

University of Wales Trinity St David
School of Engineering

Project Planning

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Mechanical Engineering

17/11/2024

Engineering Management, Innovation and
Sustainability

ACMA5007

[1] Introduction

The following document is my engineering management assignment regarding my group project, covering my group project, its tasks and time management, and most importantly my overall contribution to the project.

My group project is the IMECHE advanced design challenge for 2025. It requires us to develop and create an autonomous vehicle capable of traversing a given area in a straight line from point A to a wall, connecting with the wall at a given height and simulate charging with lights and sounds, then traversing to point b and back to the wall, connecting with an even higher point of the wall and simulate charging yet again with lights and sounds.

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[2] Engineering Team

[2.1] Team Members

Tyler Powell	2318809
Sheunesu Ziki	2205423
James Minton	2204900
Max Oliver	2205423

[2.2] Team Members Roles and Responsibilities

CAD/Designing	James
Bill of Materials	Max
Assembly	All
Programming	Ziki
Content Creation	All
Organising	James
Physics/Mathematics	Tyler
Accuracy Testing	Tyler
Design Research	James/Tyler
Component Research	Ziki/Max
Problem Identification/solutions	All

[2.3] Belbin personal roles

Strengths	Weaknesses
Creative: I am very creative, coming up with ideas and find it enjoyable to find ways to solve problems	Lenient: I won't argue my ideas against others and instruct others unless really pushed to by inadequacy
Strategic: I enjoy finding ways to make things work, creating intricate ways to solve multiple problems at once	Unfocused: I find it difficult committing small amounts of work over a large amount of time, I perform much better doing a large amount of work in a short amount of time
Practical: I can visualise most things and always see things from a practical sense and can implement ideas very well	
Team worker: I am good at working with others on areas of the project and can be delegated tasks without issue	

Based of my strengths and weaknesses, I believe the team roles that would suit me best are as follows:

Plant

Implementer

Team worker

[2.3] My Roles and Responsibilities

My roles and responsibilities are as follows:

Assembly

Assembling the device, with everyone being involved and responsible for this process, it is not solely my responsibility and not a key area of the project I will have to put much time and effort into. Also, with everyone being involved in this process, it should require little to no time to complete an assembly. With each redesign iteration/improvement, we will need to assemble the vehicle multiple times, so predicting an amount of time for my involvement in this aspect is difficult since we will not know how many times the device will need to be changed. I am expecting each assembly to take no longer than an hour, decreasing with new redesign and expecting a minimum of 5 redesigns which could be full reassemblies or minor 5-minute-long changes.

The expected Bill of materials would be as follows, however we have yet to decide on many aspects of the design as we have not weighed out the strengths and weaknesses of potential materials and types of components, so this is more of a generalised list:

- Vehicle base
- Wheels
- Motor(s)
- Wheel axle and associated gears
- Arduino/circuit board
- Plunger
- Colour sensor
- Wall sensors
- Batteries

I do not expect we will require any equipment aside from screwdrivers and a soldering iron for the assembly of the vehicle.

Content Creation

This role/responsibility is referring to the content required for the development of the project for the module and for the competition. This covers things such as creating development roadmaps, creating presentations, and noting any research and development. As this is another shared responsibility, I will not be tackling this alone and it is mostly just noting any individual progress I make on my areas of the project, no additional time should need to be made available for this responsibility.

I should only require my home PC with typical Microsoft software to complete any tasks for this role/responsibility.

Physics/Mathematics

This responsibility will require me to plan out specific technical capabilities and requirements of the vehicle. This is crucial to allow for precise component and design choices so the vehicle operates as best as it can without any issues. I will need to calculate maximum and minimum mechanical aspects, such as the torque required, optimal wheel size, traversable distance, force required to move and at what speeds it

will travel, vehicle acceleration and deceleration so the vehicle can be coded to travel the required distance accurately.

I should only require a pen, paper, a calculator and potentially my PC to double check equations.

Accuracy Testing

This will require running the vehicle multiple times, to try and assess the vehicles accuracy at completing the task. All design changes will need to be evaluated, and each change will need to have its impact on accuracy assessed to determine if the change is an improvement and if not, revert the change. Many minor things affect the accuracy of the vehicle's performance, so I expect it to take many hours over the course of weeks, of testing as we will want it to be as accurate as possible to have any chance of winning the competition.

This will require the vehicle and supplies to create the course that will be in the competition, these may include printed out sheets of targets, cello tape or another means to stick the targets down and a highly accurate ruler, ideally electronic.

Design Research

This is primarily focused on the aspects of the vehicle that we will have to potentially create and/or shape ourselves. My area of focus for this responsibility is the wheels. Researching past winners and competitors on what they did with their wheels, what problems they faced with the wheels and what their solutions were. This role also involves me designing our wheels we will be using and being responsible for any changes needed to be made to the wheels in future. I researched for about 3 or so hours, watching previous competitor's presentations etc. And the first design took about 10 to 20 minutes. I expect any future redesigns to take about the same length of time.

For this role, all I needed and will need in future is my home PC with CAD software.

Problem Identification/solutions

This is another shared responsibility; it requires no predetermined time allocation for this as it is simply just being wary of potential problems and working together to produce solutions to problems we have. The expected time needed for these solutions will vary depending on the problems complexity and the difficulty of implementing said solution(s).

The equipment required will also vary depending on the problem, but will just require whatever equipment, materials, and components we have already used for other parts of the project.

[3] Project Tasks

[3.1] Project Requirements

Research

Design the vehicle

Prototype vehicle

Create final vehicle design

Create IMECHE development poster

Create IMECHE development presentation

Create a bill of materials for the vehicle

[3.2] Overall Team Tasks

Research components, materials and past competitors

Design first vehicle iteration

Assemble the vehicle

Create the program to run the vehicle

Test Vehicle

Interim VIVA presentation

Create design iterations to combat the vehicle's lack of accuracy and/or efficiency

Make changes to the program script to combat any accuracy and/or efficiency issues

Create development poster

Create development presentation

Final project VIVA presentation

[3.3] My Tasks

Research Past Competitors

Design the wheels

Contribute to the creation of the project presentation

Participate in assembling the vehicle

Test vehicle accuracy

Contribute to the presentation needed for the competition

Contribute to the poster required for the competition

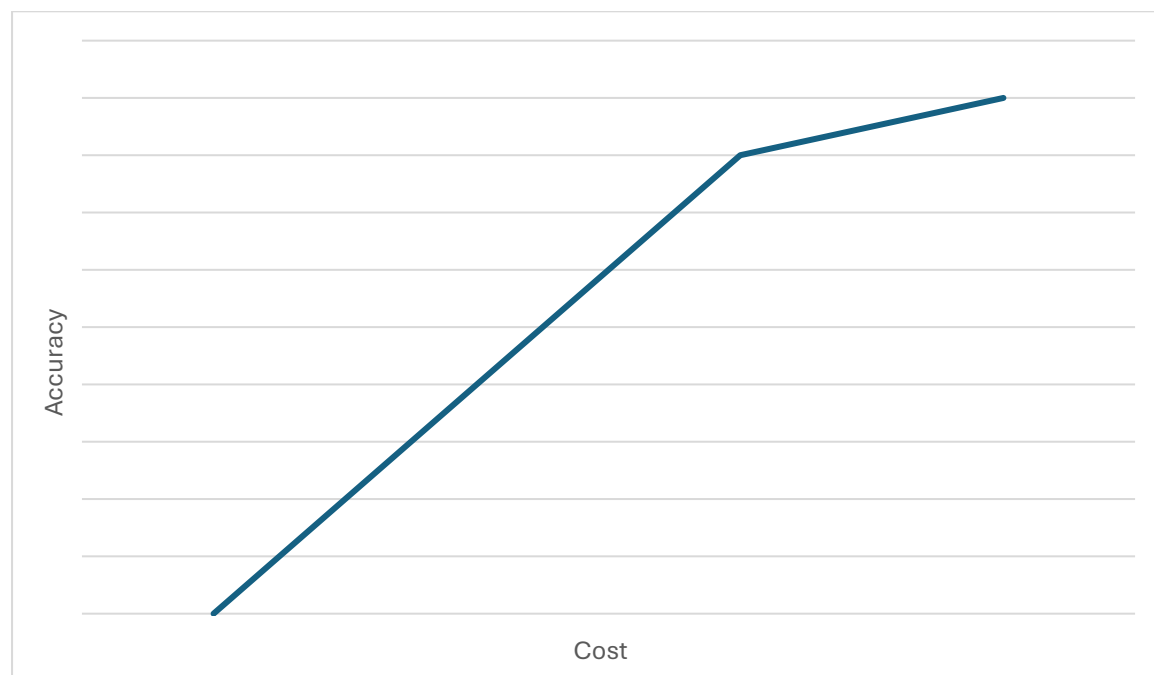
[4] Project Milestones

Major project milestones for group would as follows and in chronological order:

- Have a first fully designed vehicle, with all initial components selected.
- Fully assembled a working automated vehicle.
- Finish first wave of tests on vehicle to determine major areas of concern for the redesign.
- Created second design and conducted tests to determine what will need to be changed.
- Created and finished testing final iteration that is ready for competing.
- Completion of project presentation for the module and for the competition.
- Participated in regional competition.
- Depending on previous competition results, finish the project in the competition finals.

[4.1] Gateway Objective

One of my gateway objectives is balancing cost and accuracy of the wheels. The wheels need to provide a high degree of accuracy to the performance of the vehicle, but it cannot come at an excessive cost. I need to find the sweet spot of accuracy per cost ratio just before the accuracy per cost has diminishing returns.



[4.2] Individual Areas of Concern

The accuracy of the vehicle is an area of the project that has many concerns for me. The accuracy of the vehicle is essential to progression in the IMECHE competition, the vehicles accuracy scores us many points and I would very much like to progress far as possible. To assure our vehicles accuracy I will be conducting many tests in many manners of ways to assure the vehicles accuracy and suggesting or creating design changes that would benefit the vehicles performance and accuracy.

Another area of concern is assuring that the changes to the vehicle to help performance still keep the vehicle within budget. To combat this, all design changes need to be checked within the bill of materials and I will work with my team members to assure any changes I intend to make can fit in the budget and if not change my design alteration or work on other areas to reduce their impact on cost of the vehicle.

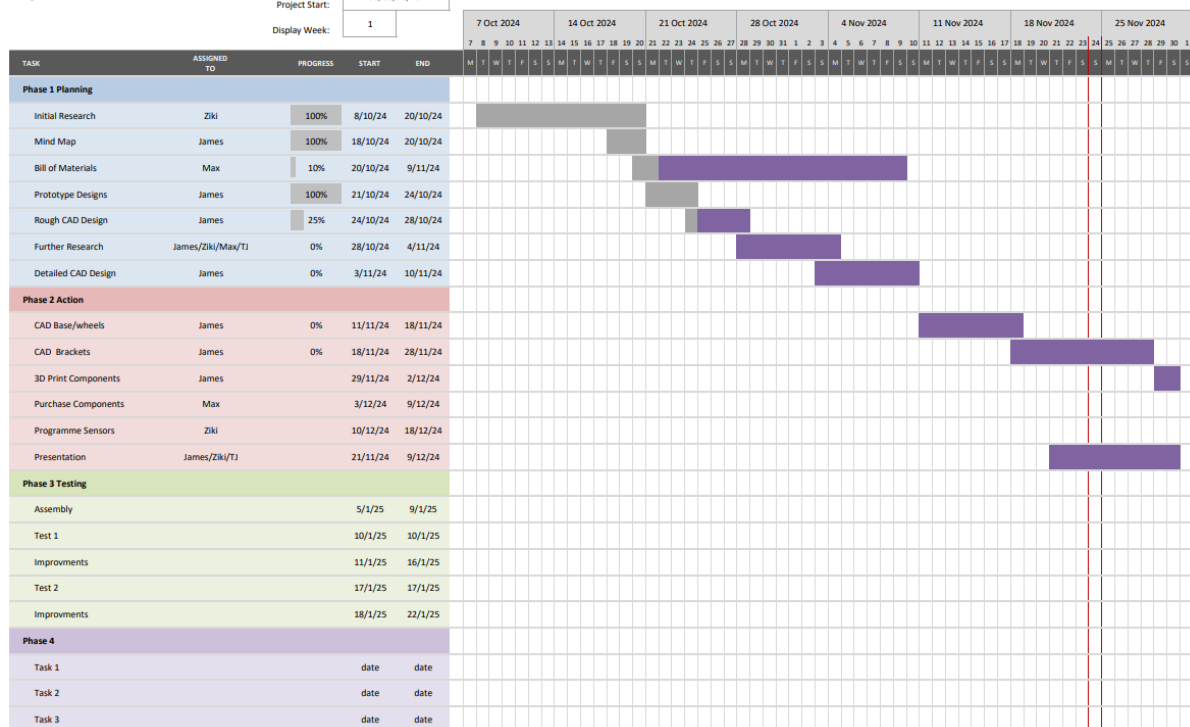
[4.3] Project Gantt Chart

IMECHE DESIGN CHALLENGE

Progress table

Project Start: Tue, 08/10/2024

Display Week: 1



[4.4] Individual Project Plan

Individual Project Task	Estimated completion date	Time required
Research past winners	05/11/2024	3 – 5 hours
Research, calculate and design the wheels	19/11/2024	3 – 5 hours
Assemble the first vehicle design	26/11/2024 – 30/11/2024	1 – 2 hours
Interim project VIVA presentation development	12/12/2024	2 – 3 hours
Test vehicles performance	01/2025	4 – 6 weeks
Create vehicle alterations	02/2025	4 – 6 weeks
Create final iteration of the vehicle	03/2025	1 week
Final project VIVA presentation development	04/2025	1 week
IMECHE project development poster	04/2025	3 – 6 hours
IMECHE project development presentation	04/2025	1 – 2 weeks