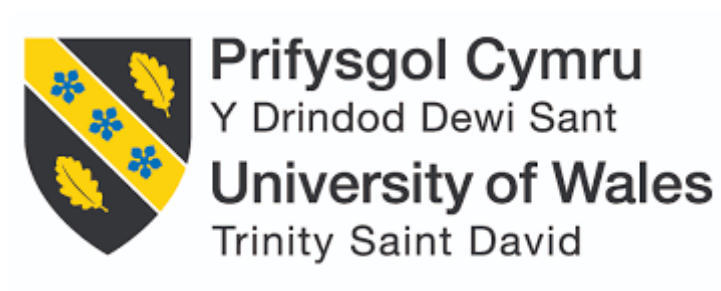


University of Wales Trinity Saint David

Wales Institute of Science and Art

Engineering Discipline



Harry Stark

2404901

Motorcycle Engineering

Engineering Skills Technical Report

01/12/2025

Engineering Skills – ACHA4022A

Word count: 2018

Contents

Table of Contents

1. Introduction	2
2. Health and Safety with Risk Assessment.....	3
3. Security Risk Matrix	6
4. Engineers Role in Society	9
5. Problem Solving.....	10
6. Team Structure	11
7. Conclusion	12
8. References/Bibliography.....	13

1. Introduction

This technical report will detail the importance of innovation and team-based cohesion whilst outlining the imperative use of Risk Assessments and Security matrixes. It will become apparent that cyber-security plays a massive role in society today. Especially considering new technologies like autonomous vehicles, which are targeted by hackers to exploit weaknesses within the network self-driving cars operate with. There are multiple ways risk in each industry is mitigated, Engineers, however, face unique project-based issues frequently. Therefore, it is vital that engineers have a few robust methods to analyze and break down a problem into comprehensible parts for a richer interpretation.

2. Health and Safety with Risk Assessment

Motorcycle racing, specifically the 'Freotech Endurance Championship' has been notorious for its associated risks. Due to the motorsport-related nature of the activity, it operates in accordance with the Health and Safety at work Act of 1974 (Hackitt, J. 2014). This is defined by the Health and Safety Executive (HSE, 2016), specifically relating to motorsport event organisation. Similar to motorsport racing, this act helps ensure the safety of all those either working within the event or actively taking part in it. Organisers such as the ACU, are incredibly detailed in how they operate to safeguard participants. This is achieved via the use of in depth Risk Assessments and risk identifying methodologies (ACU, 2025).

Whereas the Health and Safety Act 1974 is geared more for events and organisations. The Road Traffic Act 1988, sections 12A – 12F for England and Wales, relates mainly to the legalities of holding a racing event on an otherwise public roadway (UK Government, 2012). Acts like the Code of Practice in relation to motorcycle racing are mainly used for the roughly 5,000 off road sporting events in the UK (ACU, 2025). In terms of safety legislation, it is standard practice for organisers to ask participants to sign waivers to participate in events. The waiver seen in figure 1 is used by the organisers of Freotech Endurance which is signed by each rider taking part in a racing event.

ONE EVENT LICENCE APPLICATION
02.02

Complete this form CLEARLY in BLOCK CAPITALS to apply for a NORA 92 Ltd one event licence.

Section 1 – Competitor Information

First Name: Surname:
Address:
Post Code:
Date of Birth: Club Name:
Nationality:
Mobile No: Evening No:
Email:
Are you happy to receive information on future NORA 92 events? ☐ Yes ☐ No

Section 2 – Medical Information

Please answer all the questions truthfully. A false declaration may have serious consequences. If the answer is 'Yes' to any of the questions, please give full details in the space provided at the end of this section. This should include the date you first developed the condition, details of any tests, investigations and of any treatment you have undergone. Please include the names and addresses of any specialists you have seen and hospitals you have attended. Please give full details of any medication you are taking.

Have you ever suffered from or are you currently suffering from any of the following illnesses or conditions:

- 1) Epilepsy, fits, blackouts or any condition which may cause loss of consciousness?
- 2) Any condition that might cause dizziness, vertigo or loss of balance?
- 3) Have you been unconscious because of a head injury or suffered from concussion?
- 4) Any brain disorder such as a stroke, MS or Motor Neurone disease?
- 5) Any loss of strength, feeling, control or movement of any of your limbs, head or neck?
- 6) Amputation of any part of your limbs with or without an artificial replacement?
- 7) Any condition or operation involving your heart or main blood vessels or any high blood pressure?
- 8) Any kind of tumour or cancer?
- 9) Diabetes? If 'Yes' please state whether treated by diet, tablets or insulin?
- 10) Any psychiatric or emotional illness or any alcohol/drug/substance misuse?
- 11) Any condition affecting your vision or eyes, including colour blindness?
- 12) Are you taking any medication?

(Include all tablets, medicines etc. whether prescribed or bought over the counter.)

Do you suffer from any of these conditions?
NO ☐
YES ☐
If yes, please give details in the box below

Details:

MOTOR SPORTS CAN BE DANGEROUS AND MAY INVOLVE INJURY OR DEATH
Read carefully before signing to ensure you agree.

1. The answers given by me in this Licence application are true.
2. I fully understand the type of the events which the Licence allows me to enter and the rules and regulations that apply to such events and to competitors and will comply with them.
3. I will ensure that before I enter any event, I am competent to compete and that any vehicle that I use is safe and fit for the competition and nature of the course.
4. I will satisfy myself (by sighting lap or otherwise) before taking part that the venue and track is acceptable to me with regard to its features and physical layout (unless prohibited to do so).
5. I will NOT enter or take part in any competition where I have a doubt as to my safety.
6. I will tell you immediately if, for any reason, I believe that I am no longer able to satisfy the terms of this Licence or I become aware that I have become unable to compete due to physical or other disability.
7. I agree to accept the risks of injury and death that are inherent in motor sports and agree to take part at my own risk.
8. If under the age of 18, my parent / guardian has read the above and signed the declaration and agreement below.
9. I agree that my details may be passed to the NORA92 should I be treated on site by the medical team.
10. This Event Licence does not come with personal accident insurance cover.

Signed: Print name: Date:
If the applicant is under 18 Please read and sign below:
I the parent, or person with parental responsibility, do declare that the information given above is correct and that I have read and agree to the declaration as written.

Signed: Print name: Date:
NORA MOTORSPORT, Unit 9-10 Cholswell Court, Cholswell Road, Shippon, Abingdon, OX13 6HX
TEL: 08453 880992 WEB: www.nora92.com E-MAIL: office@nora92.com

Figure 1. NORA motorsport racing event waiver

2. Health and Safety with Risk Assessment

Potential Hazard(s)	Individual(s) at risk/ related to risk	Actions in place before identification Of Hazard(s)	Actions in place after identification of Hazard(s)	Action(s) carried out by			
Inadequate clothing protection , leading to serious personal injury.	Participants and potentially Organizers	Participants are recommended to wear normal track day attire such as, A helmet bearing an ACU gold certified stamp and leather racing suit.	Participants are responsible for their own clothing protection as stipulated in Waiver. If clothing requirements are not met, participants can and will be removed from the event to ensure their own safety.	Participants (signed waiver declaration).	2	5	10
Racing Circuit is too slippery from rain, leading to crashes and collisions	Participants	Racing teams will be asked to bring a set of tires designed for wet conditions, commonly referred to as "slicks".	The event will be cancelled if the conditions are deemed too dangerous. ". A yellow flag with red stripes will also be displayed on the circuit to advise caution regarding the track surface being too slippery	Organizers and safety staff.	3	4	12
Inadequate amount of Safety staff/ Inadequate training, leading to injured participants not receiving treatment when necessary.	Everyone	Marshall and safety staff are responsible for wearing high-visibility clothing to ensure identification at all times.	Safety staff are to be hired from certified hiring agencies and/or have referenced experience.	Organizers.	1	5	5
Rider riding in pit lane when they should be pushing their motorcycles. Subsequently leading to collisions.	Participants	Riders are required to dismount to ensure safety of others.	Lap penalties of up to 5 minutes will be implemented for the offending team.	Organizers and Safety staff.	3	5	15

Table 1, Proposed Risk Assessment for [Freotech Endurance](#) , using the Risk Matrix in Chapter 3

3. Security Risk Matrix

With the introduction of autonomous vehicles on the market ([Lu et al., 2025](#)), more challenges arise. LiDAR spoofing targets autonomous vehicle sensors by creating fake objects which the vehicle interprets as real objects, or it can hide objects entirely which could lead to a fatal crash([Cyberpath, 2025](#)).

The Passive Keyless entry and Start systems (PKES) are convenient but create new security risks. Relay attacks allow thieves to wirelessly capture and extend a keys fob signal, unlocking and starting vehicles without physical access ([Li, J. et al. \(2020\)](#)). This threat is quite common given its accessibility within modern vehicles.

A broader threat to the automotive industry would be Cyber-attacks like the ransomware attack on Jaguar Land Rover (JLR) in 2025, which forced JLR to shut down their operations and disrupt manufacturing of their vehicles, subsequently costing JLR around £1.9 billion. This also prevented them from registering any of their new vehicles, which also affected the reputation of the brand ([Business Matters 2025](#)).

Another physical threat that thieves use to gain access to a car is by hotwiring the vehicle. This is done by bypassing the ignition system so that the vehicle can start without a key. Starting the vehicle is done by gaining access to the ignition wiring by breaking into the steering column and physically connecting the wires that start the engine ([Godwin, D 2026](#)).

Probability	Risk Matrix					
	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
	1		2	3	4	5
		<i>Negligible</i>	<i>Slight</i>	<i>Moderate</i>	<i>High</i>	<i>Very High</i>
Impact						

Figure 2, Risk Matrix

Probability	Definition		Value
	Frequent	Very high occurrence	5
	Occasional	Likely to occur	4
	Remote	An even chance of occurrence	3
	Improbable	Unlikely to occur	2
	Very improbable	Very low occurrence chance	1

Figure 3, Risk Matrix Probability

3. Security Risk Matrix

Impact	Definition		Value
	Very High	Very high occurrence	5
	High	Likely to occur	4
	Moderate	An even chance of occurrence	3
	Slight	Unlikely to occur	2
	Negligible	Very low occurrence chance	1

Figure 4, Risk impact

Potential Hazard(s)	Probability	Impact	Risk Value Before adjustment	Risk Level
LiDAR Spoofing	3	5	15	High
Passive Keyless entry and Start Systems (PKES)	5	5	25	Severe
Cyber-Attacks (Ransomware)	4	5	20	Severe
Hotwiring	3	3	9	Medium

Figure 5, Risk rating

20 - 25	Severe	A Severe risk rating requires an immediate and detailed response outlined in the risk assessment. If severity CANNOT be mitigated, event cancellation/postponement is necessary.
15-19	High	A High-risk Rating requires immediate action to be. All Highly rated risks MUST be mitigated to at LEAST a medium-level risk rating.
6-14	Medium	A medium-level risk, if situated in the lower band (6-10) with a probability of no more than "Improbable - 2", is acceptable based on the nature of the motorcycle event.
1-5	Low	A low-risk rating is acceptable, assuming that the outcome(s) from the controlled hazard are negligible.

Figure 6, Definition of Risk Rating

3. Security Risk Matrix

3.1 Risk Response

A proportionate engineering response to PKES attacks should focus on increased signal authentication of the key fob's physical proximity to the vehicle. Using Radio Frequency (RF) fingerprinting enhances security by identifying variations in a key fob's radio signal, such as transient signals and oscillator drift. This allows vehicles to distinguish legitimate devices from relays attempting to intrude on the PKES.

To manage this risk, the PKES should implement Low-Frequency Initiated Architectures (LOFI) to reduce that attack ability of key fobs. LOFI systems ensure that the key fob is only able to generate and transmit signals in response to legitimate, vehicle-initiated requests, as opposed to passively broadcasting and responding to external queries ([Joo, K., Jo, H.J. and Choi, W. \(2024\)](#)).

This eliminates opportunities for attackers to intercept or analyse key fob transmissions and reduced exposure to relay attacks. LOFI effectively limits the window in which information can be targeted by adding an additional Safeguard on top of encryption-based authentication. Furthermore, this methodology of signal control creates a solid defence that significantly improves resilience against PKES attacks.

4. Engineers Role In Society

Reputable engineering is the backbone of any market that wants to make profit whilst maintaining good public relations ([Botha, 2014](#)). This doctrine applies greatly for Engineering, if mistakes are made at any point during the manufacturing process of a vehicle, the public will face the potentially dire consequences ([Rich, 2021](#)). The Ford Pinto, although remembered for its unique subcompact/hatchback style blend of manoeuvrability, was riddled with design and functionality problems([Shutt, 2024](#)). The primary issue being that the gas tank was placed behind the rear axle nut, essentially exposing it to a high likelihood of being punctured and causing a fire if rear-ended by another vehicle.

This exact reason is why high levels of scrutiny is now commonplace within the automotive industry. Two primary companies that deal with Code of conduct are NSPE ([National Society of Professional Engineers, 2019](#)) and IMechE ([Institution for Mechanical Engineering, 2017](#)). NSPE's code of conduct outline that Engineers are encouraged to adhere to the principles of sustainable development to protect the environment for future generations. Whilst IMechE emphasises that Engineers must balance present needs with future sustainability and regulations.

Due to recent developments in our understanding of the knock-on effect motorcycles have to the environment, brands like BMW and Honda used to include soy-based wiring to meet manufacturing regulations ([Wurster, S. and Ladu, L. \(2020\)](#)). A common misconception is that this feature reduces the weight of the motorcycle, leading to a better performance. This feature backfired as time has played a massive factor in the recessive functionality of bio-degradable wiring. Almost every motorcycle with soy-based wiring has had to be repaired or maintained to an unrealistic standard compared to that of traditional plastic wiring protection. This has led to even more unrecyclable resources being used to circumvent the soy-based wiring, thus damaging the environment more in the long-term.

5. Problem Solving

Contrary to popular belief, An Engineers role does not solely pertain to flashy monikers such as 'Formula One Racing Engineer' and 'NASA Curiosity Driver' ([NASA, 2020](#)). Most Engineers are more grounded in their roles and responsibilities, defining modern technologies through the development of robust research methods to ensure the Health and Safety of the public and professionals on the racetrack. Engineers need to operate to the highest percentile of accuracy when determining a product's capacities ([Pannell, 2023](#)) whilst also maintaining regulatory safety standard for themselves ([OSHA, 2024](#)).

Interchangeably referred to as Safety Engineers or Risk Management, this specific Engineering principle is renowned in Hazard Perception and Mitigation ([CLRN team, 2024](#)). For example, Formula One technicians and designers have created a new safety technology feature referred to as the Formula One Driver 'Halo'. According to ([Ono, 2023](#)), after the unveiling of the new safety feature post 2014 Grand Prix crash by Jules Bianchi ([Collins, 2014](#)), trends indicate that the 'Halo' is the most viable solution in terms of safety when considering the dangers of debris impacting the driver ([Monroe, 2021](#)).

Engineers addressed safety challenges using a structured problem solving approach by identifying potential solutions. Each design was assessed in regards to key factors such as impact resistance, weight, driver visibility and regulations. Practices such as , prototyping , simulations and testing are implemented to decide which designs failed to meet requirments or suffered from excessive complexity. The process of iterative refinement led to the final Halo system. This demonstrates that engineering based problem solving neccesitates multiple initial solutions and evaluating them agaisnt requirments and regulations. Redifining designs through testing to reach the most viable solution is the aim of the engineering process when facing challeneges so that the final product has both functionality and affordability.

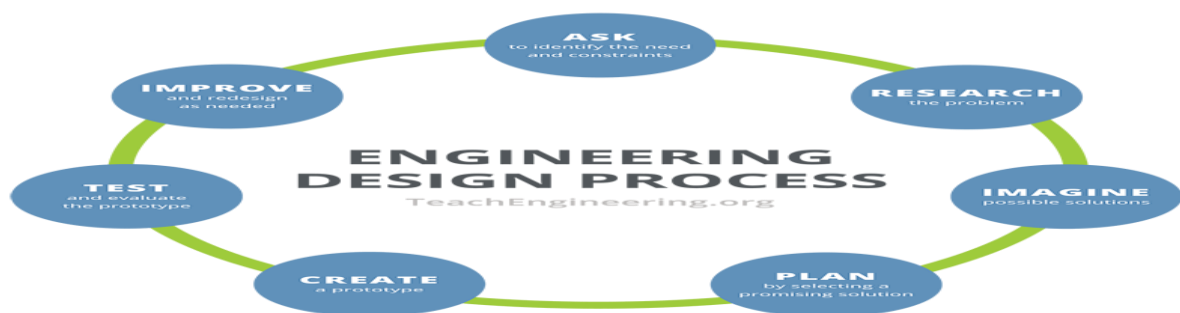


Figure 7, Problem solving Flow chart

6. Team Structure

During my time at University, I have been fortunate enough to participate in the 2024/2025 season on Freetech Endurance. Whilst very challenging in terms of my riding capabilities, my mechanical aptitude was expanded upon more thoroughly. Adjusting to each race circuit over the season, coupled with the sometimes-tumultuous weather, was truly a test of my Engineering skills and capacities. As novice track riders, with the exception to one teammate, the motorcycle we rode was badly damaged multiple times. Totalling somewhere between 8-10 crashes, with one crash being borderline catastrophic, it was a good example of our perseverance as a unit.

The team operated with a flat structure, which meant that there was no strict hierarchal leadership system in place. Responsibilities were distributed evenly across all members of the team. This allowed for quick and informed decisions to be made at a moment's notice.

One of the benefits of a flat team structure is that shared accountability and ownership are the main pillars for the team's functionality. Meaning team members have a natural investment in the outcomes of the race as each member has their own equally important role to carry out. Finally, this method promoted open communication as decisions were made collaboratively as opposed to being made by one individual.

In theory, a flat team structure could also lead to poor functionality, especially in larger teams. Since more team members are included, there will be a higher chance for miscommunication to take place. A standard hierarchal structure can be more effective within a less experienced team as accountability for mistakes is placed on the individual with the most experience. The individual with the most experience tends to be the leader of said team.



Figure 9, Crash

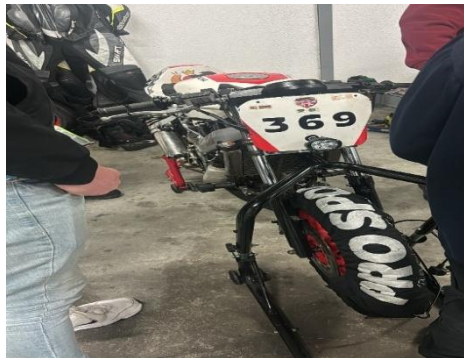


Figure 10, The motorcycle

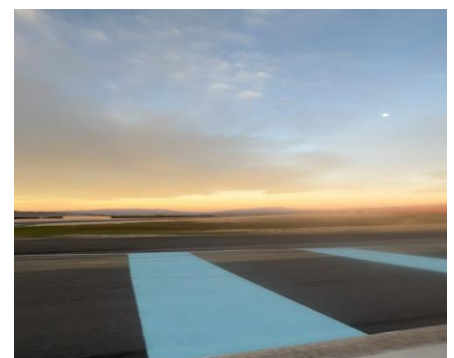


Figure 11, The Race Circuit (Andalucia)

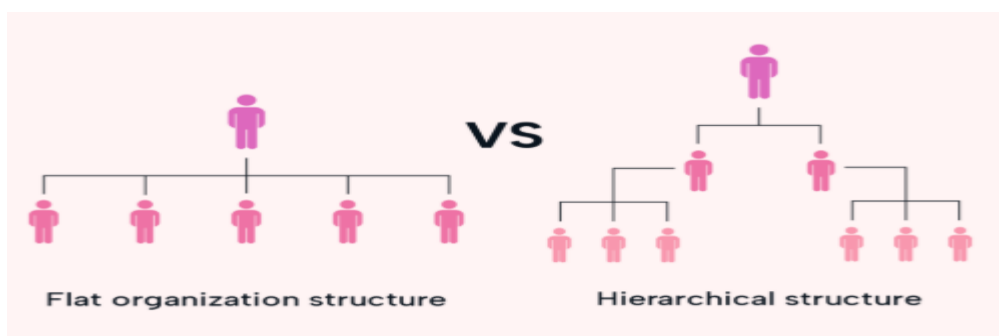


Figure 12, Flat team Structure

7. Conclusion

Being knowledgeable about different problem-solving strategies and inherent engineering responsibilities adds a significant level of competency within the engineering practice. This subsequently will lead to a more confident approach when tackling design-based issues whilst maintaining a responsive team-based cohesion throughout any project.

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