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Wales Institute of Science & Art



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Project Planning

Engineering Management (ACHA5012 & ACHA5007)

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November 2025

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1 Introduction

Rigorously plan the level 5 group project by referencing the contributions made to the project. Demonstrate specific and cognitive skills, recognising and evaluating methods, planning, costing, monitoring projects and team dynamics.

2 Roles and Responsibilities

For a project to be successful, strong team-building practices are essential to understand each individual's working styles in the group. In this case, the Belbin's team roles showcase that a person doesn't have to fit all roles to be a good member of the team. There are several roles where an individual can fall into, and they are:

- Implementers
- Coordinators
- Shapers
- Plants
- Resource Investigators
- Monitor Evaluators
- Team Workers
- Complete Finishers
- Specialists

Each role has its strengths and weaknesses. For example, Plants are creative and imaginative and can continuously create new and innovative ideas while also being able to solve difficult problems in unorthodox ways, but they are less likely to communicate frequently. Complete Finishers are painstaking, conscientious and self-disciplined. They ensure that all tasks are completed to high standards and actively search for errors, so nothing is overlooked. Their weakness is that they worry excessively and are overly concerned with details, which can lead to unnecessary stress and delays in progress. Each role covers the other's weaknesses, allowing a balanced and supportive environment to complement each other. It encourages people to share ideas and express their concerns without the fear of judgment. (*Belbin team roles, explained, 2023*)

Identifying each member's natural Belbin roles early in a project can allow the team to assign their responsibilities effectively, reducing conflict and gaps in capability of the team. Without clarification, the team may experience duplicated efforts, unaddressed tasks and misunderstandings of responsibilities. Deadlines, constraints and unexpected issues are very common in a project's lifecycle. A strong team structure is a vital asset that provides a high-performing team to tackle these situations effectively and maintain a good momentum to the project completion.

2.1 My Role in the Team

In a lecture, we were given a self-perception form to fill in for Belbin's team roles. By the end of the lecture, I found out that the roles I'm capable of are a Planter and a Complete Finisher.

Plants in a team are free-thinking and creative, thought-oriented role. They generate innovative ideas for the team and have unorthodox ways of creating solutions for difficult problems.

Unconventional solutions come with impracticality. Often introverted, preferring to work apart from the team and finds criticism difficult to handle. They are often the poor communicators in a team.

(The Nine Belbin Team Roles, 2025)

Complete Finishers are self-disciplined, meticulous and conscientious, action-oriented role. Often the perfectionist in the team sets high standards and polishes. Pays attention to details and actively searches for errors and omissions in the work. Deadline-oriented, preventing last-minute rushes.

Being a perfectionist is a double-edged sword and can be too focused on minor details. Inclined to worry unduly and are reluctant to delegate. *(The Nine Belbin Team Roles, 2025)*

How I perceive my team members:

- Kieran Bennett – Co-ordinator
- Yash Patani - Implementer
- Rhodri Jones - Team Worker

3 Overall Project Tasks – BMW Rally Aero Project

- Producing a PowerPoint
- Gantt chart
- Research and Development
- CAD modelling
- CFD Testing
- Conclusion for Interim VIVA
- Word Report, Continuation of other works for Final VIVA.

3.1 Details & Estimation of Time Required for Completion

3.1.1 PowerPoint

The production of the PowerPoint is vital to delivering the team's progress during the Interim VIVA and final VIVA. This task primarily focuses on compiling the research and testing completed into a concise and clear visual format. Producing a PowerPoint is a team effort. Drafting the content, CAD and CFD research, formatting the slides, and reviewing and refining with the team would approximately take 10 hours of effort and roughly take 3-4 days to complete. Optimistically, if our team had a meeting primarily for completing this task, it would only take a day or 2 to complete.

3.1.2 Gantt Chart

The creation of the Gantt chart is important for my team to establish the roadmap of project planning, scheduling and progress tracking in a visual format. The visual aspects help me and my team understand our individual responsibilities, setting the duration for each task and the deadlines for when they should be completed. This task would only require 2-4 hours and is updated throughout the project lifecycle.

3.1.3 Research & Development

My main task with an extra member from my team is researching concepts and designs, involving reviewing existing spoilers from different rally teams or motorsports, to create a target for how much downforce our concept spoiler should create. We are hoping to create a spoiler that has similar properties to those of a WRC rally car, but with different Regulations, it will lower our chances of doing so. Even if it isn't possible, we aim to create one that could give us an advantage over our competitors while still complying with the regulations. This part of the project may be the most time-consuming task, as it involves evaluating design feasibility, refining our spoiler concept through testing, and ensuring that it is in full compliance with the relevant regulations. This task may take 36-48 hours of work effort spread across 1-2 weeks.

If we were to create a prototype after the team agreed on the concept, we would require component manufacturing machines. The University of Wales Trinity Saint David provides their students with workshops including lathes, mills, fabrication tools and 3-axis and 5-axis CNC machines to manufacture components for the team. (*Motorsport Racing Teams*, 2025)

The cost of the material may vary depending on how much volume of the material we'll need. Easycomposites provides 210g 2x2 Twill 3k Carbon fibre cloth starting at £23. They provide different widths of the rolled cloth, and the linear metres can be tailored to the consumer's needs. They also have XCR epoxy coating resin 5kg, starting at £107.35 and vacuum bagging sealant tape 15m at £5.50. (*Easy Composites*, 2025)

3.1.4 CAD Modelling

CAD modelling is also part of this project, connecting to research. A team member has created a close 1:1 scale of the rally car. This is the technical piece of the project to produce accurate data in CFD for analysis. It's also where the spoiler concept can come to life for testing, without having to produce a prototype that can cost the project. This task may require 20-40 hours spread across 1-2 weeks, allowing for any revision based on the CFD result and the team's feedback.

3.1.5 CFD Testing

CFD testing is another part of the project that is very technical and time-consuming. It provides the evaluation of the spoiler's aerodynamic performance, such as the downforce, drag, potential vortex generation, flow behaviour and pressure distribution. This allows us to understand the properties of that spoiler and see if there are any areas that we can improve on or find an anomaly as to why the flow is behaving in a certain way. With complex simulations and multiple iterations, CFD testing may take 30-40 hours or more spread across 2-3 weeks. It also depends on the computer's specifications, as CFD software requires bulk calculations to generate accurate aerodynamic data.

4 Milestones

Significant milestones for our project are:

- Regulation Review
- Benchmark Analysis
- Concept Generation
- Baseline Model
- Iterative Designs
- Post-CFD Refinement

The first milestone is regulation review. This ensures the project is compliant with the governing regulations in the rally championship. This involves interpreting the regulations' constraints, such as the allowable dimensions and mounting positions. It influences our design within the legal boundaries to prevent wasted time on concepts that could be non-compliant.

The next milestone is benchmark analysis. This helps our team understand established aerodynamic solutions used in rallying by examining WRC, CRC and existing BMW rally conversions. This provides us with a design trend and a benchmark for aerodynamic performance, enabling my team to draw comparisons and set realistic targets for downforce and drag.

Concept generation is another milestone in our project. Several concepts are sketched to explore different shapes, chord lengths, endplates and aerofoil profiles (Tudor, 2025). Complying with the regulations, we will produce a variety of aerodynamic designs, considering the behaviours, and then narrow the selection.

Baseline model milestone transitions to a digital development phase. Creating a CAD model of the concept with features that will support later modifications and simulations. This milestone shifts the project from theoretical to practical implementation, ready for refinement and initial evaluations.

The next milestone is Iterative designs, where it focuses on producing multiple variations by adjusting the camber, angle of attack and aspect ratio of the chord and length (Tudor, 2025). It ensures my team has explored all available and practical modifications that may provide improvements.

The last milestone is Post-CFD refinement. The data from the initial CFD allows my team to observe flow separation, pressure, vortex behaviour and anomalies. This provides insight into our current model and allows refinements driven by the data to optimise the model further.

4.1 Feasibility Gateway

The gateway for this project is the feasibility, determining whether the spoiler designs created in the research and development are suitable to progress into CAD modelling and CFD testing. It ensures rigorous evaluation of each concept against technical, regulatory and practical criteria before our team commits significant resources to developing and analysing in depth. Introducing these gateways prevents my team from a concept that may be ineffective, impractical and non-compliant with the rally regulations.

The design of the spoiler must comply with the regulations. Code 5.2.7 states “such devices must not extend beyond the maximum width of the vehicle, above the maximum height of the roof”. It also states, “For saloon and sports cars, such devices must not extend longitudinally from the bodywork by more than 100mm”. Verifying this ensures the project can progress, setting a legal framework that it can be utilised for the Circuit Rally Championship. (*IJ Competitors: Vehicles*, 2021)

Another feasibility gateway is the practicality. The spoiler must be mountable to the existing bodywork of the rally car without requiring excessive modifications in the design and the vehicle. Evaluating mounting points, material options, weight implications, and the construction of the design with standard manufacturing methods such as composite lay-ups, machining and 3D printing. It becomes unfeasible if it requires complex manufacturing or if it introduces excessive weight to the rear of the rally car.

5 Risk Management

In the research and development phase of the project, several risks may affect the effectiveness, efficiency and direction of the design process. Two examples of areas of concern are the oversight and misinterpretation of the rally regulation and the risk of inaccurate or insufficient benchmarking data. Recognising the risks early in the project allows us to implement suitable methods to maintain an efficient workflow, as these risks can influence the effectiveness of our aerodynamic properties and the validity of the design with the regulations.

The first concern is the oversight and misinterpretation of the regulations. The regulations are highly specific in governing aero components, including the limitations on the size, dimensions and placement of the spoiler. They can be misunderstood due to vague wording, and if my team misinterprets these criteria in the early stages of research and development, there is a significant risk that the entire concept may later be deemed non-compliant. The hours of CAD modelling, iteration works and CFD testing become futile, causing further delays in the designing process.

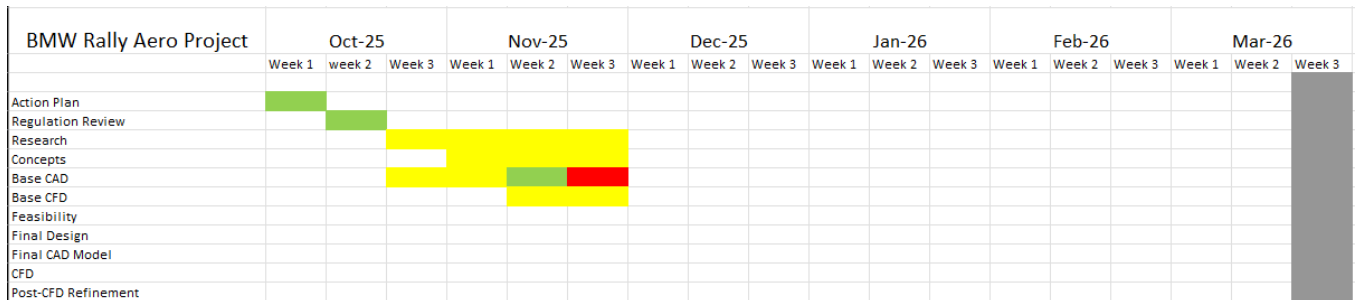
To mitigate this risk, my team can produce a summarisation of what the regulations state. Additionally, interpretations should be cross-checked with other sources, including approved homologated rally cars and other official rally regulations. Extracting sections directly relevant to the rear spoiler design ensures that all members work from the same understanding. Assigning a member as a dedicated regulation lead may further strengthen this method, being responsible for signing off designs with a checklist during the gateway.

The second concern is the potential for inaccurate or insufficient benchmarking data. Benchmark analysis is vital to generating realistic aerodynamic targets and understanding design trends within rally. However, these design details, particularly aerodynamic performance data, are considered sensitive in motorsport to prevent competitors from exploiting the data for their advantage. Consequently, limited or no data may be available, or sources might vary or be unreliable. Inaccurate or insufficient data directs my team to inefficient concepts, unrealistic performance expectations and slows project progress.

To mitigate this issue, any public data that may be available, such as technical papers, manufacturers' diagrams, and homologation documents, is utilised for our benchmarking. Photogrammetry or image-based estimation can be utilised to estimate the shape of spoilers with reasonable accuracy if no model is provided from public data. Any guessed data is highlighted, ensuring clarity to prevent incorrect data from influencing later in the project.

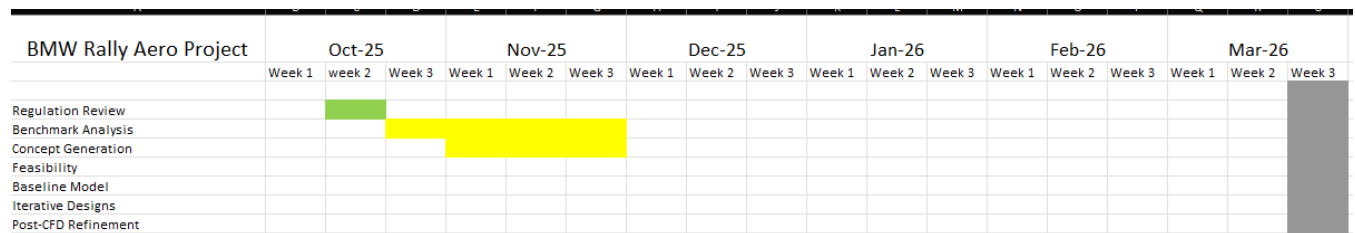
6 Gantt Chart

6.1 Overall Summary Gantt Chart



This is the Gantt chart of the whole project from beginning to end. Interim VIVA is due in the first week of December, and Final VIVA in the second week of March. The green colour indicates that the task is finished, while yellow is ongoing. The red indicates a problem. A member has encountered a problem with the CAD model of the BMW rally car when processing the model for CFD.

6.2 The Gantt Chart For My Area



This is the Gantt chart specifically for my area of the project, including the feasibility gateway.

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