

University of Wales Trinity Saint David

Wales Institute of Science and Art



Prifysgol Cymru

Y Drindod Dewi Sant

University of Wales

Trinity Saint David

Engineering Responsibilities

Workshop & Practice – ACHA4011

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Contents

1	Introduction	1
2	Health & Safety with Risk Assessment.....	2
3	Engineer’s Role in Society.....	5
3.1	Environmental & Sustainable Practise in Motorcycle Engineering.....	5
3.2	Chartered Engineers.....	5
4	Problem Solving Product Development Issues	6
4.1	Root Cause Analysis.....	6
4.2	Risk Management.....	7
4.2.1	Further Reading.....	7
5	Team Structure.....	8
6	Personal Development Plan	10
7	References.....	12
	Figure 1: UWTSD WISA supplied risk assessment form filled for IQ016b test cell.....	3
	Figure 2: UWTSD risk matrix.	4
	Figure 3: Simple root cause analysis flow diagram.	6
	Figure 4: A simple risk management flow diagram that allows for the continuous update of the risk matrix until project completion.....	7
	Figure 5: Original team structure.	8
	Figure 6: Revised team structure.	9

1 Introduction

This report aims to cover a variety of topics that an engineer might experience in an engineering position. From health and safety and team dynamics to ethical and social responsibilities, it encompasses key areas that are found in modern job roles and explores them based on the author's research and personal experiences.

2 Health & Safety with Risk Assessment

The MSR400 Dynamometer (dyno), otherwise known as a test cell, available at the University of Wales: Trinity Saint David (UWTSD) is a motorcycle specific dyno used to measure dynamic power with controllable acceleration and static power at constant speed (MAHA, 2023). It allows for the testing and diagnostics of motorcycles by providing data related to engine performance.

Fall and Owen, 2023 provide a UWTSD risk assessment that has been created to outline hazards that may harm staff and students using the facility. A total of fourteen hazards are identified alongside the potential harm, risk rating, methods of control/risk minimisation and a residual risk rating (Figure 1) that is calculated using the risk matrix (Figure 2). Note that these results are subjective, so it is important that the persons responsible for creating the report have relevant experience.

Using the risk assessment, we can find the personal protective equipment (PPE) suggested to safely operate within the test cell. Three PPE items are directly mentioned throughout the assessment, suitable footwear (steel toe cap boots), safety goggles and ear defenders.

Suitable footwear is required due to the number of trip hazards associated with a test cell. The assessment details uneven flooring along with vehicle straps and extractor hoses noted as tripping hazards, alongside the heavy machinery and vehicles present. Safety goggles are required due to the risk of flying debris caused by the rotation of the dyno and vehicle parts, mechanical failure and the strong fan supplied to assist with cooling. Ear defenders are provided and required in areas that exceed 85dB to reduce the risk of hearing loss by loud noise exposure.

Using the risk assessment, we can visualise the rating for hazards that have been identified with the majority showing a red (substantial/intolerable risk) or orange (moderate risk) colour. With the use of PPE and correct training for staff and students, the risk rating can be minimised to a low/acceptable rating. The control section details measures that are taken to minimise risk.

Further research proves limited on the health and safety legislation put in place for test cells specifically, with Martyr and Plint (2012, pg. 21) stating that test facilities generally do not have specialised health and safety regulations designed exclusively for their operations but instead typically fall under broader laws pertaining to workplace safety and environmental protection.

In conclusion it is important to respect the local health and safety legislation put in place when operating a dynamometer whilst also using common sense to identify potential hazards and dealing with them accordingly.

RISK ASSESSMENT TITLE											
SW-EN-15-01-23-I.Q Building and Workshops Chassis Dynamometer test cell IQ016b											
RISK ASSESSOR NAME	UNIVERSITY INSTITUTE / DEPARTMENT			BRIEF DESCRIPTION OF ACTIVITY				DATE VALID FROM			
Mark Fall	UWTSW WISA			Motorcycle and car testing facility. Chassis Dynamometer/Rolling Road				14/01/2023			
AUTHORISING LINE MANAGER	PERSONS AT RISK			DATE(S) / LOCATION(S) OF ACTIVITY				REVIEW DATE			
Greg Owen	Staff/Students			Location utilized as and when needed throughout the year				14/01/2024			
HAZARD	POTENTIAL HARM	RISK RATING			CONTROLS				RESIDUAL RISK		
List what could cause harm from this activity.	For each hazard, identify the type of harm that could occur eg biological, physical, chemical, safety, ergonomic or psychosocial	See Risk Ratings Tab			For each hazard, list the the measures you will be taking to minimise the risk identified.				See Risk Ratings Tab		
		Severity	Likelihood	Risk					Severity	Likelihood	Risk
Uneven flooring, vehicle securing equipment (straps and chains), extractor system hoses, cables and sensor leads, wheel mount structure and dynamometer rollers.	Slips, trips and falls - cuts, bruises, muscular skeletal and other injuries, sprains, fractures.	4	4	16	Notify all concerning the following: Ramping onto and off the equipment is raised above flooring as are mechanism covers. Securing equipment to the front and rear of the vehicle including straps and chains also to the sides of the motorcycle when mounted. Exhaust extractor hosing to the rear of all vehicles across floor when in use. Cabeling to and from computers, fans and power sources when in use. If no vehicle is mounted care to be taken around motorcycle front wheel mount and moving roller in floor. All staff Students and visitors to be restricted to assigned areas. Suitable footwear to be worn by all.				2	2	4
Electrical Equipment and Sockets	Electric shock, burns, fire	3	3	9	Pre-use checks to be carried out by user to ensure cables and plugs are not damaged - defective equipment to be reported immediately and taken out of use until repaired or replaced. Electrical equipment subject to regular safety inspection and testing (PAT) - tested appliances to be labelled to show date tested and next test date. Electrical equipment must always be operated in accordance with manufacturers instructions. Avoid using				2	2	4
Harzardous Substances - contact with oil/petrol	Contact with used engine oil/petrol - skin irritation, dermatitis, skin cancer	4	2	8	In case of spills and leakage, nitrile gloves (EN 374 standard) and cleaning equipment to be supplied and used by authorised staff. Spillages to be cleared immediately and reported using online reporting form				2	2	4
Hazardous Substances - Car Running inside	Inhalation of toxic fumes (Carbon Monoxide) - eye irritation, breathing difficulties, asphyxiation	4	5	20	Car/motorcycle exhaust to be attached to extractor when engine is running. Extraction system to be regularly maintained/serviced. CO monitor to be regularly checked and if level high enough to trigger red alarm on monitor, test to be halted and cell evacuated until levels drop with ventilation. Exraction system checked before recomencement of test.				2	2	4
Fire - General	Building damage, trapped persons, inhalation of smoke, personal injuries (burns)	5	3	15	Smoking is prohibited inside building and immediately outside building entrances. Fire Alarms to be regulary tested and serviced. Fire Extinguishers provided throughout the building. Staff/Students aware of fire procedures and familiar with fire exits and muster points. Cell fire door to be unlocked during testing. Assigned fire extiguisher personel.				2	1	2
Fire - Petrol/LPG	Storage of fuel, refuelling cars/equipment - building damage, spillage, explosive atmosphere (DSEAR)	5	2	10	Vehicles to be fueled outside of rolling road cell unless nessesary, in which case fuel to be dispenced by authorised staff utilising appropriate fuel bowser (EMILCADDY110 (Green)). No fuel to be stored inside cell. Spillages to be cleared immediately and reported using online reporting form. Staff/Students to be advised of hazards of working with petrol/LPG/Diesel fuels. Assigned fire extiguisher personel.				2	1	2
Vehicle mechanical equipment	Mechanical failure of engine and or moving parts, flying particles - personal injury (entrapment, crush injury, eye damage)	5	3	15	Vehicles must be visually checked prior to using. Any faults/damage/leakage to be reported immediately and equipment must not be used. Vehicles must not be left running when unattended. Personel to be confined to restricted zones during testing process. Barriers/restrictions must be in place and must not be removed under any circumstance when in use. Safety googles to be worn. Only trained member of staff to operate and test vehicles.				2	3	6
Vehicle mechanical equipment. Compressed Air	Explosion tyres - Blast injuries, damage to organs if introduced into body	5	3	15	Tyre failure due to stress under testing loads. Tyres inspected for suitability/damage and under correct pressure prior to testing. Personel to be confined to restricted zones during testing process. Safety goggles required				2	1	2
Compressed Air	Explosion tyres, injection of air into body - Blast injuries, damage to organs if introduced into body	3	2	6	All staff and students to be briefed on safe working procedures and the dangers of horseplay. Airline to have deadman's handle. System to be regularly inspected and serviced.				1	1	1
Vehicle Movement	Crushing injury, fractures from falling over after being srtruck.	4	3	12	Vehicles to be located onto test equipment by authorised staff. Clearly marked safe zones and walkways to be used at all times. Vehicles must be driven slowly in/out of test cell. Safety footware to be compulsory within test cell				2	2	4

Figure 1: UWTSW WISA supplied risk assessment form filled for IQ016b test cell.

Slips, Trips and Falls - Same Level	Sprains, strains, fractures from falling or slipping on oil or water or tripping over equipment	3	2	6	Good housekeeping standards maintained through regular monitoring. All areas including fire escape routes/exits must be kept clear of obstructions. all strapping/chains and linkages to be stored in relevant lockers provided when not in use. Floor must be kept free from oil and swarf. Floors to be regularly degreased. Spillages must be clear immediately and reported to Supervisor.	1	1	1
Hygiene and Comfort	Fatigue, feeling too cold or hot, facilities to wash, dry and rest	2	1	2	Toilets, sinks and a shower available for use which are regularly cleaned and maintained. Locker room/storage area provided. Building maintained at comfortable temperature. Workshop temperatures will not be regulated. Drinking water available.	1	1	1
Access to Workshop area by unauthorised personnel	Personal injury due to unfamiliarity of area/equipment and vehicle movements	3	2	6	Clear signage in place 'No access to unauthorised personnel'. Students to be inducted prior to being permitted to work in workshop. Areas to be kept locked and secured when not in use. Staff members to be vigilant and challenge any unfamiliar personnel	1	1	1
Noise	Exposure to noise - tinnitus, temporary hearing loss, permanent hearing loss	4	5	20	Noise Assessments to be carried out in areas where there is excessive noise level. Where noise levels exceed the upper exposure limit of 85dB signage must be in place and hearing protection mandatory. Task specific risk assessments will identify the need for hearing protection. Hearing protection to be provided and worn.	1	1	1

Figure 1 continued.

		Severity of Incident				
RISK MATRIX		1 - Insignificant	2 - Low	3 - Moderate	4 - High	5 - Major
Probability of Occurrence	5 - Certain	5	10	15	20	25
	4 - Very Likely	4	8	12	16	20
	3 - Likely	3	6	9	12	15
	2 - Unlikely	2	4	6	8	10
	1 - Highly Unlikely	1	2	3	4	5
Substantial / Intolerable Risk (15 - 25)		Work must stop until suitable control measures have been implemented. Additional resource / cost likely required.				
Moderate Risk (8 - 12)		Further consideration to be given to reduce risk. Additional resource / cost potentially required.				
Low / Acceptable Risk (1-6)		No or limited further risk reduction measures required. Monitor existing controls. Additional resource / cost unlikely to be required.				

Figure 2: UWTSD risk matrix.

3 Engineer's Role in Society

In 2005 the Engineering Council and Royal Academy of Engineering (RAoE) joined to produce a statement that existed to outline four fundamental principles of engineering ethics, practise, and decision-making. Similarly, the Institution of Mechanical Engineers (IMechE) produced a code of conduct document containing their rendition of principles.

Both the IMechE and the joint Engineering Council & RAoE code of conduct mention directly an engineer's environmental and sustainability responsibilities.

"Respect for life, law, the environment and public good" (Engineering Council, Royal Academy of Engineering, 2017).

"All members shall engage responsibly with the environment" (Institution of Mechanical Engineers, 2021).

3.1 Environmental & Sustainable Practise in Motorcycle Engineering

As growing public and political pressures challenge the automotive industry, motorcycle engineers and manufacturers hold accountability to ensure the products they produce fall in line with legislation and public need.

Triumph is one such manufacturer leading the transition to sustainable fuelling options, stating they have a commitment to providing a sustainable future in motorcycling. A press release in December 2022 stated that a new testing programme dedicated to the research and development of sustainable fuels had been developed with the goal of introducing E40 fuel in the Moto2 World Championship by 2024 and shifting the focus towards adopting E100 by 2027 (Triumph, 2022).

They also go on to mention their dedication to emissions reduction "Beyond current European and worldwide legislation". Further mentioning it is their focus on delivering responsible motorcycling for years to come, with a comment from Steve Sargent, Chief Product Officer at Triumph, stating "Ultimately, our aim is to take all the learnings we gain from racing to make our road bikes even better, which of course encompasses not just performance but also their impact on the environment".

3.2 Chartered Engineers

Chartership in engineering is acquired by meeting competences in a professional standard, set out in The UK Standard for Professional Engineering Competence and Commitment. Holding a Chartered Engineer (CEng) title allows an individual to prove that their education and personal experiences have provided them with the correct tools to be considered a competent engineer (Royal Engineering Council, 2023).

Professional indemnity (PI) is an insurance that covers the policy holder against claims of professional negligence. As a chartered engineer a responsibility is held for the work provided and mistakes could cause delays, increased costs or cause serious harm. A PI policy is an extremely important asset for any engineer and covers not just themselves but anything that may happen during or after a project (Markel Direct).

4 Problem Solving Product Development Issues

Addressing problems found during product development is crucial to the success of a product. There are ways that manufacturers can reduce the frequency and scale of issues during the development phase, but this does not guarantee there will be no errors.

4.1 Root Cause Analysis

Collins Online Dictionary states the term root cause as *“the fundamental reason for the occurrence of a problem”*.

Root cause analysis is the practise of finding a source of error and is a powerful tool when trying to identify why something has happened. Root cause analysis is objective analysis - it uses facts and data to determine accurately the cause of an issue (Yankelevitch, S). Flow diagrams are often a good way to show an entire process in a condensed format, Figure 3 below shows an example of how a development team might establish root cause analysis when they discover an issue.

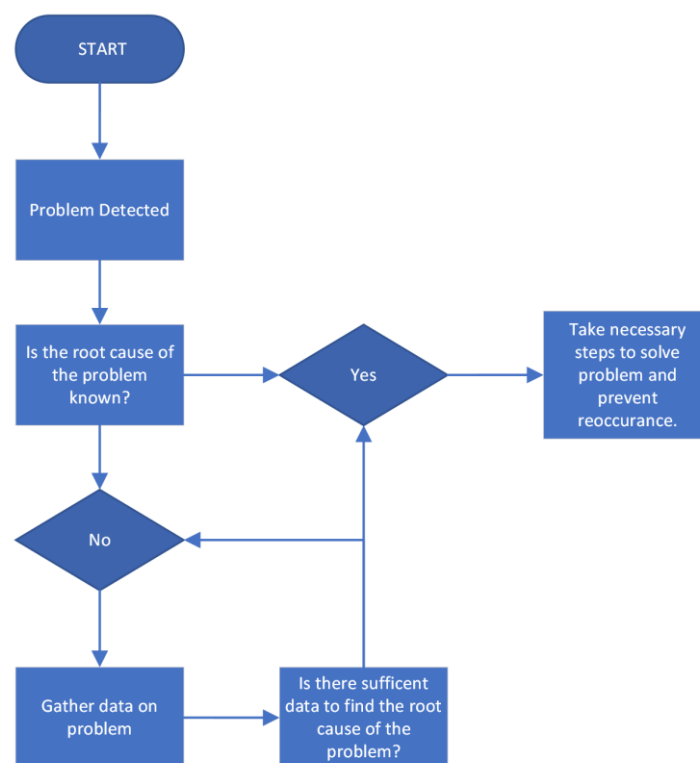


Figure 3: Simple root cause analysis flow diagram.

4.2 Risk Management

The Chartered Institute of Internal Auditors defines risk management as *“a process to identify, assess, manage and control potential events or situations to provide reasonable assurance regarding the achievement of the organisation's objectives”*.

Risk management teams may investigate the product development process to identify any potential risks that could develop, by employing policies and informing the relevant teams before issues have the chance to occur. The UWTSD test cell risk assessment detailed in Chapter 2 is a great way to visualise the potential risks involved in an activity. The regular review of risk matrix is an important aspect of risk management within a project. As a project develops some risks will phase out whilst newer, unseen risks may start to show. The act of regularly updating risk matrices allows for clear overview and enables correct handling of risks (Hopkin, P. 2017).

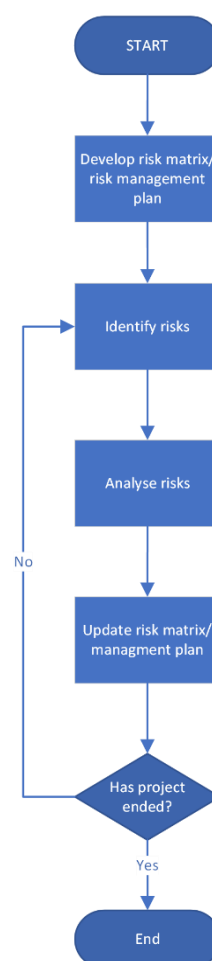


Figure 4: A simple risk management flow diagram that allows for the continuous update of the risk matrix until project completion.

4.2.1 Further Reading

ISO. (2018). *Risk management-Guidelines INTERNATIONAL STANDARD ISO 31000 ISO 31000:2018(E) ii COPYRIGHT PROTECTED DOCUMENT Published in Switzerland.*

5 Team Structure

During 2020 I spent some time in Australia working for BlazeAid, a charity that provides free labour to farmers whose land is damaged by natural disasters. My job in Braidwood, NSW, was to repair fences that bordered livestock paddocks.

After a few weeks learning the necessary training and health and safety procedures I was offered a team lead position. This leadership role was my first, and one I was excited to have achieved. I was leading around six volunteers, but this changed daily, and at one point lead a team of sixteen.

Leading a team of six was simple enough and followed a basic vertical organisational chart (Figure 5). The structure followed a traditional work group team organisation where leadership is managerially controlled along with decision making, following an authoritarian or consultative structure (Levi, 2001).

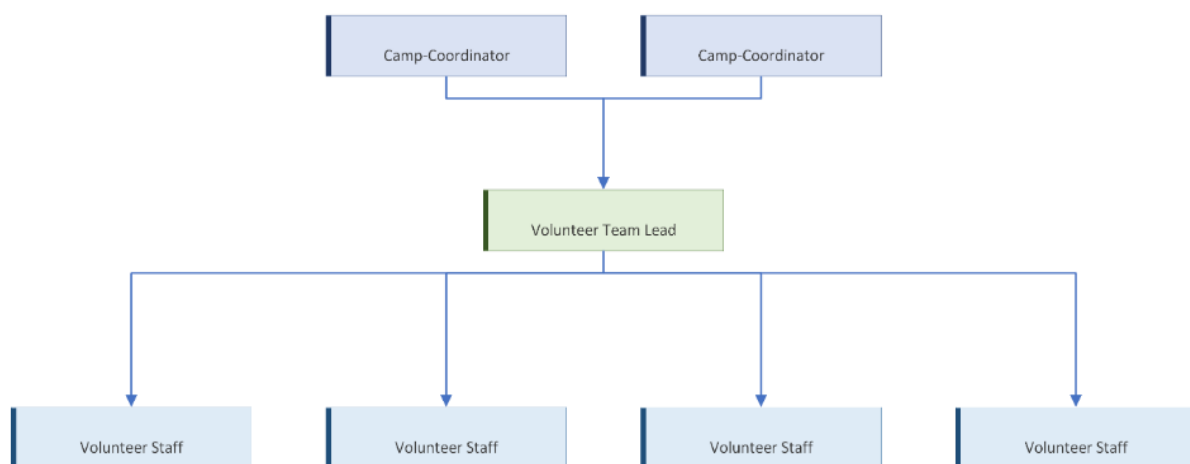


Figure 5: Original team structure.

The team structure worked well and allowed me to allocate jobs to staff that I believed had strengths in specific areas, however problems arose when the team started to grow. The structure remained the same which became overwhelming and meant mistakes were made. Volunteers were left waiting while I struggled to oversee the project and instruct volunteers whilst keeping track of stock, organising deliveries, and staying in touch with camp coordinators.

Wheelan (pg. 110), states that the creation of subgroups within teams is an effective method to improve group output and that the allocation of responsibilities is essential when large workload needs to be completed under time constraints.

Restructuring the team would have reduced the amount of workload placed on myself and would have allowed me to concentrate on the bigger picture, focusing on management responsibilities like stock, quality control and health and safety. Figure 6 shows an improved organisational structure that moves more towards the traditional team classification where leadership has restricted managerial powers on staff and instead has a consultative relationship with other team leaders who can make decisions based on the advice of the teams (Levi, 2001).

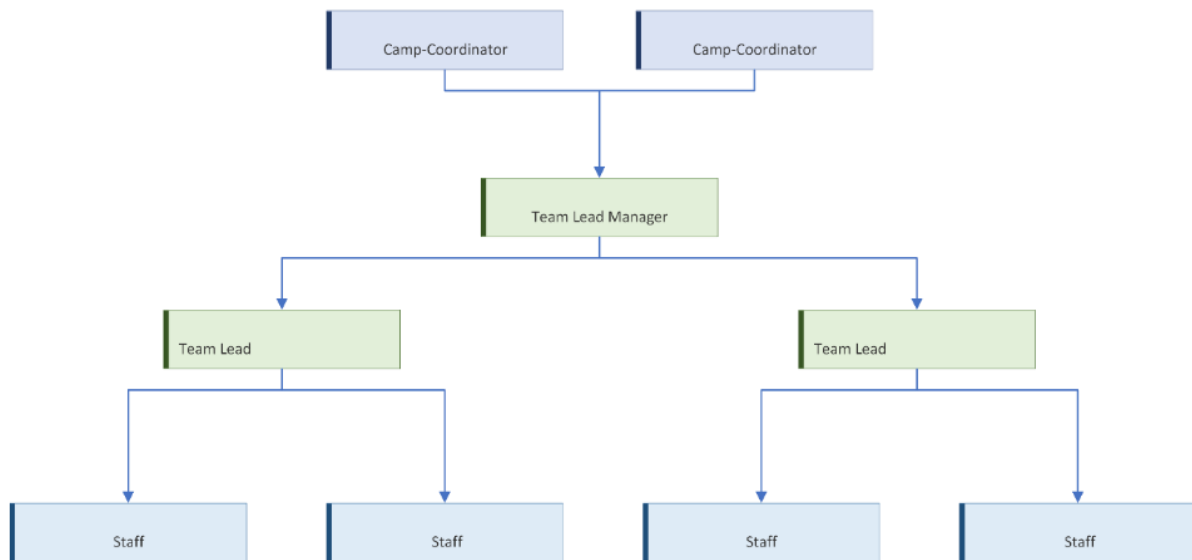


Figure 6: Revised team structure.

6 Personal Development Plan

Name: Oliver Gillson

Degree: BEng Motorcycle Engineering

Previous Qualifications: Level 3 BTEC in Information Technology (D,M,M), 6 GCES's

Previous Experience: 11 years of working experience in a range of different sectors including financial, information technology, utilities, trades, customer services, transport & delivery services, and hospitality to name a few. Travelled to various corners of the globe over the last 5 years. Currently sat on the Powertrain Systems and Fuels Group iMechE Committee.

Long Term Goals (5 to 10 years)				
Gain Chartered status. Buy a house with a small holding.				
Short Term Goals (0 to 5 years)				
Gain work experience within my desired field. Find part-time work that relates more to my studies. Gain a summer work placement at a leading motorcycle manufacturer in the UK. Complete my degree with a 1st class grade.				
Goal	Objective	Resources Required	Measurement	Target Date
Gain work experience relating to my studies.	Networking via social media and at engineering events, contact firms and request work experience. Apply for summer internships	Up to date CV. A good social media presence. Make use of the University careers service.	Spend time working within an engineering related role.	31/01/2024
Find part-time work that relates more to my studies.	Apply to relevant roles. Call and email workplaces to ask for work or work experience.	Up to date CV. Make use of the University careers service.	Acquire a role related to engineering.	ASAP
Gain a summer work placement at a leading motorcycle manufacturer in the UK.	Research and apply for relevant summer placements.	Up to date CV. A good social media presence. Make use of the University careers service.	Acquire a summer work placement.	April 2024
Complete my degree with a 1st class grade.	Reduce work hours and spend more time studying. Continue revision through half term and summer breaks. Work hard.	Strong work ethic. A good study schedule. High lecture attendance.	Graduate university with a 1 st class degree.	2026

Gain Chartered status.	Spend time in a professional engineering position. Apply for Chartered status.	Workplace experience. BEng Degree. Strong work ethic.	Gain Chartered status.	2030
Buy a house with a small holding.	Save for a deposit. Build credit score.	Full time working position.	Purchase a house with land.	2028

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