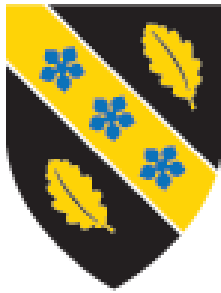


University of Wales Trinity Saint David

Wales Institute of Science & Art



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Project Planning

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1.0 Introduction

This project aims to redesign and optimise the current aerodynamic package of the Sports2000 MCR race car in accordance with the 2025 SRCC Duratec Championship technical regulations. These regulations prohibit ground effect devices and impose a flat floor design, limiting performance enhancement to surface shaping, efficient airflow management and refining overall pressure distribution on the car.

The project's primary goal is to achieve measurable improvements in aerodynamic efficiency – specifically an increase in downforce while reducing drag all within regulatory constraints. Computational Fluid Dynamics (CFD) using Ansys Fluent and 3D modelling via SolidWorks will be used to develop, test and validate these changes to the car. The project has been divided into five design areas, each assigned to an individual team member.

In addition to the aerodynamic redesign, two members will investigate droop-stop implementation. This will be done through stress testing using Ansys Finite Element Analysis (FEA) while one member will investigate performance validation through VI-Grade lap simulations. This combination of CFD, FEA and VI-Grade will enable a complete engineering approach to aerodynamic, structural and performance considerations.

This Project will be managed through structured engineering management techniques such as milestone tracking, Gantt scheduling and gateway objectives to ensure the time goals are met. Our success will be measured through comparative CFD & Simulation data demonstrating increased downforce, improved balance and improved lap performance.

2.0 Team Structure, Roles and Responsibilities

2.1 Team Structure

Jason:

Responsible for investigating droop stops and implementing them on the car. His role requires analysis of the car's current performance and position on the track using MoTeC Software. He will investigate how droop stops will affect the car and whether they are plausible with the current aero package through data analysis and testing. He is also responsible for the manufacture and installation of droop stops on the car.

Kiera:

Responsible for all data and simulation analysis tasks within the project. Her role involves the use of VI-Grade to simulate droop-stop modifications and CFD developments using a virtual model that will be created using MoTeC software to compare real-world data to a previous baseline model.

Evan:

Responsible for the rear deck and engine cover aerodynamics, ensuring smooth airflow from the cockpit/sidepods to the rear wing region. The design will aim to reduce current drag, manage airflow over the engine cover while maintaining aerodynamic balance across the whole car.

Ethan:

Project Management:

Establishing objectives and setting performance targets for each area of the group. Coordinating CFD analysis and design development. Ensuring tasks are delegated evenly, and deadlines are met accordingly.

Aerodynamics:

In charge of the design and development of the splitter, floors & nosecone for the MCR. Using CAD & CFD analysis to optimize airflow to the rear of the car to activate the deck as well as reducing the overall pitch sensitivity. Collaborating closely with Noah & Cara to ensure integration and manufacturability.

Cara:

Her role focuses on the design and development of the midriff, sidepods, and cockpit regions of the car. These areas are key to managing airflow from the front to the rear, ensuring efficient aerodynamic performance across the vehicle. She will be responsible for refining these surfaces using CAD and CFD analyses. Her aim is to reduce drag and optimise airflow continuity, ensuring smooth integration with surrounding components while enhancing overall car efficiency and on-track performance.

Louis:

Responsible for designing and analysing the effects of introducing a downforce generating device over the roll hoop and its effects on the aerodynamic efficiency of the rear wing in different locations and mounting styles. This will be proved with the use of a CAD file in CFD. Using CFD he will assess the different styles to find a model that works best with other members designs to keep the overall balance and COP within tolerance.

Will:

Responsible for the investigation into front droop stops. Understanding how droop stops work and understanding how car characteristics change with and without droop stops during cornering. Investigating where they'll be mounted and what type of design will be beneficial for performance. There is a link between suspension kinematics and aerodynamic stability which he will be looking at closely.

Noah:

Noah's role focuses solely on the aerodynamic refinement on the front section of the car, which consists of, front pontoons, pushrod covers, and wishbone shrouds. The front components of the car are crucial to the aero-mechanical interaction, where suspension and aerodynamic efficiency are directly in contact.

His responsibility is to improve the airflow around the front of the car using CFD simulations. His aim is to reduce drag and turbulence through improving designs, ensuring that the sidepods and rear deck receive smoother airflow while enhancing front-end stability and aerodynamic efficiency.

2.2 Personal Roles & Responsibilities

My personal responsibilities within the project relate to the aerodynamic behaviour of the rear deck, engine cover, and rear pontoons of the Sports 2000 MCR. These areas significantly influence the wake structure and pressure distribution across the rear of the vehicle, making them essential to the car's overall aerodynamic performance. Since the redesign stage has not yet begun, my current focus is on supporting the baseline CFD development by preparing my allocated section of the supplied CAD model for analysis and ensuring it integrates smoothly with adjoining geometry from the midriff and sidepod regions.

Once the CFD domain is established, my primary technical task is to contribute to the validation of the baseline aerodynamic model. This involves investigating Body of Influence (BOI) density variation, a process that assesses how different levels of mesh refinement in sensitive flow regions affect result stability and convergence behaviour. The outcomes of this study will be used to establish reliable meshing standards for the full team, ensuring that any future aerodynamic development is based on accurate and repeatable simulation data.

Alongside the technical work, I also contribute to intra-team coordination, particularly with Cara, who manages the mid-section and sidepods, and Louis, who is analysing the rear-wing mount and endplate geometry. Ensuring geometric alignment and consistent simulation preparation between our sections is crucial for maintaining a coherent aerodynamic model across the full vehicle.

According to Belbin's Team Role Model, my characteristics align most closely with the Completer Finisher role. I work with a high level of attention to detail, focus on accuracy, and am committed to producing reliable and well-documented work. These traits are particularly valuable in CFD validation, where precision and consistency directly influence the credibility of the project's aerodynamic baseline.

Table 1 - Project Timeline, Independent

Tasks	Hours Required	Task Duration
Run through MIRA car tutorials	10	1 week
Research and validate mesh values, create a solid run plan	25	2 weeks
Create aerodynamic maps using S2n bodywork runs	30	2 weeks
Create aerodynamic maps using S2nb bodywork runs	30	2 weeks
Continue research into areas of improvement (Rear deck focussed)	15	1 week
Run CFD of rear deck modifications	20	1-2 week(s)
Analyse key characteristics and tweak design accordingly	15	1 week

3.0 Project Tasks & Schedule

Table 2 - Project Timeline, Group

Tasks	Hours Required	Task Duration
Create aerodynamic maps using S2n bodywork runs	28 hours	2 weeks
Create aerodynamic maps using S2nb bodywork runs	28 hours	2 weeks
S2-UW CFD bodywork runs where sections of the car overlap	30 hours	3 weeks
Initial droop stops investigations	20 hours	3 weeks
Measurements of forces on droop stops	5 hours	1 weeks
Simulate droop stops in VI-Grade	8 hours	2 weeks
Analyse actuations due to droop stops in VI-Grade	8 hours	2 weeks
Simulate CFD alterations in VI-Grade	50 hours	4 weeks
Analyse and evaluate final model simulation	10 hours	2 weeks

4.0 Task Breakdown & Logistics

4.1 Independent Tasks

My individual contribution focuses on the rear deck, engine cover, and rear pontoons of the Sports 2000 MCR. These surfaces control how airflow exits the cockpit and sidepod regions and significantly influence the car's rear pressure distribution and wake structure. At this stage of the project, my work centres on preparing these areas of the provided CAD model for analysis, running baseline simulations, and carrying out validation through mesh refinement studies rather than developing any redesigns.

The CAD model of the MCR has already been supplied and verified, so my task begins with defining the simulation setup for the rear section within ANSYS Fluent. This involves applying boundary conditions, creating appropriate domains, and coordinating with other team members to ensure continuity between the rear section and the adjoining midriff and sidepod regions. My preparation work will enable consistent aerodynamic assessment across the full car model, ensuring that data from each section aligns for later integration.

During the baseline CFD analysis, my specific focus is the validation of mesh quality through an investigation into Body of Influence (BOI) density variation. This process examines how local mesh refinement in critical region - such as the curvature of the rear deck, engine cover surfaces, and pontoon edge - affects both computational accuracy and efficiency. By systematically adjusting the mesh density in these areas, I will identify the most effective balance between resolution and processing time, ensuring that the simulations converge reliably and produce stable aerodynamic coefficients.

4.2 Bill of Materials

Table 3 - Bill of Materials

Resource	Purpose	Estimated Commercial Cost	Cost to Project
ANSYS Academic Licence	CFD Simulation	~£10,000/year	£0 (Supplied by UWTSD)
SolidWorks Student Licence	CAD Modelling	~£4,000/year	£0 (Supplied by UWTSD)
Microsoft Excel	Data analysis	~£100/year (Office licence)	£0 (Supplied by UWTSD)
University Computers	CFD/FEA Computation	~£2,000 hardware value	£0 (Supplied by UWTSD)

(Ansys, 2025), (SolidSolutions, 2025), (Microsoft, 2025)

Although the project requires the use of advanced engineering software and high-performance computing resources, the direct cost to the project is £0 because all required tools are fully provided by the University of Wales Trinity Saint David. The aerodynamic analysis, mesh validation and data processing tasks rely on ANSYS, SolidWorks and Microsoft Excel, all of which are available through university academic licences at no cost to students - therefore the group. Likewise, the CFD simulations are carried out using university workstations and computing facilities, meaning no hardware investment is required by the project team. Since the project focuses solely on baseline aerodynamic assessment and does not involve manufacturing components, no materials, equipment or outsourced services are needed. As a result, the project incurs no financial expenditure, while still utilising industry-standard engineering resources supported entirely by the university.

5.0 Milestones & Objectives

To maintain control of the project and ensure that all work progresses in a structured and coordinated manner, a series of key milestones have been established across the 24-week timeline. These milestones represent significant checkpoints that allow the team to review progress, identify issues early and ensure that all subsequent work begins from a stable and validated foundation.

The first major milestone occurs in January 2026 with the completion of the baseline CFD model validation. Since the full car CAD model has been provided, this stage focuses on establishing a reliable computational setup, confirming mesh quality, selecting appropriate turbulence models and ensuring that all simulation inputs produce stable aerodynamic coefficients. This milestone is crucial, as validated baseline data forms the reference against which all future aerodynamic and structural developments will be measured.

The following milestone in February 2026 is the completion of the droop-stop FEA analysis carried out by Jason and Will. Their results will determine whether proposed suspension limitations are structurally feasible and compatible with the aerodynamic characteristics of the MCR. By the end of the same month, all team members will have produced their initial redesign concepts, marking a key transition point into the optimisation phase.

In March 2026, the project reaches another key milestone with the completion of the full-car CFD assembly, allowing the combined aerodynamic surfaces from each section to be evaluated together. This integrated model will then be used in April 2026, when Kiera completes the VI-Grade lap simulation analysis, providing vehicle-performance validation relative to the baseline model. The final milestone is the submission of the full written report and presentation on 22 April 2026.

A central element of this section is the project's Gateway Objective, which defines a measurable performance requirement for success:

To achieve a minimum 10% improvement in lift-to-drag ratio (L/D) compared to the baseline MCR configuration, validated through steady-state CFD using refined settings.

This objective provides a clear, quantitative benchmark and ensures the final aerodynamic package demonstrates a meaningful performance improvement.

6.0 Risk Management

Effective risk management is essential to ensure the successful delivery of the project within the required timeframe. The technical nature of the aerodynamic, structural and simulation tasks means that delays or inaccuracies in one area can have a direct impact on the wider team. Two key risks have been identified within my section of the project - both of which could significantly influence the quality and reliability of the baseline data that the team depends on. The first risk relates to CFD mesh accuracy and validation quality. As my responsibilities involve investigating BOI (Body of Influence) density variation, there is a possibility that incorrect refinement levels could produce misleading or unstable aerodynamic coefficients. If the mesh is either too coarse or too dense, the simulation may fail to converge or may produce results that do not reflect realistic flow behaviour. To mitigate this, I will carry out a structured mesh-sensitivity study, comparing results across multiple refinement levels and confirming stability through convergence monitoring. Regular cross-checks will be performed with the wider CFD team to ensure consistency in mesh strategy across all the vehicle sections.

The second major risk concerns project scheduling and dependencies within the team. The baseline CFD validation must be completed before any redesign concepts can be reliably evaluated, meaning delays at this stage would directly affect the timeline for other team members. Similarly, inconsistencies between my rear-section simulation setup and the adjacent geometry managed by Cara and Louis could cause issues during full-car assembly in March. To minimise these risks, weekly team meetings will be used to review progress, identify issues early and ensure alignment in simulation setup, boundary conditions and surface definitions. Shared file structures and version-controlled geometry will also reduce the likelihood of compatibility errors.

By actively monitoring these risks and implementing well-defined mitigation strategies, the project will remain on schedule and the baseline data produced during my section will provide a reliable foundation for future development work.

7.0 Summary

7.1 Gantt Charts

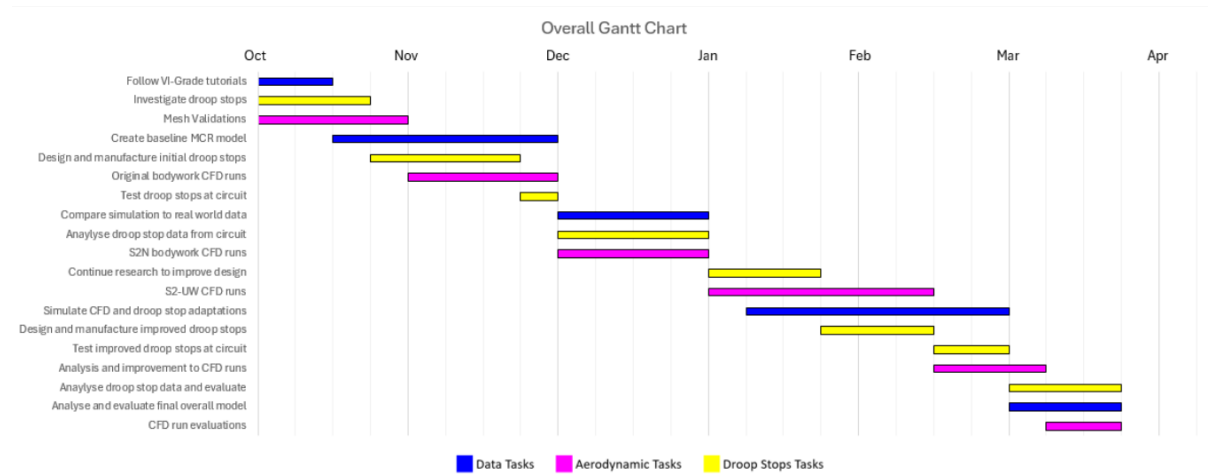


Figure 1 - Group Gantt Chart

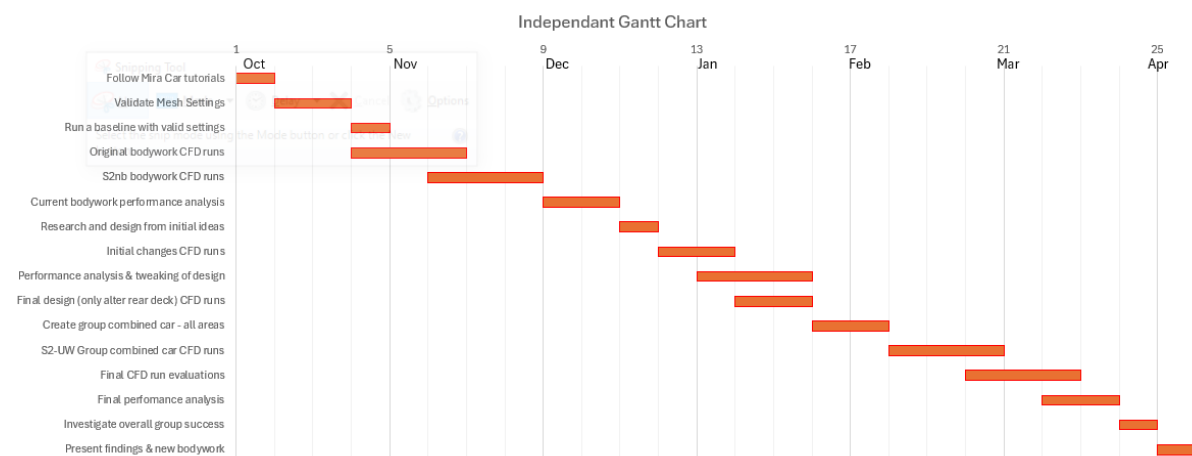


Figure 2 - Independent Gantt Chart

7.2 Team Structure Importance

A clear and well-structured project schedule is essential for ensuring that all members of the team can complete their tasks on time and in a coordinated manner, this is displayed in Figure 1. Due to the multidisciplinary nature of the project - combining aerodynamic analysis, structural FEA, and performance simulation. The schedule was developed using a Gantt chart to illustrate the timing, duration and overlap of major work phases. This visual approach allows the team to identify dependencies between tasks, plan workload distribution and highlight critical paths that must remain on schedule for the project to progress smoothly.

The project spans approximately 24 weeks, running from October 2025 to the final hand in on 22nd March 2026. Early stages of this timeline focus on baseline CFD validation and droop-top FEA work, both of which must be completed before any meaningful optimisation can take place. The mid-project period extending through January and February contains the highest concentration of activity as all team members begin producing their initial redesign concepts and preparing for full-car CFD assembly. The final month of the schedule is dedicated to lap-time simulation in VI-Grade and the consolidation of all findings into the completed written report and presentation.

Furthermore, maintaining a clear schedule ensures that each discipline within the group progresses at a compatible pace, preventing bottlenecks and enabling effective integration of CFD, FEA and simulation outputs. This structured approach strengthens both the reliability and efficiency of the overall project workflow.

8.0 Bibliography

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