

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 Management

Innovation and sustainability

ACHA 5012

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Introduction

This report aims to introduce our level 5 group project. Presenting basic tasks and sub sections that have been allocated to teams going into detail on specific team roles. Breaking down time management and responsibilities involved with the role and how it affects the group.

The group projects aim is to create an active rear wing that can be implemented onto the Morgan, adhering to certain regulations and time constraints. The regulations defining the legality of the wing design and limitations needed to pass. Time constraints define when certain tasks should be done, ensuring that the group has something to present in December is a critical part of the project.

My involvement with aerodynamics and running of the CFD simulation is a critical part to the project as it gives the group, design and forces associated with it. Allowing them to design and process their areas such as a structural parts and mechatronics to cope with the forces.

The objective of the project is to produce a scale model that has working active aerodynamics to improves the rear downforce of the Morgan. Providing the relevant data to show the increases the performance of the car.

Team Roles and Responsibilities

The team roles are assigned to the group based on prior experience and subject interest

Table 1- Roles and Responsibilities

Names	Roles	Responsibilities	
Nathan Evans	Aerodynamics Development	Aerodynamics Development	• Learn ANSYS software to test the Morgan Plus Four. • Provide data on a baseline run of the Morgan Plus Four. • Design a rear wing using research and theoretical knowledge. • Producing a CAD model of the Final Design to all departments. • Test iterations/final design of the rear wing in the wind tunnel to ensure CFD is correct • Deliver accurate data to all departments regarding the performance of the rear wing.
Oliver Wilson			
Alex Cook	Project management	Project management	• Managing the project, ensuring all group members are comfortable with their tasks. • Produce a Gantt chart. • Ensuring group moral is always at consistent level. • Risk Management – identify potential risks to the project's success and provide solutions to mitigate. • Consider Costs.
	Structural and Materials		
	Manufacturing		
Mathew Starke	Structural and Materials	Structural and Materials	• Conduct research into materials that can potentially be used to produce the rear wing. • Produce a mounting solution for the rear wing to the chassis of the Morgan. • Learn FEA procedures to carry out tests on designs. • Analyse the rear wing design using FEA. Locate regions of weakness in the design of the rear wing and mounting solutions. • Research into methods to increase any areas of weakness and then apply to design.
Conor Jenkins	Structural and Materials		
Alex White	Control Systems and Mechatronics	Control Systems And Mechatronics	• Communicate with all departments to ensure that the mechatronics can be implemented into the design without any major reconstruction of the concept. • Research into the provided mechatronics and decide which is most suitable. • Produce code and circuit allowing for the rear wing to perform outputs.
	Manufacturing		

Scott Holden	Vehicle Dynamics	Vehicle Dynamics	• Learn VI Grade software • Using the data produced by CFD, test the Morgan Plus Four performance using VI Grade software. • Produce data on the performance of the vehicle. Use this data to produce code for the control system. • Analyse data produced from the tests.
	Control Systems and Mechatronics		
Dylan Brierley	Vehicle Dynamics	Manufacturing	• Manage CAD Files of the rear wing and mounting brackets etc. • Produce multiple prototypes for the testing in the wind tunnel. • Produce the final concept assembled.

My role is to test and improve the aerodynamics of the Morgans rear wing using Computational fluid dynamics (CFD). I am interested in this area of work and took the initiative when I started the foundation course, to learn the software to assist on the MCR race team. By already knowing how the software works gives the team an advantage.

The project management role was appointed at the first meeting to Alex as he has organisational experience, with Nathan assisting with the organisation of documents and tasks.

Table 2- Overall group tasks

Group Tasks	Duration (Hours)	Start Date	Finish Date
Allocating roles and responsibilities to each group member.	3	30/09/2024	14/10/2024
Consolidate a communication platform to ensure all information associated with the project is conveyed accurately.	3	30/09/2024	4/10/2024
Familiarising the group with the regulations associated with the project.	4	7/10/2024	21/10/2024
Begin the initiation phase of the project. Using initial ideas begin producing a plan for different wing concepts and mounting solutions.	8	21/10/2024	25/10/2024
All departments begin listing tasks involved with each specific role that need to be completed throughout the project.	8	28/10/24	4/11/2024

Software related to each role (i.e. FEA, VI Grade and ANSYS). Begin the initiation process by generating ideas for each role.	8-15	14/10/2024	4/11/2024-18/11/2024
Reconvene and discuss work and ideas completed by each department. Ensure that all ideas are considered. Summarise and discuss further the route/idea the group wants to develop towards.	8	18/11/2024	22/11/2024
Each department produces work to be organised into a presentation for the interim VIVA.	20	10/03/2025	28/03/2025
Evaluate and review all work completed prior to assignment and VIVA submission.	20	10/03/2025	28/03/2025
Pre-presentation meetings to ensure all aspects of the project are understood before the final VIVA and all departments have work presented.	20	17/03/2025	30/03/2025

Belbin's model

My role requires someone who is innovative and has time management skills. To test my suitability for this role we did a Belbin's test covering a series of questions. Depending on the choices made and given scores in different categories. This showed what type of person is needed.

The Belbin's model ranks a person low to high based on percentages. There are 8 different categories that define a personality type in the model

Implementer – practical, reliable efficient. Turns ideas into action and organises work that needs to be done

coordinator – Mature, confident, identifies talent. Clarified goals. Delegates effectively

shaper- challenging, dynamic, thrives on pressure. Has the drive and courage to overcome obstacles.

plant- Creative, imaginative, free thinking. Generates ideas and solves difficult problems

resource investigator – outgoing, enthusiastic communicative explores opportunities and develops contacts

monitor evaluator – sober, strategic and discerning. Sees all options and judges accurately

team worker-cooperative, perceptive and diplomatic. Listens and averts friction

complete finisher-painstaking, conscientious, anxious. Searches out errors polishes and perfects

(Belbin, 2014)

Table 3- Belbin model

Belbin category	IM	CO	shaper	plant	RI	ME	TW	CF
My score	9	9	7	10	9	7	10	9
Best fit	8	5	9	12	7	10	9	10
variation	+1	+4	-2	-2	+2	-3	+1	-1

An aerodynamicist would desire to have higher scores as a shaper, plant and monitor evaluator. These categories are more tailored to creativity and innovating using data and finishing projects. As a result, they may not score as high in coordination or leadership as they are more specialised and focused on the project in hand.

Timing

Table 4-Personal Task

Task	Expected Time	Date	Description	Bill of materials
Prepare a base model of the Morgan with roof up and roof down in CAD software for CFD	10 min	28/9/24	The CAD model has been provided for the project. It requires downloading from teams then loading into SolidWorks (CAD) to change file formats to a para solid to be able to be used in Ansys CFD	Ansys software £8,000 Solid works £4,462
Using Ansys, run 2 separate CFD runs to establish the baseline forces associated with the Morgan	30 Min setup each 60-90 mins run time each 5 hours	12/10/24	The process of setting up the software takes some time having to define the work area and mesh it that can pose some issues, the actual running of a full vehicle requires a lot of time to calculate making it a aera for increased time taken. The objective is to get lift, drag, centre of pressure and aero balance data	Ansys software Solid works
Present to group findings and discuss directions on which we want to develop	2 hours	12/10/24	Using the data obtained, we can look at aerias of interest, how we want to tackle the challenge and bounce ideas around	
Design a wing to use from research	10 mins creating 1-2 weeks research 20 hours	1/11/24	Using research select a few different potential designs to test in Ansys. The research will help refine the search to a useful shape for our use	Ansys software Solid works
Testing wing designs in isolation in Ansys	2 weeks 40 hours	16/11/24	By testing wings in isolation can give a more detailed and accurate result on forces. This will help to inform the decision for the prototype	Ansys software Solid works
Angle of attack study	2 weeks 40	1/12/24	The angle of attack study is required as regulation allows for 60 degrees of rotation so to maximise the effective range is necessary to achieve the best performance	Ansys software Solid works
Prototyping wing for wind tunnel testing to see the correlation of the CFD analysis	1-2 weeks 50	14/12/24	The prototype will be developed alongside the structural team and then tested to confirm results found in the simulation software and if there's an acceptable margin for error	Ansys software Solid works Wind tunnel £250
Final full car run	20 hours	22/12/24	The final run will show how much improvement we have achieved with the wing and angles.	Ansys software Solid works

Total	177 hours		£12,712
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Milestones

As a group we have set out milestones that reflect significant points in our project.

Group milestone:

Milestones for the group will be agreed on a specific wing design. Allowing all the group to start developing the parts, knowing all the parameters and forces involved to start prototyping the rear wing.

Table 5- Group milestone

Milestones	Associated planned completion dates
Given the technical brief on the assigned project	30/09/2024
Assignment of all roles within the project	07/10/2024
Completed Baseline CFD simulation on the Morgan to gain data for vehicle simulation.	10/10/2024
Completed vehicle simulation test of the Morgan on a track to attain baseline performance.	27/10/24
Finalised rear wing concept designed on CAD	17/11/2024
Complete CFD of the chosen wing profile	24/11/2024
Run FEA on the chosen wing profile and mounts	01/12/2025
Attain data/ results of the chosen wing profile on the morgan plus four.	30/01/2025

Produce a prototype to test in the wind tunnel	09/02/2025
Complete a wind tunnel test of the rear wing concept. Use the data gathered from the test and compare against CFD results.	16/02/2025
Finalise control system	27/02/2025
Develop prototype and manufacture using additive manufacturing processes.	16/03/2025
Interim VIVA	10/12/2024 or 11/12/2024
Final VIVA	01/04/2025 or 02/04/2025
Upload final write up document	30/03/2025 @ 10pm

Personal Milestone:

My area in the aerodynamics has a great deal of significance in reaching these milestones. The heavy reliance on CFD and CAD early in the development process, means that my milestones are in quick succession of each other. Providing this in good time, allows for research and development.

Gateways

Personal gateway:

My personal gate way is providing the group adequate data from the (CFD) testing, so they can proceed with their tasks. Working with the figures provided, to create the appropriate designs to support the development work already done. I will provide information such as C_D , C_L , C_P , Aero balance, area and AOA data.

I will be providing Angle of attack data that will be done by CFD simulation. Running a program of different wing angles at different speeds related to the Morgan's simulated data, creating an array of results that can be used to put into an aero map. By doing this we can determine the most effective operating ranges under different driving conditions, using the data can help maximise the wings performance. Being able to feed this back to the group so they can have a working range they need to build to.

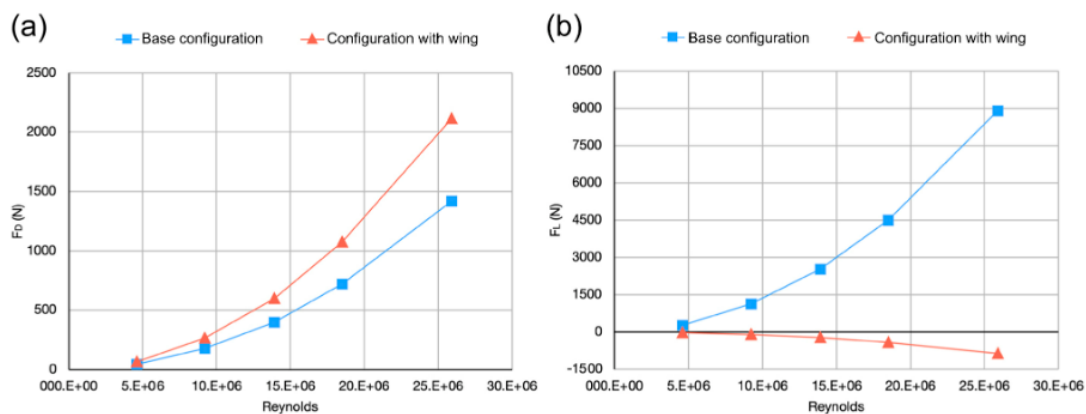


Figure 1- effect of adding a rear wing (David Zavala, 06/01/2023)

A paper looking at adding an active rear wing to the rear of an Audi R8 car shows that they were able to increase the downforce of the car by 105% whilst increasing the amount of drag by 30%. As the Audi R8 car and the Morgan have different geometry, the Audi being more aerodynamically wing shaped to the Morgan. This can give us a rough estimate of how much adding a rear wing can impact the characteristics of the car. (David Zavala, 06/01/2023)

The aim is to average 50% downforce at the rear of the Morgan. To achieve this the CFD simulation will need consistency and accuracy. By correlating a Naca 0012 wing profile in the wind tunnel to the CFD we can correlate the accuracy of the testing and gain confidence in the results provided.

The aim is to move the C_L of 0.294 down by 50% making the new overall value 0.147. whilst keeping drag to a minimum with a C_D of 0.49 overall but will allow for rises under braking due to the nature of the wing and its role at the time.

Within these data sets, I can inform the structural team on the forces acting on the wing and in turn their wing mounts, crucial for their development and success of the project. The mechatronics group will also need this data to know how much force is needed to overcome by the actuators and being able to provide the range of movement when required in time.

Risk

Area for concern during the testing process would be inaccurate data being provided to the team as it would compromise the rest of the project leading to a failure. To mitigate this happening a clear step by step process should be used to ensure every step is tracked so failure points can be established. (Raydugin, 2013)

Technical Risk

An interpretation of the rules could pose a potential risk to the entire project, knowingly pushing the regulation is inherently risky as it purposefully manipulating rules to gain an advantage and is down to the officiating body to deem it legal. For instance, rules state at a static ride height the wing must not exceed the roof height. As we are allowed to move the wing, moving it above the height of the roof whilst the Morgan isn't static will gain a significant advantage creating more downforce.

To mitigate the chances of this occurring its important that we read the regulation regularly to make sure nothing has changed, also asking the lecturers if it's an acceptable interpretation of the regulation as they will be deciding whether its legal or not.

Data and Systems

Technical risks working towards the gate way have been encountered and have potential to stop me reaching the deadline. There have been issues with the CAD model not meshing making it take far longer than anticipated. There have also been system errors with saved files not being able to be loaded after closing the project.

To mitigate this problem files can be saved onto external hard drives as back up. For meshing issues, time spent with the cad model adjusting it is needed to make sure that the model can mesh. Either by removing the problem area or adjusting the shape so the meshing can work.

Gantt chart

Morgan wing

Select a period to highlight at right. A legend describing the charting follows.

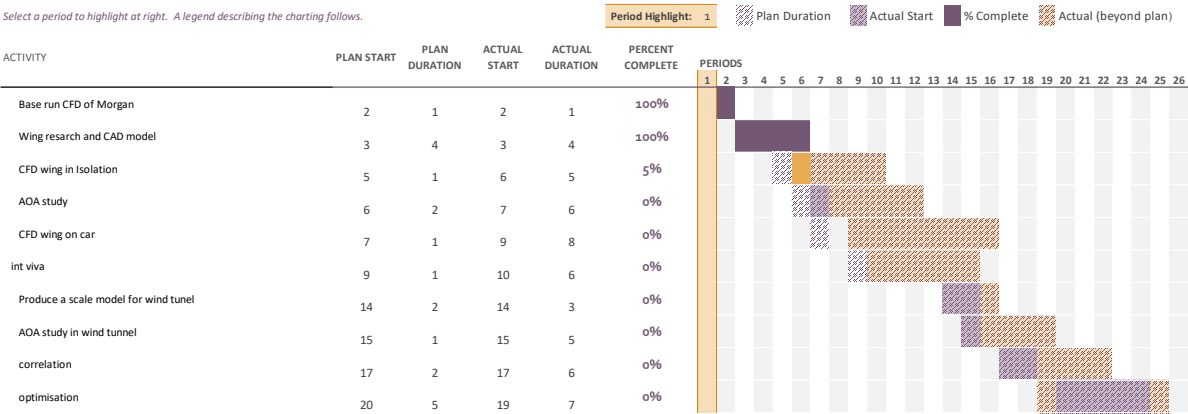


Figure 2-personal Gantt chart

Project Planner

Morgan Plus Four active rear wing project

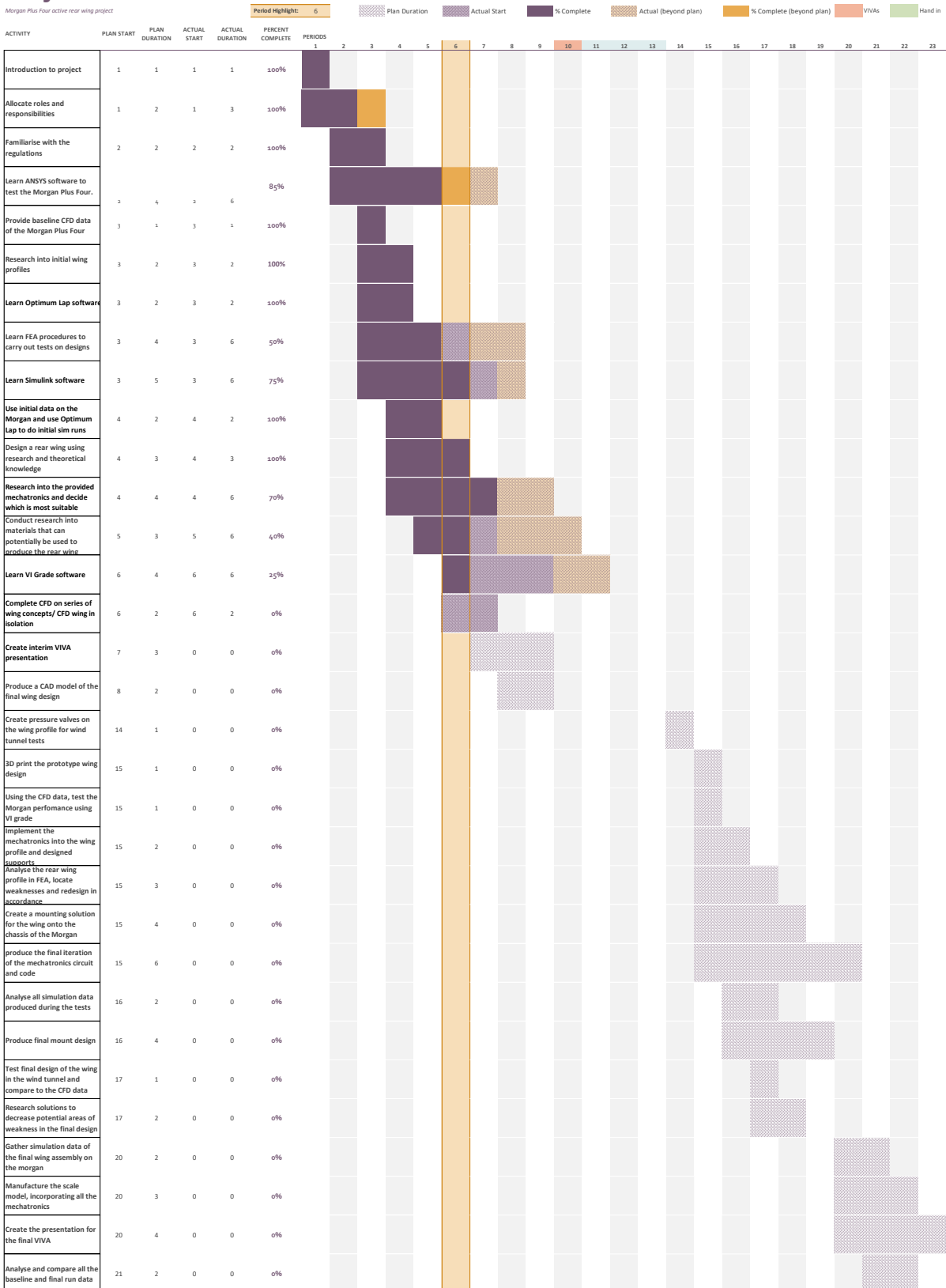


Figure 3- group Gantt chart

References

Belbin, 2014. *How to interpret and make the most of Belbin Team/Group reports*. [Online] Available at: <https://www.belbin.com/media/1169/belbin-howtointerpretandmakethemostofteam-groupreports-jan2014.pdf>

David Zavala, W. V. R. E. a. M. S.-V., 06/01/2023. *Numerical Simulation of the Effect of a Centripetal Wing Spoiler on the Flow Aerodynamics of a Sports Car*, Universidad Nacional Autonoma de Mexico, Instituto de Ingeni: SAE International.

Raydugin, Y., 2013. *Project Risk Management : Essential Methods for Project Teams and Decision Makers*. s.l.:Proquest.