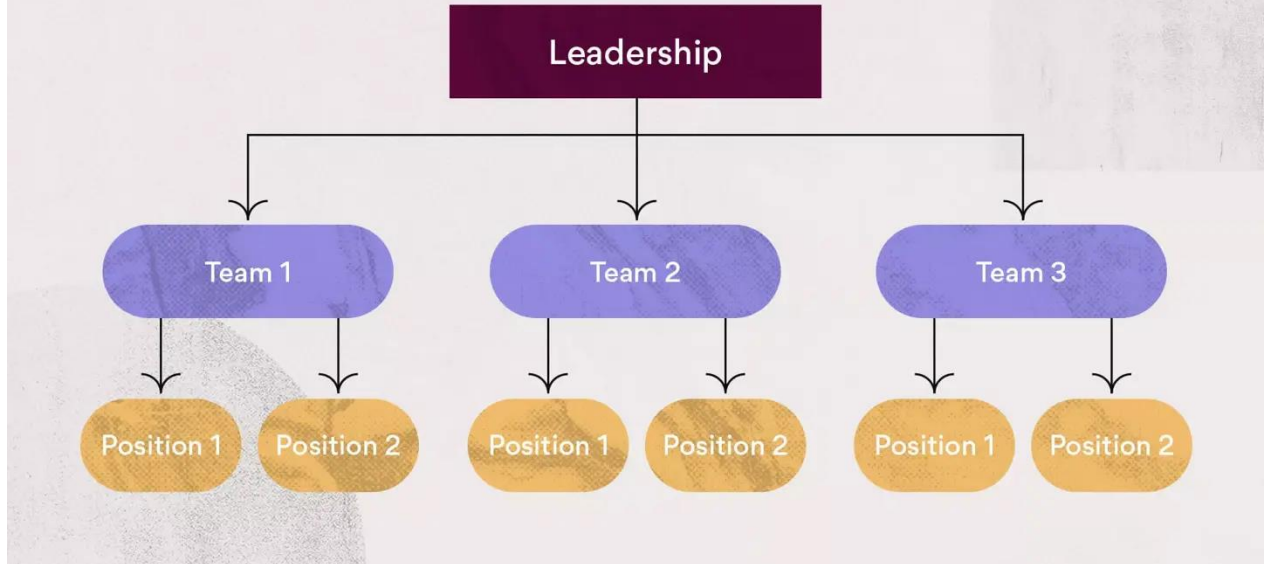


Team Structure

During my foundation year of university, I was required to work as a team to design a soap-box car. This task was as a team consisting of five people including myself. Our team structure was assigning different responsibilities to each member based on what skills they believed were their best. Our plan was to have weekly meetings to discuss how the project was going and to show the progress we made. However, due to a potential lack of communication in the team many of these meetings were down at least one member and occasionally more than one. Unfortunately, this slowed down progress in our team meaning we potentially weren't able to make this project to the best of our abilities. Despite this, when we were able to have a meeting with all members present, we were able to communicate effectively and listened and absorb ideas from every group without considering any of them to be a bad idea. This allowed us to have a wider range of ideas so that we could improve on our design in unified agreement. Our team structure could've been improved with better communication and more meetings however we were still able to complete our project with a decent grade. Another improvement we could've made was to do more work at the same time in the same room instead of individual work in our own time and combining it in meeting. In the time we did do group work our productivity and creativity improved greatly with a faster workflow and the ability to ask each other questions in the event we were unsure on what we were doing and required further input. I do believe that we worked well as a team as we did not put any ideas down as being bad by taking every suggestion into consideration and reassuring our fellow teammates in the event they did not believe in their capabilities.

An improvement we could've had to our team would've been to assign a definitive team leader. I believe that if we had integrated a form of hierarchical structure to our team we would have had a faster and better workflow. With a hierarchical structure this would've allowed one member to oversee, ensuring every member of the team were pulling their weight and organising meetings more clearly and effectively.

Hierarchical structure



(Team Asana (2025))

Conclusion

This report has explored multiple topics giving insight on their specified chapter. It has explored multiple avenues and information which has been supported by references from reputable sources ensuring the information is correct. The aim of this report was to educate and provide information on each of the chapter's topics in a concise and detailed manner which it has achieved.

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