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Engineering Skills Technical Report

Engineering Skills (ACHA 4022A)

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1. Introduction

This report intends to give a brief overview of key scenarios and skills that an Engineer will encounter and need to use within engineering environments alongside why and how they use them and what alternative methodologies have developed over time considering why they may be better suited to help engineers develop their professional careers.

2. Health and Safety with Risk Assessments

Engineering is a vast and diverse industry, which in turn generates a myriad of health and safety risks that must be assessed and controlled with proportionate responses.

An engineering activity that incurs some large health and safety risks is machining with a lathe, there is legislation in place to protect employees and employers whilst high-risk tasks like these are being undertaken, a first point of protection is the Health and Safety at Work Act 1974 (HASAWA), this is an umbrella legislation and a starting point for protection of all employees in the United Kingdom, it was also the first Health and safety legislation that had an impact on all working industries instead of specifics such as agriculture and mining which had their own legislations some years earlier, although these were not as tightly policed as modern day.

(UK Government, accessed 11/2025)

The risks associated with lathes are but not limited to, entanglement with the rotating head, chemical contact through coolants and cleaning compounds, Impact injuries from unsecured material or with material being removed and noise depending on the environment, materials and scale of operation. (Worksafe, 2017)

2.1 Personal Protection Equipment Regulations 2022 (PPER)

Impact and contact injuries can have their severity and likelihood reduced, with the implementation of Personal Protective Equipment Regulations (PPER), this legislation originating in 1992, announces the responsibility of an employer to provide appropriate PPE to employees who may be at risk. There are several PPE items that should be used when machining on a Lathe such as, safety glasses should be used to protect the eyes from swarf coming off the work piece being machined, machining can be a loud activity and machines usually are not run one at a time, in which an employer should provide hearing protection of requested within the working limits or mandate it when over the upper limit of 85 Decibels, as well as identify and mark compulsory hearing protection zones with the correct signage shown in figure 2. (HSE, 2022, accessed 11/2025)

2.2 Provision and Use of Work Equipment Regulations 1998 (PUWER)

Another method of protecting employees is the safety systems on tools and equipment itself, within the context of a Lathe would be a machine guard, (Figure 1), which is the first point of protection from impact risks, another equipment safety mechanism would be kill switches attached to guards to prevent accidental engagement of machinery whilst a guard is not positioned, the relevant legislation to this is PUWER this intends to keep the machines maintained to a safe operating standard so features such as the aforementioned safety mechanisms stay in place and function correctly to protect employees regardless of ownership. (HSE, 1998; Harraway, 2002)



Figure 1- Lathe Guard (Solon Systems 2025)



Figure 2 - Mandatory Hearing Protection (HSE 2025)

2.3 Lathe Risk assessment Table

Table 1- Basic Lathe Risk Assessment

Hazard Proposed	Personnel at Risk & Possible Injury	Control Measure	Implementation Date / Time	Review Intervals
Entanglement	Operators Scalping, Death, De-gloving	Machine Guard all Times, long hair tied	All operation time Daily Pre use inspection.	When workshop Modified, else 6 Months
Impact	All Room Staff Breaks / Fractures Crushing, Contusion, Embedding.	Machine Guard All times, All work Clocked in with DTI and Secure, Eye Protection Steel toe caps.	All operation time	3 Months
Chemical Contamination	Operators Allergic reaction to fluids, irritation from corrosive chemical exposure.	COSHH storage & visibly marked. COSHH paperwork available to all. Smock Eye protection Steel toe Caps Eye wash station.	Daily Inspection to be carried out by H&S Officer before any work commences.	Last working day of each month.
Falling Injury due to Spills.	All Personnel Falling and impacting caused by spills of coolant or other liquids in the workplace.	Spills kit, All spills to be clearly marked with slippery floor signage, spills to be cleaned immediately. Slip resistant shoes.	Immediately Upon Spillage Happening.	Spills Kit to be checked, restocked and maintained daily by H&S officer.

3. Security Risks and Matrix

The transportation industry has shifted from the mechanical analogue age to the digital, solid-state era, improving performance and reliability; however, these technological advances come with some real security threats to the industry.

3.1 Local CAN / Diagnostic spoofing

With Controller Area Networks (CAN) being standard practice within the automotive sector, control systems have never been more interconnected than they are now, unfortunately these connections have opened the opportunities for spoof attacks where malicious hardware and software can fool vehicles into engaging certain protocols and scenarios from fake messages, an issue that can and has put people at risk is spoofing Airbag warning lights, when an airbag system is inactive or not present at all, this can cause a major safety issue if an end user is not aware their airbag system is missing or deactivated, if a crash occurs the likelihood of injury or fatality is much increased, frontal airbags can reduce fatalities by up to 29%, the motivation around this most likely to be a financial move and not malicious as these safety systems can cost a lot of money and time to replace and repair. (IIHS, accessed 11/24; Hoppe, Kiltz and Dittmann, 2011; Viano, 2024)

3.2 Remote Hacking - Denial of Service

Denial of Service (DoS) attacks originate from the IT industry, and are a traditional style 'overload' attack, in where data packets are sent in mass to overwhelm a server or CPU, with many electrical components in cars now having remote access such as Tesla's remote phone connection to control parameter such as the climate control. These cars are now broadcasting data paths into themselves which need to be heavily guarded with methods such as encryption, if these communication methods were to be breached, a DoS attack is a possible threat with the possibility of malicious parties locking certain features of the car including safety features or even shutting down a whole car, events like this at high speeds could be fatal to the end user and surrounding parties. (*History of Distributed Denial of Service Attacks* | StormWall, no date; Dangwal *et al.*, 2025)

3.3 Insider Threats

With continuous developments in technology for componentry to continue to work in the automotive industry software and firmware will need to be updated at some point in its life cycle, this exposes manufacturers to internal threats, especially with a strong change in social views and government, the current likelihood of this is increasing, an internal threat in the form of an update could be extremely hard to detect initially and affect a huge number of people.

3.4 Ransomware attacks

Ransomware is now a commonly occurring issue with internet connected computers and it is extremely easy to be infected with such software, unless good security protocols are in place from the start, an example of this was the colonial pipeline event, in the terms of automotive industries these could shut down manufacturing lines, causing major delays and effects for the manufacturer and consumer. (Easterly Jen, 2023)

Table 2 - Security Risk Matrix

		Impact					
		1	2	3	4	5	
Probability	5	5	10	15	20	25	Local Spoofing = $P2 \times I3 = 3$
	4	4	8	12	16	20	Remote Hacking = $P3 \times I4 = 12$
	3	3	6	9	12	15	Insider Threats = $P3 \times I5 = 15$
	2	2	4	6	8	10	Ransomware = $P2 \times I5 = 10$
	1	1	2	3	4	5	Higher Score = Higher Severity
							1 = Low 5 = High

3.5 Insider Threat Response

To reduce the likelihood of insider threats causing damage to business all updates and outgoing data should be peer reviewed and screened by a non-biased cyber security team, to prevent unwanted information and actions to be made available to the public.

4. Engineers Roles in Society

4.1 Institution of Mechanical Engineers Code of Conduct

The Institution of Mechanical Engineers (IMechE) provides a code of conduct for all members of the institution regardless of experience, qualifications, location or any other social or environmental parameters.

There are four primary areas given by the IMechE in their code of conduct firstly being, 'Practise competently and maintain up-to-date knowledge and skills, Act with integrity and respect for others, Promote sustainability, Exercise engineering leadership'. (IMechE, 2025). With respect to environmental and sustainability issues, all of these have a link to the motorsport industry.

Developing Knowledge and being competent, motorsport is all about development and refinement, therefore it is critical for these motorsport engineers to be constantly expand their knowledge to make room for development, all this development runs back to promote sustainability, with the experimental materials and research motorsport brings.

Acting with respect for others can encompass environmental issues as the environmental impact on the planet affects the world's entire populace. (Achariyaviriya *et al.*, 2024)

4.2 Yamaha Code of Ethics

Yamaha Motor's Code of Ethics very much shapes an engineer's career and even personal life, it emphasizes maintaining and developing Yamaha's positive in socioeconomic reputation, which is the driving point of their Code of Ethics, this reputation aspect covers many subjects such as the, health and safety, wellbeing of its employees and associates and tries to embed respect for internal affairs and employees, as well as externally to the company.

Yamaha pushes social responsibility into their employee's private life, asking employees to be law abiding citizens, to not engage in antisocial activities and to not display or promote antisocial behaviour; especially regarding driving etiquette as Yamaha manufactures transportation equipment.

With Respect to the future Yamaha aim to limit their environmental impact, by being careful with their usage of non-renewable resources and ensuring they're fully compliant with environmental laws and regulations, they have goals to solve social issues and contribute to sustainable development of society via their business activities. (Yamaha Motor, 2021)

5. Problem Solving

Engineering as an industry is fuelled by problem solving, the industry and skill go hand in hand, engineering is effectively structured and planned problem solving with the aim to meet and improve real world needs and desires. (El-Zein and Hedemann, no date)

5.1 Root Cause Analysis

Developing new products to meet demands and needs can throw up a lot of issues in the process there are many structured approaches that Engineers can take to tackle these issues, a root cause analysis (RCA) is commonly used approach over many industries, this is primarily a quality control analysis and management method to find the initial or root cause of an issue developed further on in a products development or even in some severe cases after a product launch.

All problem solving starts at the same point, which is Identify the problem, RCA generally has an order of, identify, collate an RCA network, identify possible causes, research and solve root cause(s), develop and test solutions, finally implement changes where necessary whilst monitoring effectiveness of solution; a basic version of RCA can be seen in figure 3. (IBM, accessed 11/2025; Team Asana, 2025)

Root cause analysis is a canopy term that encompasses many problem-solving methods, such as a Fault Tree Analysis (FTA), is a visual approach and uses much more binary style logic and allows a visual map to be laid out which can make the hierarchy of processes and potential causes easier to understand, as displayed in figure 4. (IBM, accessed 11/25; Microsoft, accessed 11/25)

5.2 Workaround Solutions

Workaround Solutions are not to be mixed up with a contingency plan, the main difference being a contingency plan is used for potential risks and issues that have been identified earlier on that could become a problem, whereas workaround is an on-the-spot temporary or permanent solution to allows projects to keep moving, for example feature reduction, if there is an issue with a feature of an item due to internal issues or external issues such as supply chain, removing features of a product in development would allow the project to keep moving, allowing for the features to be added at a later date.

Another high-risk approach could be to linking back to section 3.1 would be to bypass failing or problematic features and modules via spoofing or disabling components to force products to work, this is a high-risk approach increasing the chances of bugs and issues in product post production. (PM PrepCast, accessed 11/25)

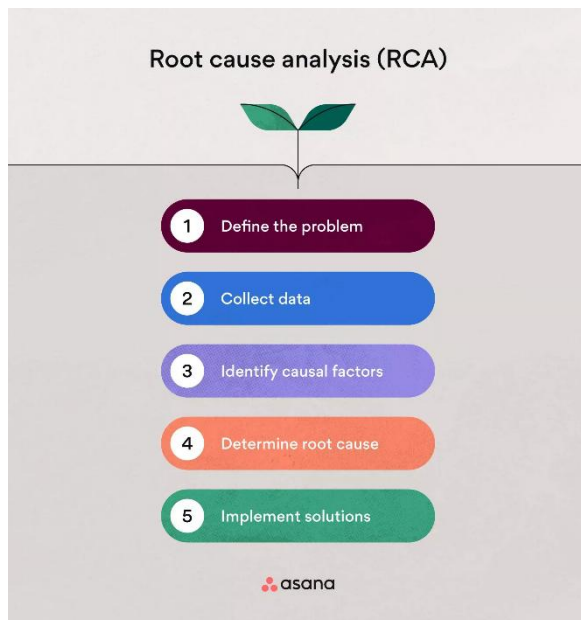


Figure 3 - Root Cause Analysis diagram (Team Asana, 2025)

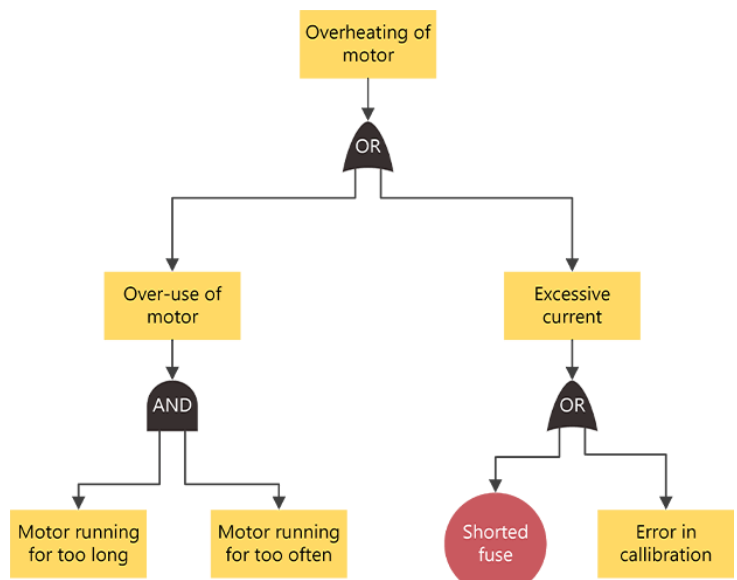


Figure 4 -Root Cause Analysis diagram (Microsoft, accessed 11/25)

6. Team Structure

In my motorsport career working as a team has been one of the most used, desirable and important skills I have learnt and developed, unlike most other skills it cannot be practiced and comes from firsthand experience, it is a communicative skill that I have found to be a fundamental part of working in a motorcycle racing team.

Teamwork ability is not a measurable or quantifiable skill, which can make it difficult for others to convey their ability to others, it can also be an environmentally driven skill where the team or personnel you work with can impact the overall teamwork ability of individuals or the team as a whole, this can also be affected by team structures.

Hawk Racing British Superbike Team, the team I work in, uses a conventional style hierarchical structure (figure 5), for the most part this works well, allowing each individual component of the chain to report back a superior all the way to the team manager, this structure benefits from each component clearly knowing and understanding their job within the activity and their superiors within the team, it also helps to promote the feel of importance to the majority of the roles as everybody is part of a chain and if the chain is broken the work struggles to be completed if at all.

A drawback of this structure I have encountered is that it relies heavily on individuals and communication, information easily gets distorted in the communication chain, furthermore it can put employees in a place of power where they are uncomfortable or unqualified, a situation I have been in, is where a major decision needed to be made with regards to a mechanical issues with a motorcycle, reporting to my higher who then sends me to their higher until reaching the top of the chain who is not present or available leaving a decision out of my role to be made by myself.

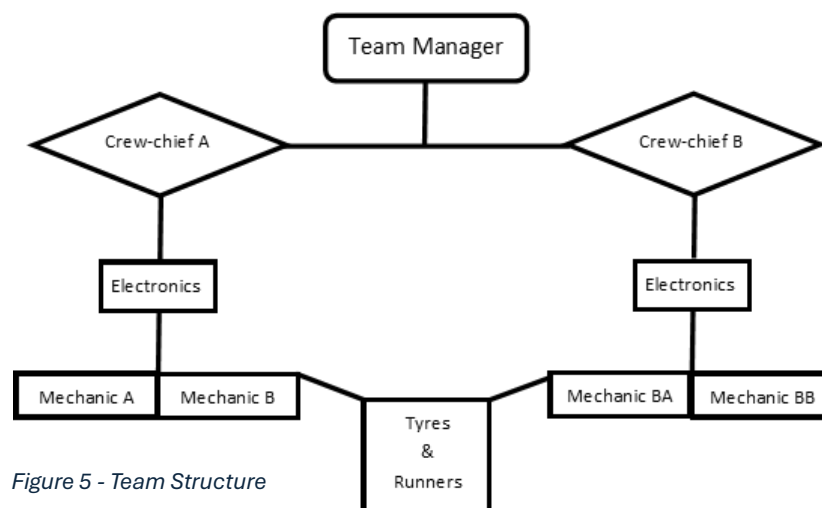


Figure 5 - Team Structure

6.1 Alternative Structure option

A cross-functional team structure (figure 6) may also work in my working environment, it promotes a mutual goal for each team member, increasing employee engagement and reducing the 'I have done my bit, it's not my problem anymore' mentality. (Future Processing, 2025)

This method should increase autonomy within the team making members less reliant on others to help complete their work, it should also pool the data stream meaning everyone can be at the same point of progress all the time. (Danilkievych, 2022)

Difference between functional teams and cross-functional teams

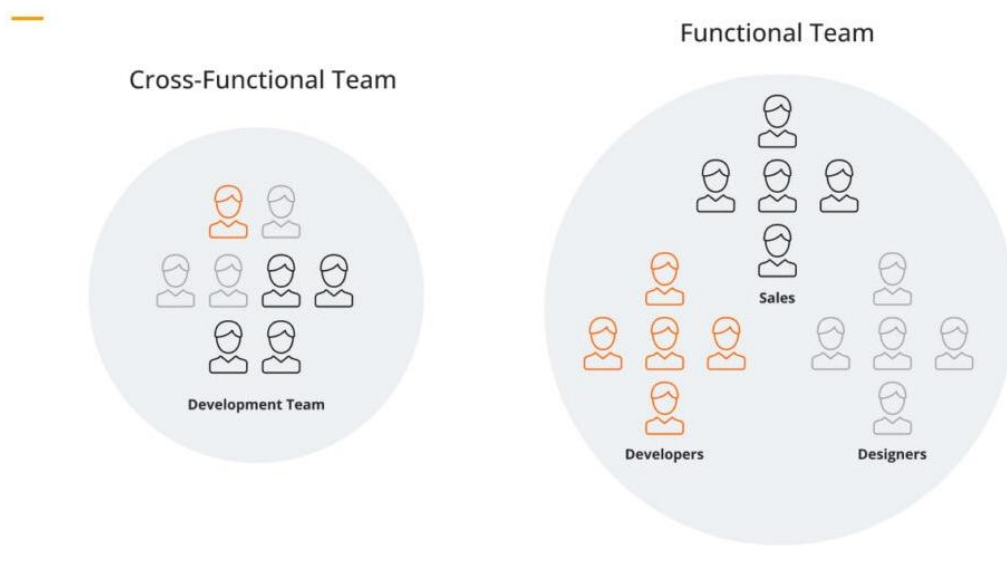


Figure 6 - Cross Functional vs Functional Teams (Future Processing, 2025)

7. Conclusion

This report surmises that an engineer's job goes further than, designing, developing and machining, it is a role in society, that can have long lasting effects, on the environment and population. Engineers need to calculate risks to themselves, the environment and others around them whilst working, there is a responsibility to create a safe and developed future for the planet, requiring a variety of skills to enable problem solving and development usually in a team to pool efforts for a better future.

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