

Engineering Technical report

Workshop and practice (ACHA4011)

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Table 1: Abbreviations

<u>Abbreviations</u>	<u>Meaning</u>
PUWER	Provision and Use of Work Equipment Regulations
PPER	Personal Protective Equipment at Work Regulations
PPE	Personal protective equipment
HSWA	Health and Safety at Work etc.
IMechE	Institution of Mechanical Engineers
EC	Engineering Council
RCA	Root cause analysis
FTA	Fault tree analysis
DofE	Duke of Edinburgh

2. Introduction

This report consists of 5 main chapters:

A safety risk assessment for an engine strip workshop carried out at UWTSD including relevant legislation and what said legislation recommends in terms of PPE. There will also be a risk matrix for said engine strip outlining risks of the workshop how severe and likely they are to occur and what steps can be taken to mitigate the risks.

A chapter on the role of chartered engineers in society in terms of sustainability and environmental issues. It will lay out the code of conduct from two different engineering organisations and what they comment on engineers' roles which will be focused on the field of motorsport engineering.

Chapter 5 consists of three scenarios where issues are discovered at different stages of development, and it goes through which problem-solving methods engineers could employ to as well as a flow diagram for each.

Chapter 6 speaks on a time which the author of this report worked in a team with other people, what type of structure the team was and the pros and cons of how that structure worked.

Chapter 7 is a personal development plan written by the author on 7 goals he wishes to achieve in the short/long term, what resources he will require for each and when he hopes to achieve them by.

3. Health and safety with risk assessment

An example of a workshop activity at UWTSD is an engine strip workshop. Participants in this workshop must adhere to firm health and safety regulations to keep themselves and others safe, as well as a risk assessment stage in order to identify any dangers before they arise. There are many health and safety legislations which should be adhered to, these include:

3.1 Provision and Use of Work Equipment Regulations 1998

This set of legislation ensures that the machinery and tools used by a company/individual is safe, appropriate for its intended use and supplied with appropriate health and safety measures. This set of regulations also mandates that 'Employers must ensure that all persons who use work equipment have received adequate training for the purposes of health and safety' (PUWER 1998), if employers are seen not to follow these regulations, they will face fines and or legal prosecution.

3.2 Personal Protective Equipment at Work Regulations 2022

These regulations go through the responsibilities of employers to 'ensure their workers have sufficient information, instruction and training on the use of PPE' (PPER 2022) in the workplace as well as mandate its use. Employers must assess the risks, choose the appropriate PPE and then ensure it is properly maintained before use. The aim of these regulations is to mitigate the risks of injury to employees while working in dangerous environments.

3.3 Health and Safety at Work etc. 1974

This is the main piece of legislation which governs health and safety rules in UK workplaces. It sets out the main duties which both employers have to their employees and members of the public, but also the duties employees have 'to take reasonable care for the health and safety of himself and of other persons who may be affected by his acts or omissions at work' (HSW, 1974).

3.4 Typical PPE for an engine strip workshop

- Steel toe capped boots (in case any part of the engine were to fall on your foot during the disassembly process).
- Safety goggles (to protect against oil or other flying materials)
- Overalls / protective clothing (prevents oil and dust from getting on your skin and clothes)
- Gloves (stops receiving cuts and preventing oil from getting in them)

Table 3.1: Risk assessment matrix for engine strip workshop

		Severity		
Likelihood		Low	Medium	High
	High	1a	1b	1c
	Medium	2a	2b	2c
	Low	3a	3b	3c

- 1a. Trapping fingers between components
- 1b. Slipping on spilt oil
- 1c. Dropping heavy engine parts on yourself
- 2a. Using hand tools
- 2b. Breathing in engine debris
- 2c. Lifting heavy components
- 3a. Not letting engine/oil cool before stripping
- 3b. Spilling cleaning chemicals on yourself
- 3c. Fire from spilt oil/fuel

4. Engineers' role in society

Chartered engineers are held to exceptionally high professional standard all over the world, these regulations are put forward by several different industry bodies which ensure that standards on topics such as ethical practices, which includes sustainability and environmental impact, are upheld to the specified level. Two of the most important organisations in the motorsport sector are:

4.1 The Institution of Mechanical Engineers

One of the four principles of the IMechE is the promotion of sustainability. This principle states that its members should 'Recognise the importance of socioeconomic and environmental factors' (IMechE, 2021). For the field of motorsport engineering this involves designing more fuel-efficient engines which can then be used in road cars to help the general public save on fuel as well as being better for the environment.

4.2 The Engineering Council

The UK's EC is the body which sets out guidance for UK engineers concerning sustainable development, the protection of the environment and the safety of the general public. In motorsport engineering, this

would involve developing technologies such as synthetic fuels, regenerative braking and increasing aerodynamic efficiency of vehicles.

Both of these organisations emphasize just how important engineers are in the sustainability of the motorsport sector and the world as a whole. Throughout the years motorsport engineers have brought forward many new ideas and inventions as well as furthering the development of technologies such as hybrid power trains (which has had a massive development boost since their introduction into F1 in 2014), and innovations in wind tunnel development which has led to the production of more aerodynamic road cars which in turn are more fuel efficient. By following these preset and ever evolving standards engineers contribute to a more sustainable industry while simultaneously driving development in the public sector.

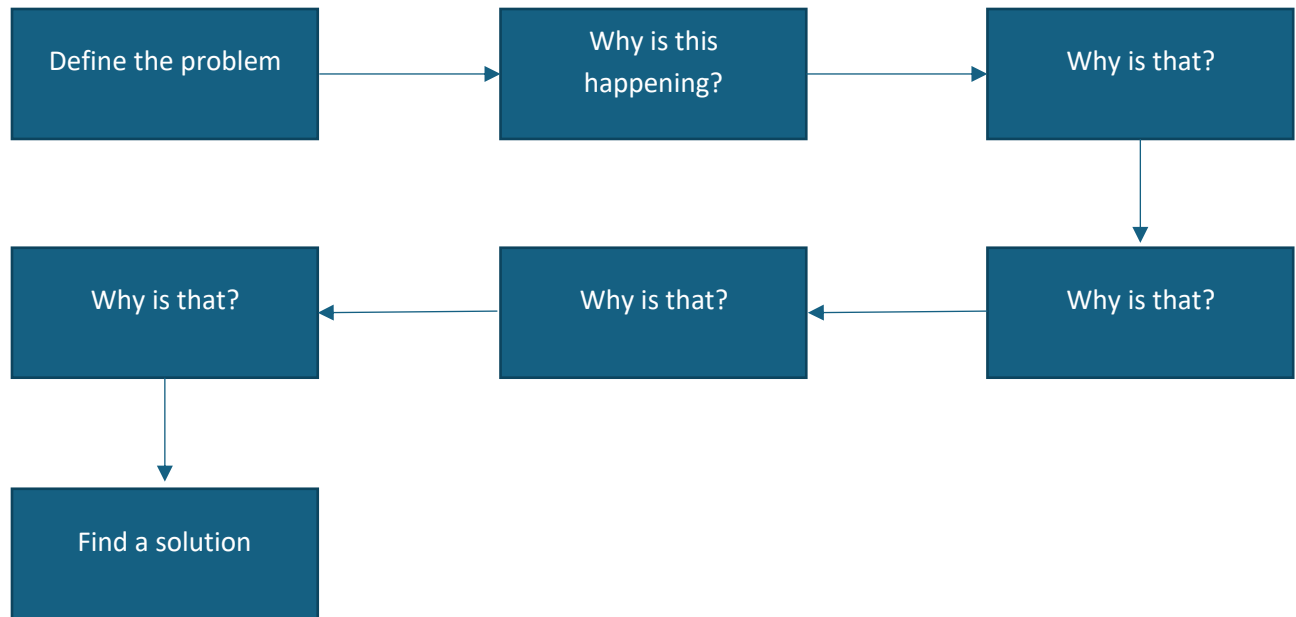
5. Problem solving

Often during the development/deployment of new products engineers will face problems throughout each level of testing. When an issue is discovered, engineers will employ several different strategies to try and identify the root cause, as well as the most effective solution they could employ to remedy the problem. These are 3 different methods engineers could use to solve issues in the specific scenarios.

5.1 Issue found during development

When engineers find issues during development, an effective method which can be deployed is the 5 whys. The 5 whys can help by continuously asking why there is a problem until you dig down to the root cause of an issue, at this point you find a solution which will solve the original problem. For example, a car is overheating. Why? Because the engine is running too hot. Why? Because the cooling for the engine is not working properly. Why? Because there is not enough coolant in the system. Why? Because there is a leak in the radiator matrix. Why? Because the matrix has rusted through. Solution is thus to buy a new radiator.

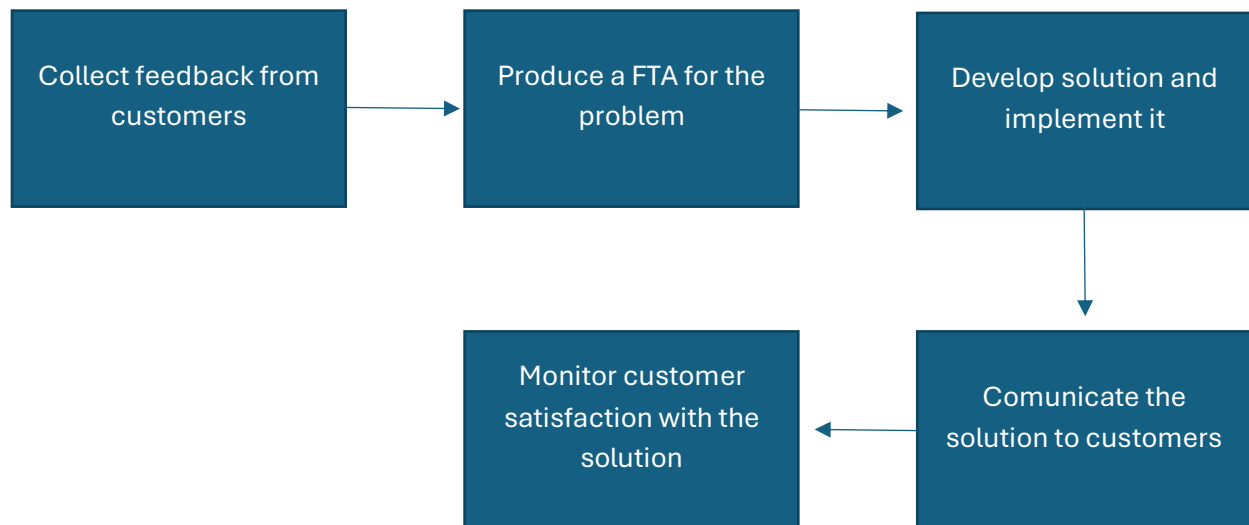
Diagram 5.1 Development flow diagram



5.2 An issue found once on the market

When an issue is found after a product has gone out to market, engineers can use a FTA diagram to identify the root cause of the problem. A FTA does this by writing the main failure at the top of the tree (for example the front right of a car is starting to bounce), you then write down why that is (for example the damper on the front right is failing), you would then write down factors which were contributing to that (such as part of the car was rubbing on the damper). This will then allow the engineers to implement changes to the product such as changing the design or implementing improved quality control measures.

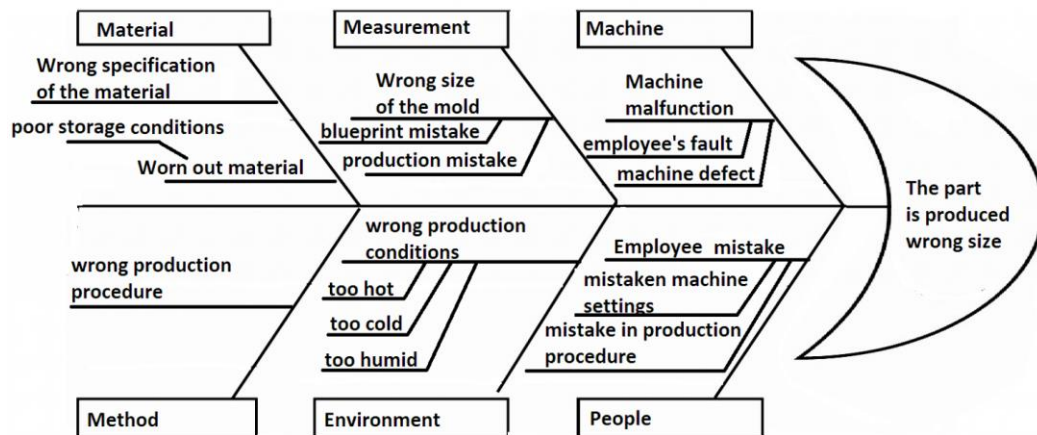
Diagram 5.2 Market flow diagram



5.3 A supplier issue in the production process

An issue with suppliers during production processes could be tackled using a fishbone diagram. A fishbone diagram helps to identify the root cause of the issue by looking at the: Equipment, Process, people, materials, environment and management. By exploring each of these fields an engineer can more efficiently target the exact issue and develop more specific solutions for the problem.

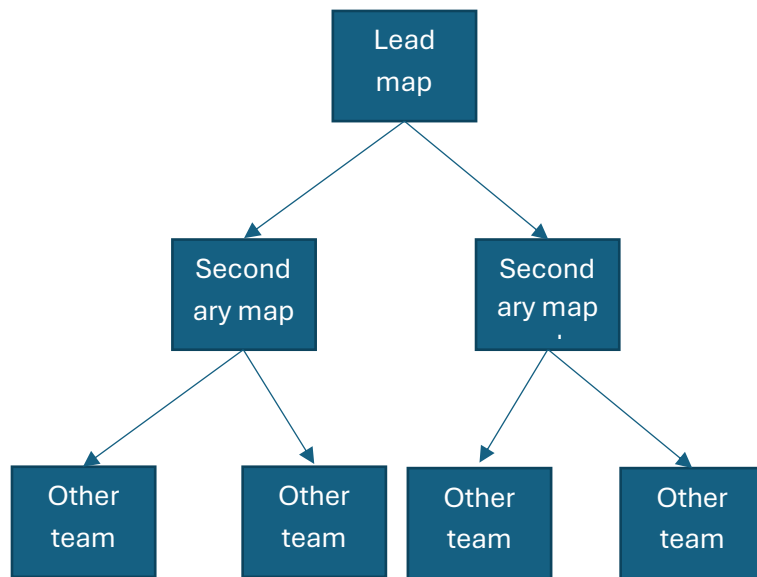
Diagram 5.3 Fishbone diagram example, 2021



6. Team structure

During my time in secondary school and 6th form, I completed my bronze, silver and gold DofE expeditions. Through these our team structure changed and evolved based on our previous expedition in order to make a more effective and cohesive team. We found our team worked best when each person had pre-designated roles, the most effective team structure we found was a hierarchical one. This is where there is one person in charge who makes the big decisions for a team (in this case it was who was at the front reading the map and following our planned route). 'A hierarchical structure has many layers of management, and businesses with this structure often use a 'top-down' approach' (BBC 2024). We found this most effective as we only had three maps, so we gave them to the people who were the best at map and compass reading.

Diagram 6.1 Our gold DofE team structure



6.1 Positives

Our Gold DofE expedition took place on Dartmoor in April 2022; we used this structure for all 4 days hiking. For the first three and a half days I was usually the person leading the group and reading the main map. This worked very well for the first two days during which we had no arguments and didn't get lost once. Having one person in charge led to fewer arguments within the team and when the leader had any doubts about where they were going, they could ask for advice from the other two map readers who would help get us back on track. We were still open to comments from the rest of the team, but usually it meant we spent less time discussing our decisions and could get back on track quicker than if we had to have input from all members of the team.

6.2 Negatives

However, on the third day it had been raining almost all day, we were all very cold and tired and had gone slightly off course earlier that morning which had caused some friction between the three of us reading the maps and the rest of the team. It came to a head in the late afternoon as we tried to pass through a floodplain, one of my team members started to fall and grabbed the nearest thing to him which was a barbed wire fence. He ended up with a cut along his right hand, but we couldn't fix it in the middle of the bog, so we had to wait another ten minutes to get to solid land. When we got there three of the team started to yell at us three map readers for taking us through the floodplain. They stayed annoyed until we made it to camp a few hours later. I think the main negative of a hierarchical structure is that it means a small group of people end up taking the blame for decisions however that also means you can hold those people in charge to account easier which means they will try harder for the team.

7. Personal Development Plan

Name – Alexander Joseph Jay

Degree – Motorsport Engineering BCS

Previous Qualifications – A-level Maths, Physics, Biology and EPQ.

Previous Experience – 2.5 Years working as crew member at McDonalds

Long Term Goals (5 to 10 years)
Visit all 7 continents. Work in F1 or WEC. Climb Mount Kilimanjaro

Short Term Goals (0 to 5 years)				
Complete the three peaks challenge in under 24 hours. Receive a 1 st in my degree. Become fluent in a new language. Visit all 7 wonders of the world				
Goal	Objective	Resources Required	Measurement	Target Date
Complete the three peaks challenge in under 24 hours	To climb the tallest mountain in Wales, England and Scotland in a single day	Fitness, Correct hiking equipment, Hiking partner	Take a selfie with hiking partner	August 2025
Receive a 1 st in my degree	Pass my degree with the highest grade I can	Sustained effort, Planning	Receive a 1 st by the end of my degree at UWTSD	July 2027
Become fluent in a new language	To become fluent in a second language of my choice which will help my employability	Time, Commitment	Be able to have a full conversation with a local in their native country	December 2027
Visit all 7 wonders of the world	See all 7 wonders of the world	Money, Time	Take photos with ever modern wonder of the world	May 2028
Work in F1 or WEC	Be qualified enough to have a job in a motorsport team competing in either F1 or WEC	Degree, Experience in industry,	Have a job in Formula One or World Endurance Championship	January 2029
Climb Mount Kilimanjaro	To become fit enough to reach the peak of Mount Kilimanjaro	Money to pay for guide, Fitness, Correct hiking equipment	Picture at the peak	August 2030
Visit all 7 continents	Experience as many different cultures as I can	Money, Time off work,	Have visited Europe, Asia, South America, North America, Africa, Australia and Antarctica	January 2033

8. Conclusion

This technical report highlights the importance of health and safety, professional standards, problem solving and working as a team in motorsport engineering. Compliance with legislation such as PUWER, PPER and HSW is vital in keeping workplaces safe along with correct risk assessments and PPE usage.

Engineering organisations such as IMechE and EC help to push the motorsport world towards a more sustainable and environmentally friendly future through advancements in technologies such as synthetic fuels and more efficient aerodynamics.

Problem solving is a part of any engineer's life, employing methods such as the 5 whys and fish bone diagrams help engineers to effectively conduct RCAs on a range of product issues. Team structure is also very important when it comes to tackling problems. For example, those I encountered on DofE, with us finding the hierarchical structure to be a good balance between strong leadership and accountability. An effective team structure can greatly increase team cohesion, efficiency and morale.

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