

University of Wales Trinity Saint David

Wales Institute of Science and Art

Project Planning

Engineering Management (ACHA5012)

Brody Crockford

2300783

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Y Drindod Dewi Sant
University of Wales
Trinity Saint David

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Contents

1	Introduction	1
2	Team Structure	2
2.1	Members Roles & Responsibilities.....	2
2.2	Personality Analysis	2
3	Group Tasks & Timings	5
4	My Project.....	6
4.1	Tasks & Appropriate Timings	6
4.1.1	Milestones & Gateway Objective	7
4.2	Bill of Materials & Specialist Equipment.....	8
4.3	Risk Assessment.....	10
4.3.1	Twist Rig Availability (Dissertation Work).....	10
4.3.2	Fitment Issues	11
5	Overall Gantt Chart.....	13
5.1	Group Gantt Chart.....	13
5.2	Personal Gantt Chart	13
6	Bibliography	15
	Table 1 - Group project assigned roles and responsibilities.	2
	Table 2 - Belbin model results for the author.....	3
	Table 3 - Project timings for group members.....	5
	Table 4 - Project timings for the author.....	6
	Table 5 - Tasks with their relevant objectives for the author.....	7
	Table 6 - Required materials and their lead times for the project, including materials for prototyping and manufacturing.	8
	Table 7 - Specialist equipment required for the authors project for data gathering and part development.	9
	Figure 1 - Group project Gantt chart for every member.....	13
	Figure 2 - Personal Gantt chart for the author, including more detailed tasks, specific dates and hours allocated.....	13

1 Introduction

The project focuses on developing a prototype motorcycle built around the RS660 engine, aiming to improve the vehicle's adaptability and performance across various racing circuits. This development integrates full adjustability in chassis and electronics to allow precise tuning for optimal performance under diverse track conditions along with parts to maximise the engine performance at all operating points. The project also aligns with the University's advancing research into the Aprilia RS660 — a promising platform for exploration in the fields of performance engineering and motorcycle design.

The primary objectives of this project include achieving notable progress in the overall motorcycle design, with an emphasis on performance enhancement. Specific goals are to complete the design, prototyping and manufacture of the seat unit, variable inlet stacks, and frame assemblies, which collectively contribute to the weight reduction, engine performance and handling performance of the motorcycle.

2 Team Structure

2.1 Members Roles & Responsibilities

Table 1 - Group project assigned roles and responsibilities.

Group Member	Project Role	Project Aims
Brody Crockford	Project Manager Chassis Design	- Meeting organisation and running - Timeline management - Increase adjustability of the frame - Increase torsional stiffness of the frame - Decrease weight of the frame
Jay Wexler	Self-Supporting Seat Unit Airbox Cover	- Reduce weight of the tail section - Improve rider ergonomics
Sam Stainsby	Variable Inlet Stacks	Optimise the torque delivery of the RS660 engine

2.2 Personality Analysis

The Belbin Team Role Model is a framework developed by Dr. Meredith Belbin to identify the different roles individuals naturally adopt when working in a team. It outlines nine distinct roles, each representing a specific set of behaviours, strengths, and weaknesses that contribute to team dynamics. These roles are Complete Finisher, Shaper, Plant, Resource Investigator, Team Worker, Coordinator, Implementer, Monitor Evaluator, and Specialist. Each role serves a unique purpose, such as driving the team forward, generating ideas, or ensuring high-quality outputs.

The model is widely used in project management and team development to optimize team performance by ensuring a balanced distribution of roles. By identifying team members' strengths and potential blind spots, managers can assign tasks more effectively, promote collaboration, and address gaps in team functionality. Additionally, understanding one's own preferred roles helps individuals work more effectively within the team and develop complementary skills. Overall, the Belbin Model serves as a practical tool for building cohesive, high-performing teams. (Belbin, 2015)

Table 2 - Belbin model results for the author.

Coordinator	Team worker	Implementer	Monitor Evaluator	Resource Investigator	Plant	Shaper	Complete Finisher
4	4	7	6	9	10	12	17
Low	Low	Average	Average	Average	High	Average	Very High

In my role as Project Manager, I find that my strengths as a complete finisher, shaper, and plant align perfectly with the demands of overseeing the group's progress and ensuring we meet our goals. As a complete finisher, I focus heavily on attention to detail and quality control, ensuring that every task is completed to the highest standard. I take pride in meeting deadlines and making sure the project deliverables, including reports and prototypes, are polished and error-free. This trait allows me to effectively monitor the team's work and ensure that nothing is overlooked, which is critical for a project of this scale.

As a shaper, I thrive under pressure and enjoy driving the team forward. When challenges arise, I am quick to respond, keeping everyone focused and on track. I work to maintain the team's momentum, pushing through obstacles and encouraging others to stay motivated. My ability to problem-solve under tight deadlines ensures that we remain adaptable and efficient, even when the project presents unexpected difficulties. Additionally, my plant traits help me think creatively and strategically. I often find myself coming up with innovative solutions to scheduling conflicts or resource limitations, ensuring that our project remains aligned with both short-term tasks and long-term objectives.

In my role as Chassis Designer, these traits also play a vital part. As a complete finisher, I am meticulous in my approach to design and testing. I ensure that every chassis iteration undergoes rigorous validation, including Finite Element Analysis (FEA) and prototype testing,

to identify and resolve any flaws. My drive for perfection pushes me to achieve high performance standards, such as optimising chassis stiffness while reducing weight, along with ensuring the part integrates into the assembly perfectly. As a plant, I bring creativity and innovation to the design process. I enjoy exploring new design elements and configurations that could enhance the motorcycle's performance, and I thrive on conceptualising complex structures that balance functionality and efficiency.

Finally, my shaper qualities support the fast-paced, iterative nature of design work. I ensure that each stage of the chassis design, from initial CAD models to prototype development, is completed on time. When setbacks occur, such as fitment issues or discrepancies in testing, I am quick to identify solutions and adapt the design. These traits allow me to take ownership of my roles, balancing leadership with technical expertise to contribute effectively to the project's overall success.

3 Group Tasks & Timings

Table 3 - Project timings for group members.

Task	Description	Start Date	End Date	Responsible Member(s)
Initial CAD Model	Develop base CAD model for frame and seat unit	Nov 1, 2024	Dec 10, 2024	Brody, Jay
Data Collection	Gather required data for chassis and inlet stacks	Nov 4, 2024	Dec 10, 2024	Brody, Sam
FEA and Design Iteration	Perform FEA analysis and update CAD models	Dec 10, 2024	Jan 10, 2025	Brody, Jay
Prototype Development	Prototype manufacturing and iterations	Jan 10, 2025	March 1, 2025	All members
Parts Manufacturing	Manufacture components for the final build	March 1, 2025	May 1, 2025	All members

4 My Project

4.1 Tasks & Appropriate Timings

Table 4 - Project timings for the author.

Task Name	Description	Start Date	End Date	Hours Allocated
Calculation Program Development	Development of an excel workbook which calculates chassis characteristics based on setup. To be used when finding ideal setups prior to track testing.	28 Oct	17 Nov	10
Twist Rig Building	Building the required parts to fit the OEM RS660 frame into the twist rig.	18 Nov	08 Dec	10
Twist Rig Testing	Measuring displacement of the frame when under torsional loads.	18 Nov	08 Dec	20
Twist Rig Data Processing	Displaying the gathered displacement data in an understandable way for future reference.	02 Dec	08 Dec	10
FEA Testing	Doing computer simulated testing of the frame CAD model through Finite Element Analysis. To be compared with the twist rig findings to show progress and targets moving forward.	09 Dec	29 Dec	15
CAD Modifications	Modifications to the frame CAD model to improve the flex characteristics as a result of the FEA testing.	16 Dec	29 Dec	20
FEA Validation - Calculations	Doing manual calculations of stress figures which can be compared to controlled Finite Element Analysis	23 Dec	05 Jan	3

FEA Validation – Computer simulations	Complete computer simulations of known beams and materials to align with the previous calculations	23 Dec	05 Jan	7
Prototype Manufacture	3D Printing the frame model to begin modelling the remaining parts of the bike.	30 Dec	05 Jan	10
Prototype Analysis	Ensure correct fitment & measure for additional mounting points and bracketry.	30 Dec	12 Jan	20
Final CAD Model	All the modifications required as a result of the prototype applied to the CAD model ready for manufacture.	13 Jan	23 Feb	20
Final FEA Testing	FEA tests conducted to ensure the strength and flex figures haven't been compromised as a result of the modifications prior to manufacturing.	10 Feb	28 Feb	15
Part Manufacturing	Machining of the finished components. This includes doing technical drawings and assisting the machinists throughout the process.	01 Mar	04 Apr	40

Total Hours Allocated	200
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4.1.1 Milestones & Gateway Objective

Table 5 - Tasks with their relevant objectives for the author.

Task	Gateway Objective
Chassis Calculation Software	Must be an automated calculation tool which changes all calculations within the program with only one input.

Twist Rig Data Gathering	Only completed when data has been gathered for the frame both individually and with crankcases, up to a force deemed 150% of those seen in real data.
FEA Testing	Data must be gathered for the frame in all case scenarios seen on data, including braking, acceleration, lean braking and lean accelerating.
Prototype Analysis	Prototype frame is only deemed acceptable if all mounting points line up as desired, base geometry remains within 5% of the OEM part and all parts of the prototype have desired clearance to the engine and surrounding hardware.
Final CAD Model	CAD model is only deemed acceptable if it is able to be machined by the appropriate CNC milling machinery, as well as having a predicted weight 5% lower than the standard assembly.
Final FEA Testing	The frame is approved for manufacturing if all tests come out with a minimum factor of safety of 1.25 and torsional displacement is reduced by 10% compared to the equivalent twist rig tests.

4.2 Bill of Materials & Specialist Equipment

Table 6 - Required materials and their lead times for the project, including materials for prototyping and manufacturing.

Materials	Price	Lead Time
SLS Print Material	£600	5-7 Days
PLA Printing Filament	£70	2-3 Days
5083 Aluminium Billet	£1,200	7-10 Days

Table 7 - Specialist equipment required for the authors project for data gathering and part development.

Specialist Equipment	Product Type	Price
SolidWorks Education	Computer Aided Design (CAD)	£38
Ansys Student	Finite Element Analysis (FEA)	£0
2D WinARace MotoStudent	Data Analysis Software	£0
Brecknell Bench Scales	High Mass Scales for Twist Rig	£200
CNC Mill	Computer Numerical Controlled Milling Machine	£500,000
SLS 3D Printer	Sintered 3D Printing Machine	£20,000
Filament 3D Printer	Filament 3D Printing Machine	£500
Total Project Cost	£522,608	

4.3 Risk Assessment

Managing risks is a critical component of project planning, particularly for engineering projects where precise execution and resource availability are essential. This section identifies two significant risks that could impact the success of the prototype motorcycle project: the unavailability of the twist rig and potential fitment issues during the frame design process. Both risks could result in delays and increased costs, but proactive mitigation strategies have been developed to minimize their impact.

4.3.1 Twist Rig Availability (Dissertation Work)

One of the primary risks facing this project is the potential unavailability of the twist rig, which is essential for chassis stiffness testing. The twist rig is a shared resource and may be occupied by a dissertation student during critical periods of our project. Since the twist rig provides crucial data on how the chassis responds to torsional loads, its unavailability could significantly delay my ability to validate the chassis design. This delay could disrupt the project timeline, affecting subsequent phases such as Finite Element Analysis (FEA) analysis and prototype completion.

4.3.1.1 *Potential Consequences*

If the twist rig is not available when needed, it could lead to delays in obtaining vital data required for validating the chassis stiffness. This, in turn, could push back other interconnected tasks, such as frame FEA testing and validation, creating a bottleneck in the project schedule. Additionally, increased downtime between tasks could cause a cascading delay, disrupting the project's overall progress and leading to potential missed deadlines. Such delays could also impact the availability of other resources, such as manufacturing processes or other specialist equipment, compounding the problem.

4.3.1.2 *Mitigation Strategies*

To mitigate the risk of twist rig unavailability, two key strategies will be implemented. First, task preparation will ensure that all preparatory work, such as CAD modelling and initial FEA simulations, is completed before the twist rig becomes available. By front-loading these tasks, we can reduce downtime and be ready to commence testing immediately when the rig is accessible. This approach minimises idle periods and ensures efficient use of the rig's availability.

Second, maintaining consistent communication with the dissertation student who also requires the rig is vital. Regular updates will help monitor their progress and provide clarity on when the rig will be available. Establishing a mutual understanding and cooperation can help prioritize testing slots, ensuring that both projects can progress without major interruptions. By

staying informed and flexible, we aim to optimize resource usage and keep the project on schedule.

4.3.2 Fitment Issues

Another significant risk relates to fitment issues during the frame design and assembly process. These issues may arise due to inaccurate measurements or discrepancies between the CAD model and the physical components. If the frame does not fit correctly, it could lead to costly rework, including the reprinting of components and iterative adjustments to the design. Such errors would not only increase project costs but could also result in significant time delays, affecting the project's ability to meet key milestones.

4.3.2.1 *Potential Consequences*

Fitment issues could have several negative consequences. Delays caused by the need for additional measurements and redesigns would push back the timeline for subsequent tasks, such as prototype testing and final assembly. Financial costs could also escalate due to the wastage of materials, particularly if 3D-printed parts must be reprinted multiple times. Additionally, compounding delays during critical testing phases could risk the project's overall delivery schedule, impacting final assessments and the quality of the deliverables.

4.3.2.2 *Mitigation Strategies*

To address the risk of fitment issues, several mitigation strategies will be employed. First, cross-referencing measurements will involve validating all key dimensions using multiple data sources, including external measurements from the MotoSpec chassis software, to help ensure that the initial CAD model is accurate and aligns with the physical components.

Second, In-Situ Validation will involve regularly cross-referencing the CAD measurements with actual dimensions taken directly from the bike. By doing this throughout the design process, any discrepancies can be identified early, reducing the likelihood of significant fitment errors during the assembly phase.

Finally, Incremental Testing will involve performing fitment checks on smaller prototype sections before proceeding to full-scale production. By testing individual components early and often, we can ensure compatibility and adjust as necessary without impacting the entire design. This approach not only minimizes the risk of major fitment issues but also helps maintain the project's timeline and budget.

These targeted mitigation strategies are designed to minimise both the impact of resource constraints and the risk of design errors. By implementing these measures, I aim to ensure

that the project remains on track, meets its milestones, and delivers high-quality results within the allocated budget and timeframe.

5 Overall Gantt Chart

5.1 Group Gantt Chart

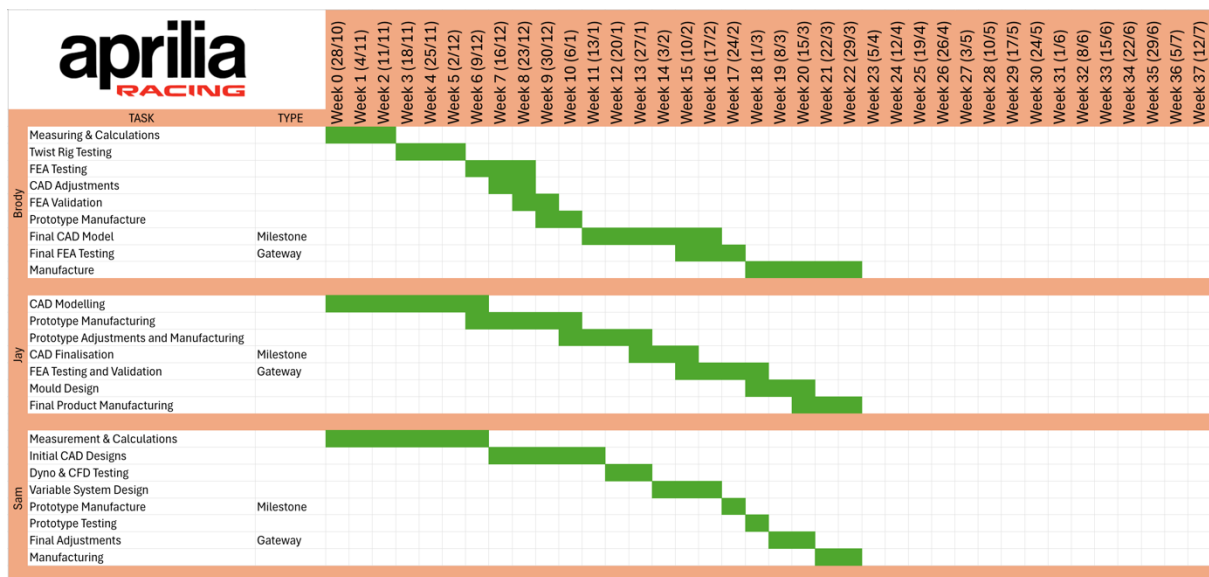


Figure 1 - Group project Gantt chart for every member.

5.2 Personal Gantt Chart

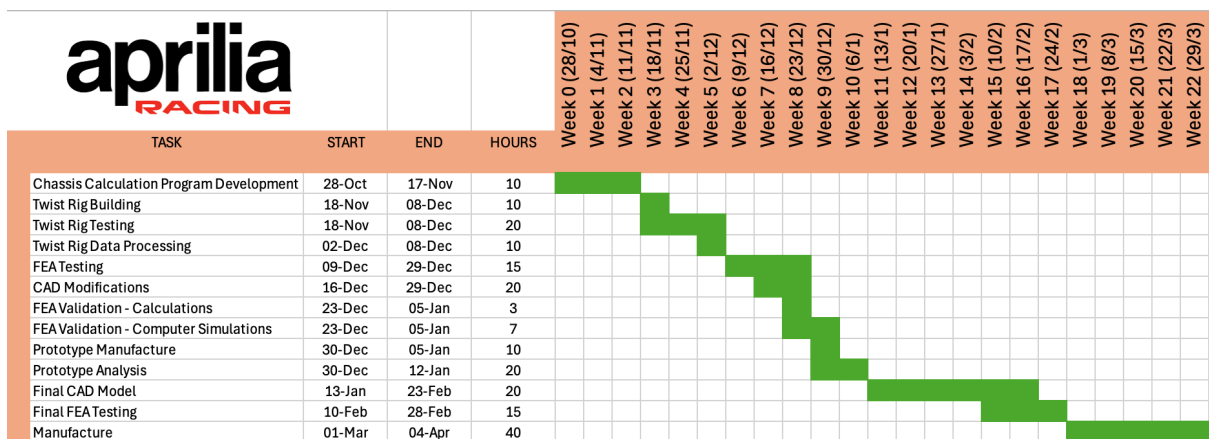


Figure 2 - Personal Gantt chart for the author, including more detailed tasks, specific dates and hours allocated.

6 Conclusion

This report has provided a framework for planning and executing the development of a prototype motorcycle using the RS660 engine. Through effective project management and technical design, we aim to deliver high-quality outputs that meet the project's objectives, including enhanced performance and adaptability. By leveraging team strengths identified through the Belbin Model, we can ensure efficient collaboration and task allocation. Furthermore, the risk assessment and mitigation strategies outlined in this report demonstrate a proactive approach to addressing potential challenges, ensuring that the project stays on schedule and within budget. Ultimately, this report has highlighted the importance of strategic planning, teamwork, and technical precision in delivering successful engineering outcomes.

7 Bibliography

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