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Engineering Technical Report

Workshop and Practice (ACHA4011)

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Introduction

This Engineering technical report will discuss five main topics: Health and safety and Risk Assessments, An engineer's Role in Society, problem-solving, Team Structure, and Personal Development. In these topics, relevant research will be made for an in-depth discussion. The objective of this technical report will be to discuss health and safety in consideration of an activity undertaken in the university since the beginning of the course. Secondly, research engineers' societal roles and discuss whether a code of conduct should be followed. Problem-solving and team structure will also be a focus point of this report as it will analyse engineering teams' problem-solving options; this will lead to a review of a personal account of working in a team to discuss the structure used and the positive and negative aspects. Finally, this report will conclude with a personal development plan.

Chapter 1 – Health & Safety with Risk Assessments

Health and safety legislation in engineering workshops is critical to a secure and compliant working environment. Within the area of engineering workshops, many regulations and standards are in place to ensure the well-being of workers and the prevention of workplace hazards/ accidents. This chapter will consider the health and safety and risk assessment in correlation to an engine strip and rebuild, which has taken place since the start of the course in university. The engine strip/ rebuild takes place in one of the workshops on the UWTSD IQ campus; this means there are legislation and rules to follow when participating in this activity. The first of which is the use of steel toe boots (Figure 1),



Figure 1 1(steel toe boots)

which have to be worn and are supplied to all students and staff members who enter any workshops in the university (UWTSD, 2023), this follows the Personal Protective Equipment at Work Regulations 1992 (gov.uk, 2022). The PPE at Work Regulation 1992 states that suitable PPE must be supplied to anyone exposed to a risk to their health or safety while at work (gov.uk, 2022). PPE is mandatory in the university workshops and includes steel-toe boots and protective clothing. These both fall under the Protective Equipment at Work Regulations 1992 legislation and would both be relevant to the engine strip/ rebuild activity. Another relevant legislation to the activity would be the provision and use of work equipment regulations 1998 (gov.uk, 1998). The Provision and Use of Work Equipment Regulations (PUWER) 1998 is a piece of legislation in the UK that addresses the use of work

equipment across many industries, including engineering workshops. PUWER aims to make sure that work equipment is maintained correctly, safe to use, and suitable for its intended purpose (gov.uk, 1998). This legislation is relevant to the activity as training and information on how and when to use the right equipment would need to be provided when taking apart an engine and reassembling it. Using a general risk assessment matrix for mechanical workshop areas, the engine strip/rebuild could be seen as medium to low risk; this is dictated as seen in Figure 2.

What are the hazards? (See list of sample hazards)	What are the risks?	Who might be harmed? (eg Staff, students, visitors)	What control measures are required to eliminate or reduce the risks?	Risk Evaluation			Risk Rating Low, Medium or High
				Consequence (1 – 3)	Likelihood (1 – 3)	Overall risk (C x L)	
Using general mechanical workshop machinery including lathes, mills, grinders, guillotines, welding plant, Band saws	abrasions, cuts, burns, eye injury, entanglement in moving machinery, severance of limbs, crush injury	Technicians	- Appropriate PPE <u>must</u> be worn - Access to the workshop machining areas are strictly restricted to authorised personnel only - No one may operate workshop equipment unless they have received a sufficient training and permission from the management. - Specific risk assessments for machinery and the generic risk assessment for power hand tools have been completed and safe systems of work issued to operatives. - Guards on the machines <u>must</u> be used. - All workshop equipment is regularly maintained and serviced. - Long hair <u>must</u> be completely covered and suitable eye protection worn	3	1	3	M
Using power hand tools and associated electrical equipment for use on machine tools.	Electric shocks or burns from using faulty electrical equipment with possible electric seizure or fatality. Abrasions and eye injury.	Technicians, Logistics personnel	- Appropriate PPE <u>must</u> be worn - Access to the workshops portable electrical equipment is restricted to certified personnel only. - There is a validated PAT testing for electrical safety on each portable appliance. - Electrical cables and plugs should be regularly visually inspected by the user for damage. - Any defective equipment will be reported to the technician-in-charge and taken out of use until the repair has been effected. - Electrical equipment is always operated in accordance with manufacturers' instructions.	3	1	3	M
Manual handling of heavy/bulky objects	Back injury, crush injury, Entrapment, damage to goods being lifted or transported	Staff, Students, Visitors	- A risk assessment <u>must</u> be completed for lifting heavy and bulky loads that present a risk of injury. - Training in lifting techniques will be provided for workshop staff who undertake the lifting of heavy loads. - Appropriate PPE for lifting operations must be worn. - Appropriate lifting tackle used for specific job. - Lifting equipment will be registered with the University's Engineering Insurers and annual inspections carried out. Records of the inspections must be kept in the safety file.	3	1	3	M

Figure 2: Risk Assessment Matrix (University of Glasgow, 2017)

Image 2 shows that power hand tools, general mechanical workshop machinery, manual handling and associated electrical equipment are all medium risk; this is determined as they all have a high consequence to the person operating/performing them in the risk evaluation. However, these have a low likelihood of happening. The risk evaluation shows these potential hazards as medium risk in the mechanical workshop area; this would mean that these potential hazards would also be a medium risk when carrying out the engine strip/rebuild in the university workshop area. These risks, however, would come with control measures to prevent them, for example, providing lifting equipment and training in safe handling and comprehensive training programs for mechanical tools.

Chapter 2 – Engineers Role in Society

The Engineering Council (UK) and the Institution of Civil Engineers (ICE) (the Institution of Civil Engineers, 2018) are two organisations that establish codes of conduct specifically for chartered engineers. The Engineering Council in the United Kingdom manages the engineering profession and sets the standards for professional engineering competence and conduct. It provides the "UK-SPEC" (Engineering Council UK, 2023) for professional engineering competence and a corresponding code of conduct. Chartered engineers in the UK must adhere to this code, which emphasises chartered engineers' ethical responsibilities, integrity, and accountability in their professional practice.



Figure 3: Engineering Council Logo (Engineering Council UK, 2023)

The Institution of Civil Engineers (ICE) provides specific guidelines for chartered engineers and its general code of conduct. The code of conduct for chartered engineers emphasises professional integrity, competence, and ethical behaviour. It promotes sustainable and ethical engineering practices by emphasising client, colleague, profession, and society responsibilities. The Institution of



Figure 4: The Institution of Civil Engineers (ICE) Logo (The Institution of Civil Engineers (ICE), 2023)

Civil Engineers (ICE) and The Engineering Council (UK) stress engineers' vital role in addressing environmental and sustainability issues in their professional practice as engineers contribute to the rising climate change concerns (Lawlor, 2017).

The UK Standard for Professional Engineering Competence (UK-SPEC) recognises the importance of sustainability in engineering. Regarding motorsport engineering, sustainability considerations must be integrated into various aspects of the sport, including vehicle design, fuel efficiency, materials used, and waste management. Engineers are urged to create new technologies that improve efficiency while reducing their environmental footprint. ICE's engineering code of conduct emphasises the importance of considering the environmental impact, even in specialised fields like motorsport. Chartered engineers should consider the long-term impact of their work on the environment and society. In motorsports, this involves promoting sustainable vehicle designs and efficient engines, reducing the sport's ecological impact.

Chapter 3 – Problem-Solving

Engineers in the industry encounter various issues on a day-to-day basis and must use problem-solving solutions quickly and efficiently (Herro, 2021). Figures 5,6 and 7 show flow diagrams for problem-solving when a problem is found during the development of a product, once on the market, or when a supplier issue is in the production process.

Issue Found During Development (Figure 5)

Identifying the Problem:

Issue Discovery: Identify the problem during the development or testing phase.

Resolving the problem:

Root Cause Analysis: Investigate to determine the root cause of the issue.

Solution Generation:

- Brainstorming: Get the engineering team to generate potential solutions.
- Prototype and Test: Develop prototypes and test potential solutions.

Implementation:

- Selection: Choose the most effective solution.
- Integration: Implement the chosen solution into the product design. (Pluralsight, 2022)

Validation:

Test the modified design to ensure the issue is resolved.

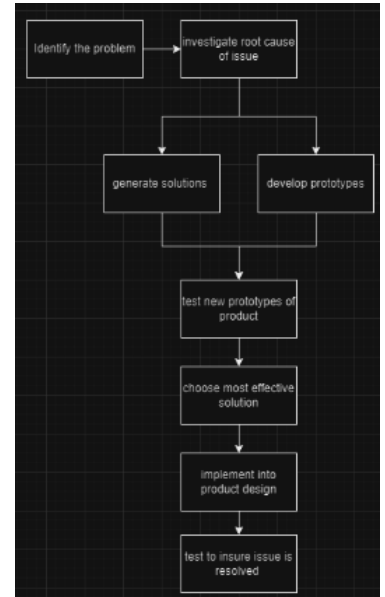


Figure 5: Issue Found During Development flow diagram.

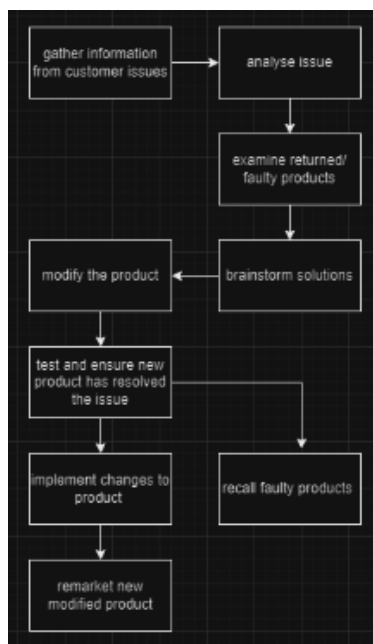


Figure 6: Issue Found Once on the Market (flow diagram).

Issue Found Once on Market (Figure 6)

Problem Identification:

Customer Feedback/Complaints: Gather customer information regarding the issues.

Problem Resolution:

Root Cause Analysis:

- Data Collection: Collect data and analyse the issue.
- Product Examination: Examine the returned or faulty products.

Solution Generation:

- Team Collaboration: Engage cross-functional teams to brainstorm solutions. (Proctor, 2018)
- Rework Design: Modify the product design or components.

Implementation:

- Manufacturing Changes: Implement changes in the manufacturing process.
- Product Recall or Update: Recall faulty products or issue updates.

Quality Assurance:

Ensure the fix resolves the issue by testing and validating the modified product.

Supplier Issue in Production Process (Figure 7)

Problem Identification:

Supplier Communication: Communicate with the supplier regarding the issue.

Problem Resolution:

Root Cause Analysis:

- Supplier Investigation: Investigate the supplier's process or component causing the issue. (Immerman, 2021)
- Quality Check: Evaluate the supplied components for issues.

Solution Generation:

- Alternate Supplier: Identify alternative suppliers if necessary.
- Negotiation/Resolution: Discuss and resolve issues with the existing supplier.

Implementation:

- Supplier Improvement: Collaborate with the supplier for process improvements.
- Quality Control: Implement strict quality checks on incoming components.

Monitoring and Evaluation:

- Continuous Monitoring: Regularly monitor the supplier's performance.
- Quality Assurance: Ensure ongoing quality of supplied components.

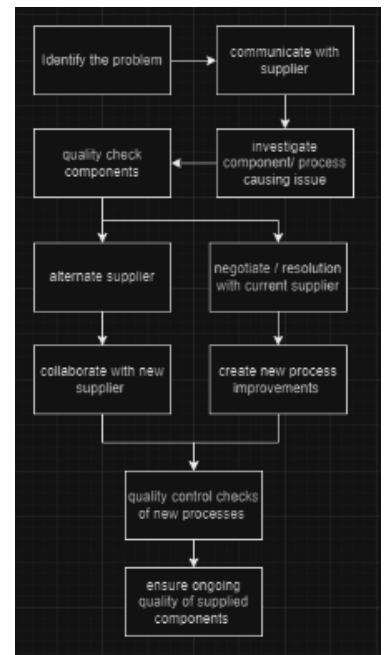


Figure7: Supplier Issue in Production Process flow diagram.

Chapter 4 – Team Structure

Last year in foundation, we were assigned to design a soapbox car, which had to adhere to specific regulations. As a team of 6, we did not have any team structure. Our team delegated tasks equally and worked on separate assignments simultaneously to gather information more efficiently between us. This, however, did not work as planned and tended to cause more delay in the project as tasks were left to be done later. This was one of the negatives of not having a designated team structure. In our team, tasks were assigned to people based more on their ability and interest in completing them. This was a positive in our team as tasks were completed to a better standard and had more quality to them. This, of course, comes with its positives and negatives. One of the negatives of working without a team structure was the lack of coordination. As there was no established

structure, coordination among our team members became challenging. This led to tasks falling through the cracks. Working without a structure also had its positives, however. Our team had no structure, so we worked more creatively and devised unconventional, out-of-the-box ideas that applied to our soapbox car design. This effect of working without a team structure is supported by (Paula Anzola-Román, 2018). Figure 8 shows a visual representation of what our team structure looked like. Figure 8, compared to Figure 9, shows that we, as a team, had more of an organisational structure rather than a hierarchy structure. This, of course, came with its positives and negatives.



Figure 8: Organizational Structure

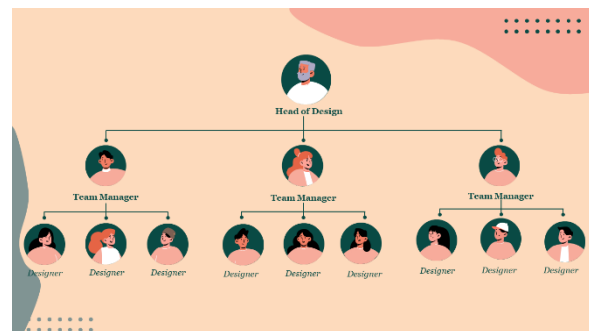


Figure 9: Hierarchy team structure

Suppose we had adopted the hierarchy team structure. In that case, we might have benefitted from more positives, including Improved Communication, having a chain of command, and being designated defined roles within the team. A pyramid-shaped formal hierarchy is created when most team members have low or moderate authority and a few possess high authority (Henrik Bresman, 2013). This structure reflects a positively skewed authority distribution as suggested by (Wellman, 2020). If our team had used this pyramid-shaped hierarchy, we could have benefitted from more positive authority distribution. Another positive effect of a hierarchy team structure is accountability. In a hierarchical structure, the allocation of responsibility is clearly defined. Team members are accountable to their immediate supervisors or managers, which can help assess individual performance and commitments. Working within a hierarchical structure can have its benefits in certain aspects, but it also has its drawbacks. One of the negatives of this structure is that complicated chains of command can arise, which will slow down decision-making and the team's overall progress (NI Business info , 2023). Balancing the need for clear structure and efficient decision-making with flexibility, creativity, and open communication often involves finding a middle ground. Some organisations adopt hybrid structures that combine hierarchy elements with more modern approaches to create innovation while maintaining organisational clarity.

Chapter 5 – Personal Development Plan

Name – Conor Jenkins

Degree – Motorsport Engineering

Previous Qualifications – A-LEVEL

Previous Experience – N/A

Long Term Goals (5 to 10 years)				
Working in the Motorsport industry Working in Formula 1 Work for RedBull Racing				
Short Term Goals (0 to 5 years)				
Pass 1 st year of university Complete all three years of university Gain experience in the motorsport industry				
Goal	Objective	Resources Required	Measurement	Target Date
Complete all three years of university.	Pass all modules and examinations throughout the three years and complete the final project.	Commitment to course, e.g., time and work applied	Graduation/ gaining a degree	2026
Gain experience in the motorsport industry.	Work/ gather information in the motorsport industry to further my knowledge.	Complete a year in industry work within motorsport.	Gaining experience/ working within the industry	2026
Work in a motorsport team/ company	Work for a company/ team directly correlated to the motorsport industry.	Knowledge of the industry and experience gained from university.	Being hired by a team/ company	2030
Work within Formula 1	Gain experience in lower divisions of racing and move up to Formula 1	Experience in Motorsport engineering and working for smaller racing/ industry companies.	Working for lower racing division teams progressing to Formula 1	2033
Work for RedBull Racing	Build my way up in the industry to apply for RedBull Racing job	Experience in Formula 1 motorsport Teams	Gaining a job with RedBull Racing	2033

Conclusion

In conclusion, this report has discussed health and safety while undertaking an activity at university, considering the relevant legislation and risk assessment matrix and discussing the use of PPE and risks involved with the activity.

This report gathers research and information into two different charter engineers' organisations and how their codes of conduct are applied to sustainability and environmental issues in motorsport, considering their responsibility.

Information has been gathered by exploring various team structures to show the significance of collaboration and effective communication in achieving common goals. While hierarchical structures offer clarity, they may stop creativity, whereas flexible structures can create innovation but might need a more precise direction. Finding a balance between these approaches is important in harnessing both strengths.

Navigating issues during different product development and production phases is an inevitable aspect of the engineering process. Problem-solving solutions must be used quickly and efficiently when deciding how to move on when faced with an issue.

Lastly, this report concludes with a personal development plan for myself, considering my short/long-term goals for the future, giving brief target dates for these goals and objectives on how I am to achieve them.

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