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Project Planning

Engineering Management

Management, Innovation and Sustainability

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1 Introduction

The team working on this group project are aiming to design and test a new active rear wing aero solution for the Morgan Plus 4 road car. The design brief for the team states the manufacturer wants to create a performance version for this model of car. This includes increasing downforce, needed at higher speed, and increasing drag, to aid deceleration. The brief also states that the system requires design in multiple areas which are: Aerodynamics, Structural Design, Control Systems, Mechatronics and Vehicle Performance Assessment. I have selected to be apart of the vehicle dynamics department, focusing on simulation to help the group test the car to add to the performance analysis.

2 Team Roles & Responsibilities

<table>
<tr><th>Names</th><th>Roles</th><th colspan="2">Responsibilities</th></tr>
<tr><td>Nathan Evans</td><td rowspan="2">Aerodynamics Development</td><td rowspan="2">Aerodynamics Development</td><td rowspan="2">• 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
• Working with Manufacturing/ prototype department to produce the final concept to test in the wind tunnel
• Using the wind tunnel test the wing profile and gather data.
• Deliver accurate data to all departments regarding the performance of the rear wing.</td></tr>
<tr><td>Oliver Wilson</td></tr>
<tr><td rowspan="3">Alexander Cook</td><td>Project management</td><td rowspan="3">Project management</td><td rowspan="3">• 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.</td></tr>
<tr><td>Structural and Materials</td></tr>
<tr><td>Manufacturing</td></tr>
<tr><td>Mathew Starke</td><td>Structural and Materials</td><td rowspan="2">Structural and Materials</td><td rowspan="2">• 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.</td></tr>
<tr><td>Conor Jenkins</td><td>Structural and Materials</td></tr>
</table>

Alexander 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.
Scott Holden	Vehicle Dynamics		
Dylan Brierley	Vehicle Dynamics	Vehicle Simulation	• Learn OptimumLap software. • Use initial data on the Morgan and OptimumLap to do initial sim runs. • 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.

*(**Table 1**: List of roles and responsibilities within our group)*

2.1 Personal Skills & Traits

My role, on the vehicle dynamics and simulation team, requires certain skills and personality traits to be a successful team member. These skills include:

Time management and task management

Time management is needed as the simulation work is often needed soon after the team decide to request for the data from a test run. This means that the sim team need to build up some data even if they don't have a set task for that moment in time, therefore, if the team request some data the team either have something to build on or previous data to provide them with.

Team and project manager communication

It is important to have strong communication with the team and the project manager so that the simulation team are up to date with new tasks and can forecast potential tasks that could come up in the future.

Strong understanding in area of interest

A good understanding and willingness to learn within the department would allow me to respond to questions from the project manager and be able to problem solve, where needed, to move the team forward.

2.2 Belbin's Model

Belbin's model is the theory that teams have a mix of behaviours and personality traits between each team member. Certain traits and skills can advantage teams if the teams are organised to suit their roles. These behaviours are grouped into a set number of related clusters, to which the term Team Role is applied (Belbin, R.M. 2024).

I completed Belbin's self-perception inventory, which is a behavioural questionnaire designed to group my skills and traits into a set number to categorise my typical behaviour within a group. Below is a table displaying my scores, and whether they are low, average, high or very high, as well as the average score for each category.

Belbin's Category	**Implementer**	**Coordinator**	**Shaper**	**Plant**	**Resource Investigator**	**Monitor Evaluator**	**Team Worker**	**Complete Finisher**
Description (Belbin, R.M. 2024)	Needed to plan a workable strategy and carry it out as efficiently as possible.	Needed to focus on the team's objectives, draw out team members and delegate work appropriately.	Provides the necessary drive to ensure that the team keeps moving and does not lose focus or momentum.	Tends to be highly creative and good at solving problems in unconventional ways.	Uses their inquisitive nature to find ideas to bring back to the team.	Provides a logical eye, making impartial judgements where required and weighs up the team's options in a dispassionate way.	Helps the team to gel, using their versatility to identify the work required and complete it on behalf of the team.	Most effectively used at the end of tasks to polish and scrutinise the work for errors, subjecting it to the highest standards of quality control.
My Score	11 – Average	10 – Average	4 – Low	7 – Average	5 – Low	7 – Average	14 – High	**12 – Very High**
Average Score	10	8.8	11.6	7.3	7.8	8.2	10.9	5.5
Ideal Score for My Role	9	10	10	9	7	8	10	8

*(**Table 2**: Belbin test scores and description)*

3 Group Tasks & Timings

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	04/10/2024
Familiarising the group with the regulations associated with the project.	4	07/10/2024	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	28/10/2024	04/11/2024
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 VIVA.	20	25/11/2024	10/12/2024
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

*(**Table 3**: Group tasks completed with all group members present)*

4 Personal Tasks & Timings

Task	Hours Required	Task Duration	Equipment/Data Required	Costs and Lead Times
Make an informed decision on what simulation software we are going to use for the project.	2 Hours	1 Week starting 7th October	PC Device to research differences in software and download/run the chosen program.	PC (around £500) – 3 days (delivery)
Learn and understand the first chosen simulation software, OptimumLap.	4 Hours	2 Weeks starting 14th October	Device capable of running OptimumLap. Base Morgan Plusfour data.	OptimumLap is free. – 10 mins to download and install.
Provide the group with a first simulation run with meaningful data around any chosen track.	2 Hours	2 Weeks starting 21st October		
Further OptimumLap simulation, sweep test of Cd and Cl round varied tracks.	4 Hours	4th November – 11th November		Further tracks downloaded from internet – free.
Learning the more accurate and complex sim software, VI Grade.	20 Hours	4 Weeks starting 11th November	Device capable of running VI Grade. Aero and CFD data.	VI Grade software package cost – tailored quote per customer. – 15 mins install. Microsoft Uni subscription – tailored quote depending on devices and IT
Gather information from the aero department to begin modelling the car in VI Grade.	4 Hours	1 Week starting 18th November		
Begin running simulations in VI Grade with known data to build on the performance analysis.	16 Hours	2 Weeks starting 25th November		
Analyse current data and add to the group presentation for the interim VIVA.	4 Hours	2nd December – 9th December	Saved Morgan data files. PowerPoint	
Multiple simulations to build up a performance analysis of prototype wing profiles.	16 Hours	13th January – 20th January	Wing profile and aero data. Device capable of running VI Grade.	

Analyse all simulation data produced during the tests.	16 Hours	20th January – 3rd February	Wing profile and aero data. Excel. Device capable of running VI Grade. CFD and wind tunnel data. Prototype wing modelled.	PC, VI Grade, Microsoft subscription – previous fixed costs.
Use wind tunnel and CFD results to further simulate and analyse performance.	16 Hours	3rd February – 17th February		
Simulate the chosen prototype wing to evaluate changes before manufacturing.	20 Hours	17th February – 3rd March		
Final simulation performance analysis.	16 Hours	3rd March – 16th March	Includes all known data to organise. Word.	
Group project report.	16 Hours	16th March – 30th March		
Group meeting allocated time.	8 Hours 10 Hours 6 Hours 20 Hours	4 Mondays 30th September – 21st October 5 Wednesdays 6th November – 4th December Pre-presentation meetings. 2025 meetings.	Laptop for notes and presenting data. Meeting room.	

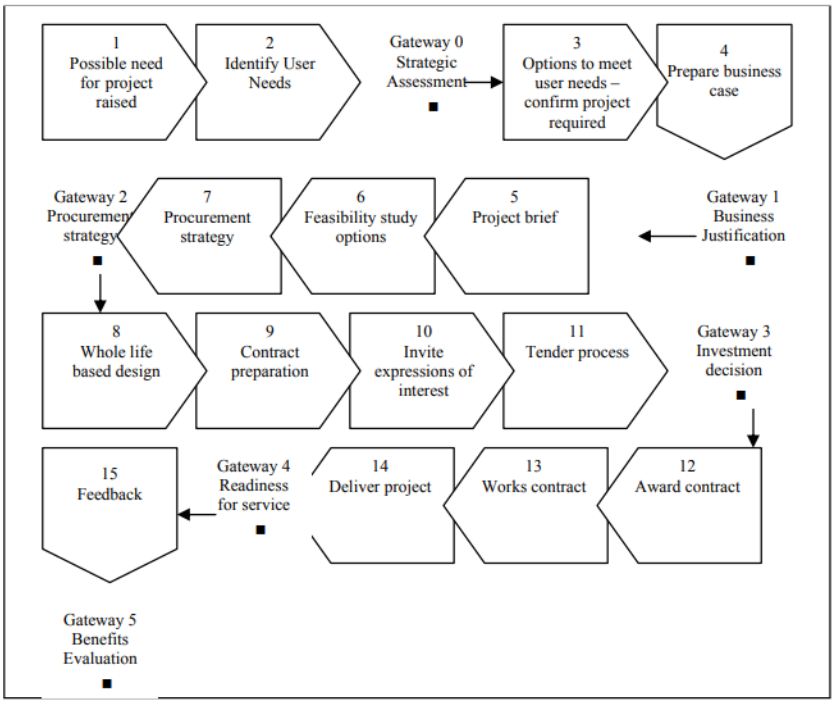
*(**Table 4**: Comprehensive list of personal tasks)*

4.1 Significant Project Milestones

Milestones	Associated planned completion dates
Baseline CFD simulation on the Morgan to gain data for vehicle simulation.	08/10/2024
Vehicle simulation test of the Morgan on a track to attain baseline performance.	27/10/2024
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.	12/01/2025
Attain data and results of the chosen wing profile on the Morgan.	30/01/2025
Produce a prototype to test in the wind tunnel.	09/02/2025
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 systems.	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

*(**Table 5**: Milestones shared throughout our group)*

4.2 Personal Gateway



*(**Figure 1:** Gateway/project flowchart (Hare, B., Cameron, I. and Duff, A.R., 2003)*

The OGC system was initially developed from British Airports Authority approach to review the financial aspects of larger projects (Hare, B., Cameron, I. and Duff, A.R., 2003).

A gateway provides a way for the project manager or departments to measure task completion towards a milestone. This means that a task that is due with a deadline is given a gateway for departments to combine progress to move the project on. This helps plan to make sure critical tasks are completed on time so that progress isn't delayed.

A personal gateway for simulation to meet is the baseline simulation run on the Morgan. This means that, using given and researched data, I would simulate the car around a track to feedback some base figures to the group. Areas of data include a base laptime, downforce, drag force, lateral and longitudinal acceleration. All these data points will be very useful for adjusting the wing to suit the car and the different tracks. This baseline is an important gateway for the group to reach the first development milestone. It also gives the group an idea of how much the car can be improved and what areas of the car's aero performance need work.

The technical performance of the Morgan was evaluated in this gateway, showing that the car produces a negative downforce coefficient of -0.316. A negative coefficient means the Morgan produces lift as opposed to downforce. This is something we would be looking to change with the modification of our wing. We aim to increase the coefficient and break into the positives, indicating that downforce is being produced.

A car with a cL of zero over both axles is ideal; the handling doesn't change at any speed. To do get that balance often requires a big spoiler or wing, to cancel out the lift (Occamsracers, 2024).

4.3 Areas of Concern

Risk 1: Delayed data

This is a large risk in terms of personally not being able to deliver on my area of the project. This is due to the possibility of departments being behind on scheduled tasks. The delay will then affect my ability to deliver on time as the simulation data won't be available for the development made.

Precaution 1: Adjust certain variables in the existing data to estimate for the data which is delayed. To do this I would choose a data set, for example CFD providing a new coefficient of downforce to be simulated around a lap, and I would adjust the variable to provide a range of data. This range would then allow me to predict the closest figures that match the changes made to deliver on time.

Precaution 2: Communicate with the department that is providing the data and evaluate their timescale. This would allow me to potentially readjust my tasks so that I can complete a task scheduled for after the simulation, beforehand. However, I am aware that this will not always be possible due to the nature of the tasks scheduled.

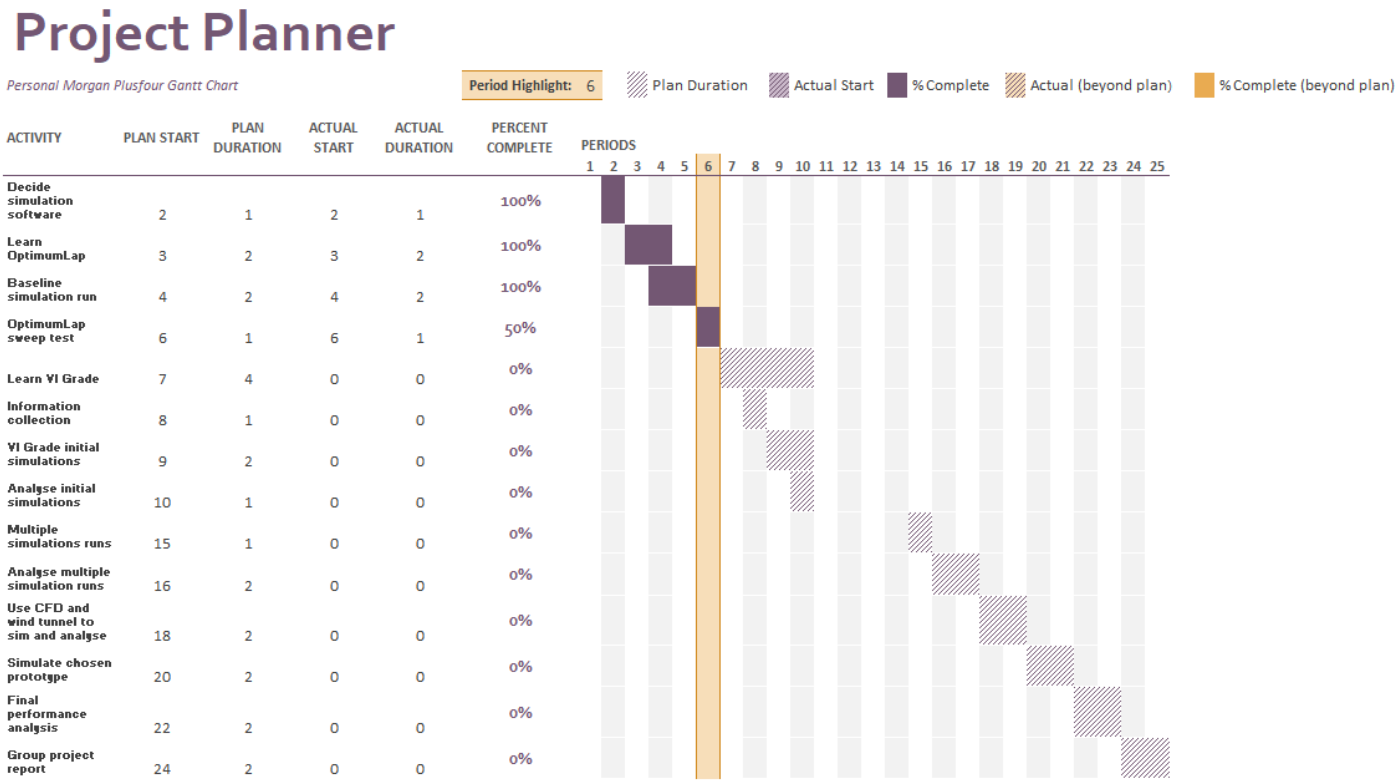
Risk 2: Simulation Model Inaccuracies

Another risk related to the simulation department is inaccuracies within the model of the car or wing. This could provide some irregular data or issues with analysing when the team review the test. It is very important that the risk in this area is mitigated otherwise the data could be meaningless and won't help the development in performance of the vehicle. Here are some precautions to mitigate the risk:

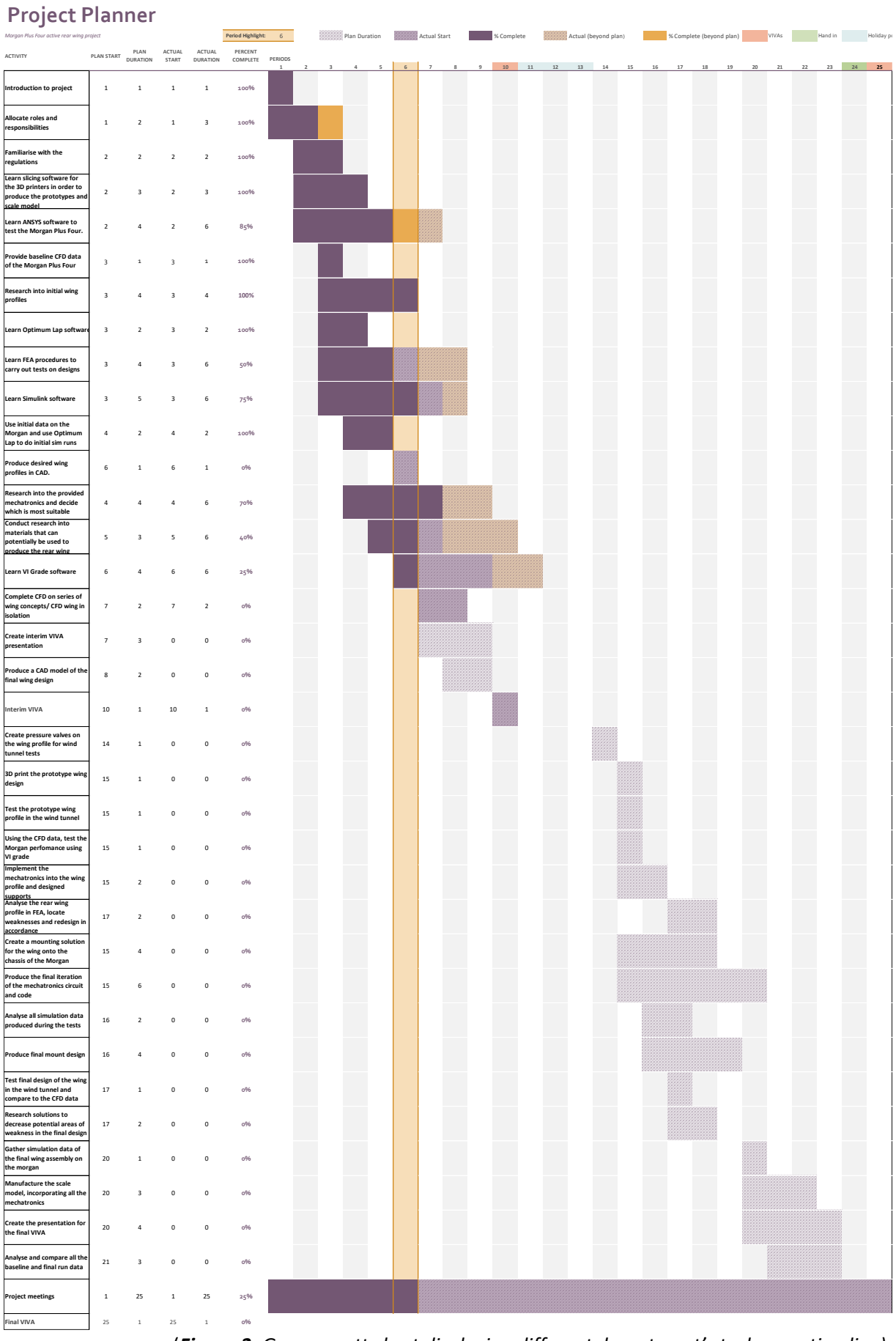
Precaution 1: Back up sim data with some real-world figures. This would mean researching the car or similar cars to see what lap time the Morgan should be roughly aiming to set. I can then compare the data including what the downforce and drag coefficients are, allowing me to validate my simulations.

Precaution 2: Run multiple simulations with the same data and check variables. By running extra simulations and checking the input data each time, the data can be validated to reduce the chance of errors.

5 Personal & Group Gantt Charts



(***Figure 2**: My personal gantt chart of tasks)*



(***Figure 3**: Group gantt chart displaying different department's tasks as a timeline)*

Reference List

Belbin, M. (2024) *The nine Belbin team roles*, *Belbin*. Available at: https://www.belbin.com/about/belbin-team-roles (Accessed: 15 November 2024).

Hare, B., Cameron, I. and Duff, A.R. (2003) *INTEGRATION OF HEALTH AND SAFETY PLANNING IN CONSTRUCTION PROJECT MANAGEMENT THROUGH THE DEVELOPMENT OF A BEST PRACTICE "GATEWAY" MODEL* Available at: https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=6707c2b16e39d38d89784de1c1aa89751e9ec3fe#page=214.

Occamsracers (2024) *Thinking in aerodynamic coefficients*, *Occam's Racer*. Available at: https://occamsracers.com/2024/03/22/thinking-in-aerodynamic-coefficients/ (Accessed: 15 November 2024).