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ENGINEERING TECHNICAL REPORT

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Programme and Module

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Chapter 1 - Introduction

This technical report delves into the key aspects of engineering, including the significance of health and safety and how risk assessments are used to aid this. Furthermore, the report examines the responsibilities of engineers and the seriousness of their code of conduct. Problem solving is a crucial part of engineering, therefore the report also explores the importance of different techniques throughout the industry. Additionally, the crucial element of team structure is also mentioned and how this can impact a project's success.

Chapter 2 – Health & Safety with Risk Assessments

Health and Safety is a key element in engineering. Health and safety laws and legislations are enforced, with the sole purpose to prevent accidents and ensure safety in the workplace. To achieve this, risk assessments must be undertaken to identify hazards and their potential impact to employees.

A technician was tasked with stripping and rebuilding an engine as part of a practical workshop project. The primary purpose of this task was to emphasise the importance of teamwork and safety.

The Health and Safety at Work Act 1974 is the main piece of legislation covering health and safety in the workplace. It outlines the responsibilities of both the employer and employee, ensuring there is a safe working environment. Furthermore, the legislation also Portrays that it's the employer's response to ensure the well-being and safety of their employees while at work. This means that Employers must provide the necessary and adequate training to maintain a safe working environment.

Not to mention, the safety act places a clear responsibility on employees to take care of their own health and safety, as well as to acknowledge that their actions can directly affect the well-being of others in the workplace. These responsibilities include; employees are required to inform the employer of any illness or injury that could affect their ability to perform their job safely, to help prevent additional harm. (BBC, 2023)

The Personal Protective Equipment (PPE) at Work Regulations 2022, effective from 6 April 2022, updated the previous PPE regulation, Personal Protective Equipment at Work Regulations 1992 (Legislation.gov.uk, 2023). The Objective of the PPE regulation is to deliver clearer, concise and comprehensive guidelines on the use of protective equipment in the workplace. Additionally, these regulations were implemented to protect employees from workplace hazards that could cause injury or ill-health, this includes supplying necessary protective gear, such as safety helmets, gloves, and protective clothing, that will help reduce the risk of injuries or health issues. (Health and Safety Executive, 2022)

A primary example of PPE would be a technician, as they are expected to wear steel-toe safety boots and a dust jacket when stripping and building an engine. The boots protect the feet from heavy objects that could cause injury and provide slip resistance. The dust jacket shields the technician from debris, chemicals, and oils, ensuring safety and cleanliness while working with engine parts.

2.1 Risk Assessment Matrix Table

When looking at a risk assessment matrix, there are two main risks associated with building an engine. Firstly, the engine could topple over and fall onto a technician's foot. This is a likely scenario and could result in major injury, making it a high-risk situation and a rating of 12 on the assessment matrix. Secondly, oil can cause irritation when it comes into contact with skin. While this is a minor consequence compared to an engine falling, it is more likely to occur. Therefore, it could still be classified as a high risk, with a rating of 8 on the risk assessment matrix.

		Likelihood				
		1	2	3	4	5
		Rare	Unlikely	Possible	Likely	Almost Certain
Consequences	5 Catastrophic	5	10	15	20	25
	4 Major	4	8	12	16	20
	3 Moderate	3	6	9	12	15
	2 Minor	2	2	6	8	10
	1 Negligible	1	2	3	4	5

2.2 Risk Assessment Matrix Key

	No Action Is Needed – Acceptable
	Action Is Needed – Minor Changes
	Action Is Needed – Significant Changes
	Action Is Needed – Immediately

Chapter 3 – Engineers Role in Society

The Institution of Mechanical Engineers, often referred to as the 'IMechE', is a professional organisation devoted to Offering advice and opportunities to its members worldwide. Founded in 1847, their purpose is to contribute to the engineering field by supporting career development, education. To achieve this, IMechE has established a code of conduct that engineers are expected to follow. There code of conduct consists of four main principles; practicing competently and maintaining up-to-date knowledge and skills, acting with integrity and respect for others, promoting sustainability, and exercising engineering leadership. (Institution of Mechanical Engineers, 2023)

Similarly, the Engineering Institute of Technology (EIT) is a global institution with a mission to inspire and shape the future of engineering worldwide. To Attain this, EIT share knowledge that addresses the daily challenges faced by engineers and helps them promote the field of engineering. On top of that, the EIT also Retains a Code of Conduct to support its members and encourage managing the conflicting interests and demands of employers, society, and the environment. (www.theiet.org, n.d.)

From analysing both organisations, it is clear that a vital element is the promotion of sustainability. In terms of motorsport, it helps reduce the environmental impact of the industry while promoting innovation in green technologies. IMechE's emphasis on sustainability within its Code of Conduct clearly encourages eco-friendly technologies and urges its members to design sustainable solutions. Similarly, with its focus on addressing engineering challenges, the EIT Can mentor future engineers and provide leadership in Managing the expectations of employers, society, and the environment. This could include the adoption of greener technologies in motorsport, such as alternative fuels. Overall, through their codes of conduct, both organisations have the potential to shape the future of motorsport by incorporating sustainability into engineering practices.

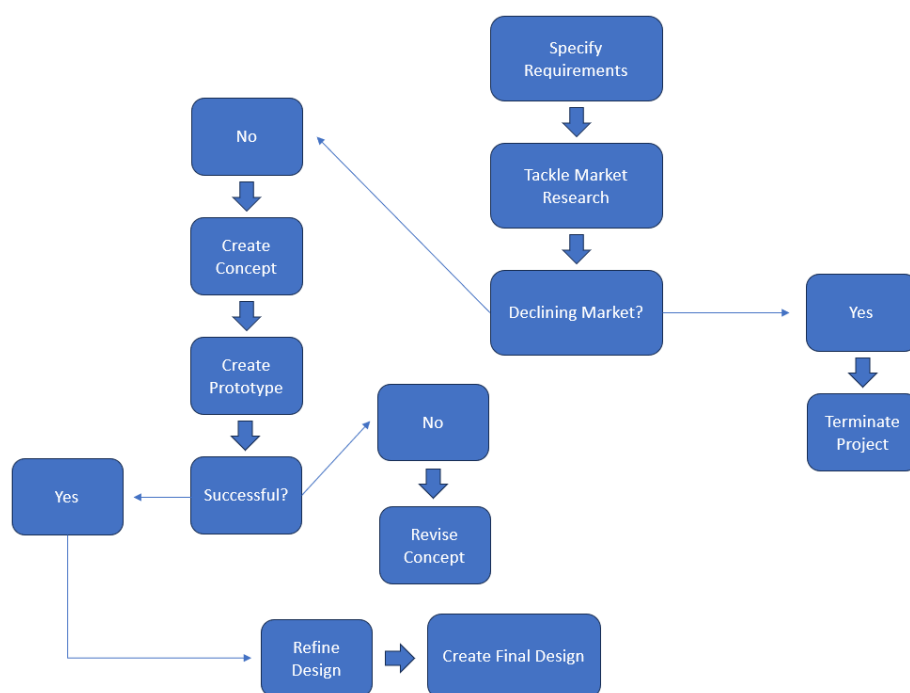
Chapter 4 – Problem Solving

Problem-solving is a crucial part of engineering and involves recognising challenges and identifying practical solutions. Engineers use their knowledge and creativity to analyse problems and implement effective and efficient strategies to meet requirements.

Flowcharts are significant for problem solving, as they help visualise processes and identify areas for improvement. Furthermore, flowcharts pinpoint sophisticated problems by showing how various elements are connected. (MiroBlog, 2024)

Flowcharts can be implemented to solve various issues in different stages of the development and production process of engineering and manufacturing. Flowcharts are a vital tool in engineering, particularly during the development phase. By exploring possible causes and solutions while following logical steps, flowcharts enable engineers and developers to gain a clear, visual representation of processes. (Lucidchart.com, 2019)

4.1 Development and Production Process Flowchart



In addition, Flowcharts also have great importance of when a product is on the market. Flowcharts can assess operational issues, meaning once the root cause of a problem is pinpointed, it usually resolved by customer complaints or product failures.

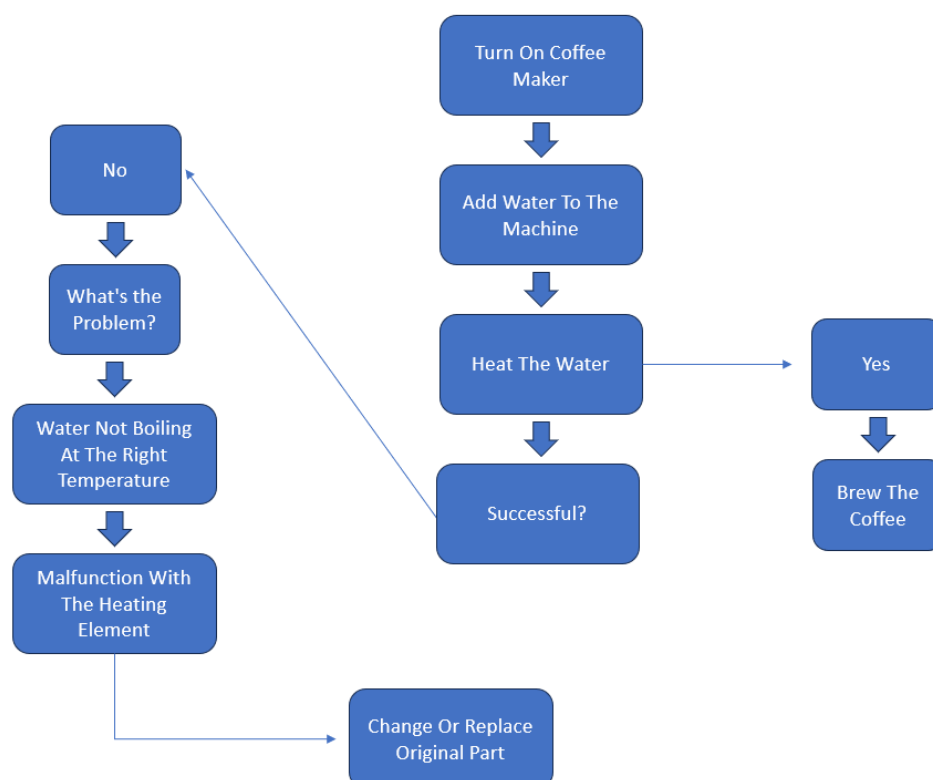
Finally, flowcharts are immensely useful for addressing supplier-related issues in production. Delays in materials or quality issues are common in the production process. By guiding the team through steps to assess the situation, flowcharts help in finding alternative suppliers.

An example could be, a company releases a new coffee maker, but customer feedback reveals that the machine isn't performing at its best and isn't brewing coffee hot enough. The flowchart outlines the steps involved in making coffee:

1. Turning on the machine
2. Add water
3. Heat the water
4. Brew the coffee

After reviewing the flowchart, it becomes clear that the issue lies with the heating element. The flowchart allowed the company to quickly identify the problem and repair the heating element, resolving the issue for customers.

4.2 Product on the Market Flowchart

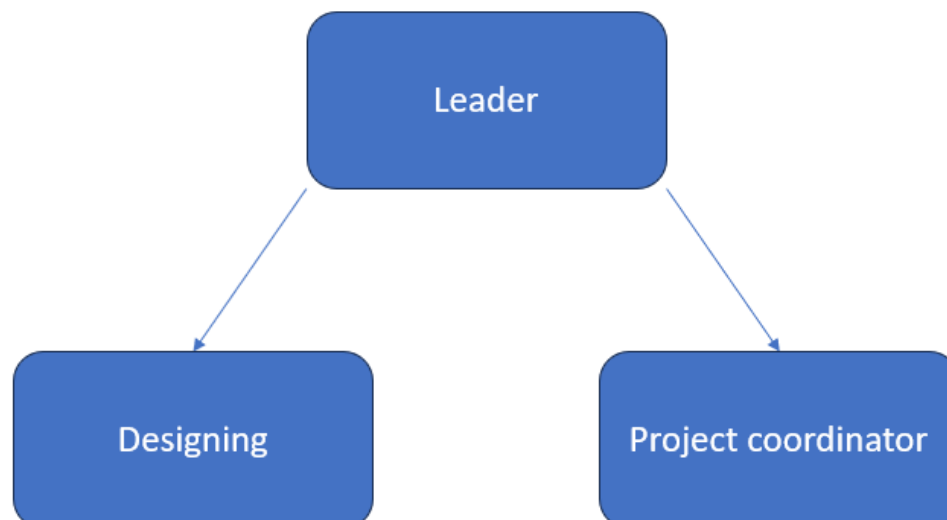


Chapter 5 – Team Structure

While in college, myself and a group of students decided to take on a major project. The driving force behind our initiative was the environmental damage caused by modern combustion engines, and the increasing push for green technologies. To address this challenge, we decided to enhance the cooling system on a Greenpower vehicle. Collectively, we decided that the best way to cool the 240W 24V electric motor, was to design motor heatsinks fins. We chose this idea for the reason, it is proven to work, as motorcycle companies use it as a source of natural cooling for their V-twin engines.

For our team structure, we believed a functional structure would be the best fit for our small group, especially since we wanted one person in charge. The reason for choosing this structure was its ability to establish a clear hierarchy, where each team member is responsible for specific tasks. Additionally, this structure made it simple for one person to oversee operations and ensured efficient communication. Having one leader at the top allowed us to maintain an efficient decision-making process and keep our goals aligned. Overall, a functional structure provides clarity and efficiency. (Indeed, 2023)

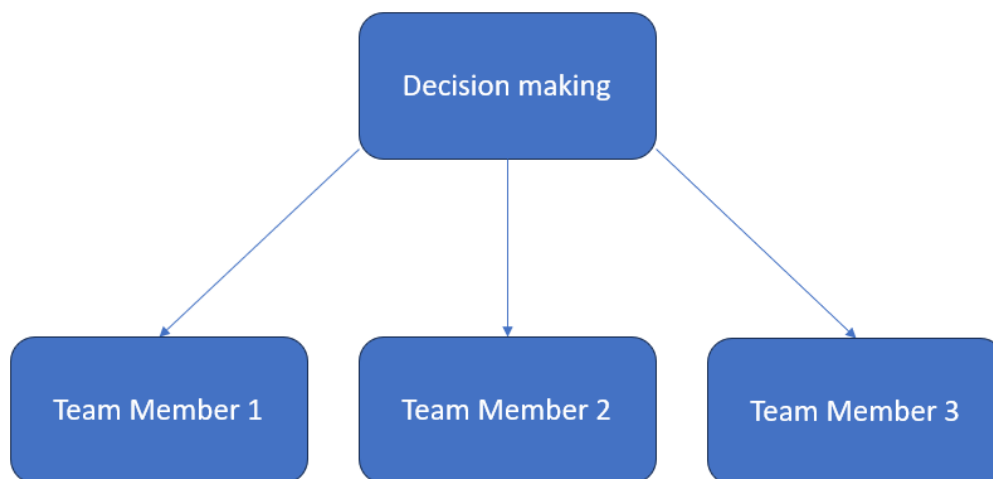
5.1 Functional Team Structure Layout



Choosing this structure did have its disadvantages, for example, while having one leader was beneficial for decision-making, it also meant there was an over-reliance on that leader, which at times led to them becoming overwhelmed, hindering the project's progress. Furthermore, this type of structure can be less adaptable to changing project needs or unforeseen challenges. In the case of creating a cooling system for a Greenpower vehicle, where flexibility is crucial, this could be a significant disadvantage as the structure doesn't easily allow for quick shifts in roles or responsibilities.

An autonomous team structure is self-managed, meaning the team takes full responsibility for its own decision-making and task management. This means that this structure requires extensive communication and a high level of trust. However, the advantages of this structure would mean that we would be Flexible and responsive to change, if necessary, which is what we struggled with initially.

5.2 Autonomous Team Structure Layout



Overall, a functional team structure originally gave clarity and efficiency for our project, it also created limitations, which came down to the over-reliance on a single leader and the inability to quickly adjust roles. If I were to undertake this project again, I would choose an autonomous team structure as it has greater flexibility, empowering all team members to contribute to decision-making and task management.

Chapter 6 – Personal Development Plan

Name:	Robbie Sandford
Degree:	Motorsport Engineering
Previous Qualifications:	BTEC Level 3 Motorsport Engineering
Previous Experience:	I am an 18-year-old enthusiastic, committed and confident navigator, that has experience of national and international rallying in forestry and tarmac. I'm a proud graduate of the Motorsport UK Academy for Co-drivers and have been fortunate to learn from seasoned professionals such as; Nicky Grist, Seb Marshall, together with M-Sport Ford World Rally Team, which has been invaluable in my development. In June 2023 at the age of 17, I took part in the 5-day Mille Miglia race in Italy as part of a crew supporting one of the famous Italian road race automobiles, which started and finished in Brescia and included destinations like San Marino, Rome and Tuscany. My role was one of navigation for the 'chase car' through reading the numerous route books to keep ahead of the competing vehicles, together with coordination and logistics management with other members of the team. Through competing and attending motorsport events, I have been able to meet numerous individuals, who work within the motorsport industry, which has enabled me to create a network of useful contacts. These contacts have provided unique opportunities, like the Mille Miglia, which did result in some offers of employment. However, whilst this was extremely well received and appreciated, completion of my academic studies was my primary focus. As a graduate of the Motorsport UK Co-Driver Class of 2024, I was fortunate to join the M-Sport World Rally Team on the Acropolis Rally in Greece, which was an incredible experience and one I will always cherish. As part of the logistics crew, my primary responsibility was to arrange vantage points, and organise temperature readings, which I could then relay back to the team to inform their tyre choice. The ambience of the event was electric, as I worked amidst the stunning Greek landscapes, filled with the excitement and intensity of the rally. Being part of such a skilled and passionate team taught me the importance of precision and communication in rallying, and witnessing the strategic decision-making process in real-time deepened my appreciation for the sport. It was rewarding to contribute to the team's success on such a historic and iconic rally, surrounded by the energy of the fans and the thrill of the competition.

6.1 Short and Long Term Goals

Short Term Goals 0-5 Years:				
Goal:	Objective:	Recourse Required:	Measurement:	Target Date:
Degree	Obtain a First Class Honours degree in Motorsport Engineering at the University of Wales Trinity Saint David in Swansea.	Liaise with lecturers over topics, which are not clear. Attend extra study sessions, where additional guidance and support is provided.	First Class Honours degree, at graduation	Summer 2027
Employment	Obtain full time employment in the motorsport industry (ideally the Word Rally Championship) post-graduation, with either M-Sport or Hyundai.	Maintain relationships with Richard Miliner Team Principal Ford World Rally Team at M-Sport and Seb Marshall Hyundai WRC Logistics Co-ordinator over progression through the degree course, advising of progress and discussing potential opportunities post-graduation.	Successful job offer, post-graduation.	Summer 2027
Co-driver	Develop my co-driving skills in the Motorsport UK Academy for co-drivers and complete at the highest level.	Maintain active dialogue with my mentors Nicky Grist, Paul Spooner and Seb Marshall. Obtain a competitive seat for the Welsh Forestry Championship for 2025 to challenge myself against some of the most iconic. Compete on the five-day Roger Albert Clark Rally to experience the event which is trying to create the golden era of rallying from the 1970's and 80's.	Successful invitation to attend Year 2 of the Motorsport UK Academy for co-drivers. Win the under 25 Welsh Forestry Championship. Finish the Roger Albert Clark Rally.	November 2025
Long Term Goals 5-10 Years:				
Employment	Travel the world with M-Sport or Hyundai in the Word Rally Championship, engaged in team logistics and have a team of engineers reporting to me.	Once employed by either M-Sport or Hyundai, proactively pursue opportunities to seek a prominent position within the business/team structure.	Recognised in the World Rally Championship as a key contributor and within the respective businesses in a position of authority.	Employment
Co-driver	Aspire to compete at the highest level on national or international rallies. Complete on a round of the World Rally Championship, to experience at the principle of our support.	Continue to challenge myself year on year on all types of rallies (closed road or forestry), to obtain more seats. Maintain and develop the relationships created through the Motorsport UK Academy for co-drivers. Share my experiences and mentor the next generation of young co-drivers, trying to find their way in the sport.	Recognised as a very professional, competent and experienced co-driver throughout the UK rally community. Following from my graduation from the Motorsport UK Academy for co-drivers, I hope to be sitting in top 10 entries on a regular basis.	November 2029

Chapter 7 – Conclusion

In conclusion, this report has studied the important aspects of engineering, providing an insight into health and safety, risk assessments, problem solving techniques, and finally, team structures.

Health and safety are a vital part of engineering. Furthermore, a significant part of health and safety is the responsibility to protect both employees and the public. Through risk assessments, engineers can identify potential hazards, and ensure measures are put in place to overcome this. Through research, finding regulations such as the Health and Safety at Work Act 1974 (BBC, 2023) and the Personal Protective Equipment at Work Regulations 2022 (Health and Safety Executive, 2022) it has become apparent, that they are the backbone to health and safety in the workplace, meaning they can reduce injury and ensure a safer working environment.

Furthermore, the report also analyses the important elements of engineer's responsibilities, which is backed by global organisations like IMechE and EIT. The codes of conduct set by these organisations highlight the requirements for engineers to act with competence, integrity, and respect for others. On top of that, sustainability is a fundamental value to both the IMechE and EIT, supporting eco-friendly engineering practices.

Moreover, an essential aspect of engineering is problem solving. The report has explored the use of flowcharts as a tool for tackling complex engineering challenges. The example of the coffee maker conveys how flowcharts can swiftly pinpoint the source of a problem, leading to faster resolutions, which ultimately can improve customer satisfaction.

The report delves into the role of team structure in engineering projects. The initial choice of team structure when undertaking the Greenpower vehicle project was functional, as it allowed for clear task delegation and efficient decision-making. However, as the project progressed, the challenges faced by the team outlined the importance of flexibility, leading to the conclusion that an autonomous team structure would be the way forward.

Overall, health and safety, problem solving, and efficient team structures are paramount to the success of engineers, engineering organisation and manufacturers. On top of that, engineers must not only have technical expertise but also manage complex social, ethical, and environmental responsibilities. The right tools and team structures means that engineers can contribute to projects as well as being responsible and sustainable.

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