

MJ project management

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Engineering & Project Management

ACDA5025

Project proposal:
Smart Hybrid Propulsion System

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1. Introduction

The rapid growth of tourism has led to a significant increase in the use of small petrol-powered boats. These boats play a crucial role in tourism and supporting local economies. However, many of these boats rely on outdated engine technologies, which contribute heavily to environmental degradation.

These boats produce substantial air and water pollution which negatively impact marine ecosystems, contribute to climate change and pollution. In addition, high levels of boat traffic generate a significant amount of noise pollution disrupting nature. Despite the availability of fully electric boats, the use of these remains limited due to the high costs which would require a full vessel replacement.

This project proposes an accessible human integrated smart hybrid propulsion system that can be implemented to current boats. This approach aims to reduce fuel consumption and emissions while maintaining practicality and affordability. This system also promotes awareness to sustainable practices.

2. Background research

Older tourist boats in dream destinations such as Phuket and nearby islands often use outdated petrol or diesel engines, which are inefficient and can degrade after heavy use over a long duration which also increases sea and air pollution.

The number of travels to Thailand in 2024 increased by 15% compared to 2023 [1], with more travels set on this dream destination year on year. Research shows that boat traffic contributes directly to water contamination, which will be an increasingly more alarming issue as more tourists visit Thailand.

~~Approximately 75% of the world's coral reefs are currently threatened by pollution~~

Many due to small tourist boats [2]. And many reefs in Thailand are extremely vulnerable with 30% of Thailand's coral reefs are in poor condition with tourism related activities being the primary cause, mainly to blame are outdated petrol-powered tourist boats along with plastics and sunscreen waste. [3] Furthermore, most rivers and lakes in Thailand have seen 25% increase in pollution in direct coloration with the increase of boat demands. An extreme case such as Maya Bay where 80% of the coral has been destroyed due to heavy

boat traffic and pollution.[4] which in turn affects loss of marine habitats and desecration of scenery which could also reduce tourists and income for island locals.

Heavy demand of tourists is likely to increase the pollution in already venerable places, therefore leading to the extinction of these beautiful places. According to 'Global News Bangkok' Phuket's tourism has surged dramatically with around 13 million tourists in 2024 alone [5] contributing a 40% increase in pollution, with 15% of that being water and air pollution [6].

3. Problem statement

Tourist coastal locations around Thailand such as Phuket and other island rely heavily on small petrol or diesel-powered boats to transport visitors. While these boats play a vital role in supporting local economies, many use outdated engine technologies that have inefficient power utilisation, while also highly polluting the surrounding air and water nearby.

In addition, fuel leaks and oil discharge contaminate the water around, negatively impacting sea life and marine ecosystems. These sensitive environments, including coral reefs and coastal habitats are very vulnerable to this pollution, this results in long term ecological damage.

Despite the availability of fully electric marine propulsion systems, the use of them is limited due to high costs and the need to replace existing vessels entirely. For smaller scale tours especially in developing regions transitioning vessels is economically challenging and unfeasible. As a result, there is a significant gap between current practices and sustainable alternatives. Furthermore, these traditional boat tours do not promote user awareness in sustainability, while tourists continue to participate with little understanding of the environmental impact.

Therefore, there is a clear need for a cost-effective solution that can be integrated into existing boats or new built boats in order to reduce emissions, improve energy efficiency and promote sustainable practices. Contributing not only to environmental improvements but also to educate locals on the need to preserve.

4. Aim & objectives

Existing boat Research and problem analysis

- Research and analyse existing hybrid / electric propulsion systems
- Investigate environmental impacts of current petrol-powered tourist boats, in highly visited regions such as Phuket

Design system

- Design a hybrid propulsion system with features such as electric motor, pedal powered generator and internal combustion engine.
- Develop clear system architecture and system explanation process with a block diagram

Cost effective

- Market research on current petrol/diesel powered systems
- Analyse system and effective cost breakdown to ensure system is within budget

Performance analysis

- Estimate power output
- Estimate energy efficiency
- Fuel saving

Environmental assessment

- Evaluate reductions in CO2 emissions
- Evaluate potential water pollution
- Evaluate potential noise pollution

Risk assessment

- Identify product hazards
- Evaluate the feasibility of implementing the system in real world scenarios
- Identify potential risk

Ethical considerations

- Analyse ethical implications of product
- Evaluate the impact on tourism and locals

5. Work Structure Breakdown

Project Management

- Define scope and objectives
- Create Gantt chart
- Track progress

Research and background analysis

1. Identification of problem
 - Identify problem and investigate pollution from tourist boats
 - Study tourism impact to pollution in areas such as Phuket
2. Literature Review
 - Research hybrid propulsion systems
 - Analyse existing products

System Design

- Create block diagram
- Component selection
- Battery selection

Modelling and calculations

- Calculate appropriate motor and pedal output
- Calculate energy consumption
- Evaluate efficiency
- Comparing the new system to current diesel engines

Environmental impact analysis

- Estimate emission reduction
- Assess how it will reduce water and noise pollution
- Evaluate tourism benefits

Risk and ethical analysis

- Identify risks for this product
- Evaluate impact of risks
- Risk mitigation, propose solutions to reduce risk
- Asses environmental risks

Report Writing

- Include all necessary parts, introduction, conclusion, background research
- Include methodology and flow chart design
- Results and evaluation
- Prepare presentation slides
- Summarise key findings

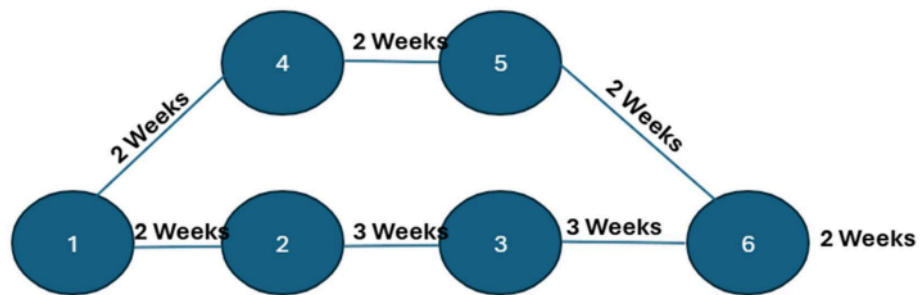


Figure 1: shows the critical path

Activity	Preceding activity	Time
1	None	2 Weeks
2	1	2 Weeks
3	1,2	3 Weeks
4	1	2 Weeks
5	1,5	2 Weeks
6	1,2,3,4,5	2 Weeks

Program evaluation

Most likely time (m) = 12 Weeks

Optimistic time (a) = 10 Weeks

Pessimistic time (b) = 14 weeks

- Expected time $t_e = \frac{(a+4m+b)}{6}$
- Activity standard deviation $S = \frac{(b-a)}{6}$

Figure 2: shows the equation for expected time and standard deviation

Expected time = 12.6 Weeks

Deviation = 0.66

A small deviation means the activity duration is more predictable

6. Literature Review

Research based on hybrid propulsion systems reveals multiple potential advantages including fuel savings, lower air and sea pollution along with reduced noise emissions. [7] Hybrid electric systems take advantage of two technologies by utilizing both combustion engines and electric motors together. Sources [8] and [7] suggest fuel saving of up to 30 and 50%. Which have a heavy effect impact to fuel leaks along with gas pollution. Fuel savings also allow local business vendors to have less expenses which could increase profits. Other reports [9] reveal that hybridisation leads to a 40% reduction of fuel without the need to compromise performance power.

With the help of pedal power generation, research shows an average person can generate approximately 50-200 watts of power, with a pedalling rate of 30 to 70 rpm [10] although this output is relatively small it can be effective for charging the boats battery and supplementing overall energy efficiency.

Based on research a gap that was discovered, while research exists on hybrid propulsion systems, there is limited focus on integrating human powered energy generation systems,

such as pedal generators, particularly for tourist boats. This supports the development of the proposed system as a practical and environmentally beneficial add on for tourist boats. Furthermore, the demonstrated research papers only highlight the use of hybrid propulsion systems on heavy cargo and big boats, however this system has not been implemented in smaller tourist boats that could also contribute heavily to the reduction of emissions and pollution.

7. Environmental impact

The system offers a significant amount of environment benefits by reducing emissions, fuel consumption and pollution from existing tourist boats. While there are some extra costs associated with manufacturing and battery use, they are significantly outweighed by the long-term reduction of pollution and hazardous waste.

The emission difference between fully diesel engines and smart hybrid systems are significant. Diesel engines are typically between 35% to 55% efficient due to energy loss, exhaust gasses and mechanical friction. Whereas electric propulsion systems can achieve efficiency levels of 75% to 90% [11]

Lowering the reliance on petrol/diesel engines has a benefit as there will be a 40% decrease in emissions which contributes to cleaner air quality and reduced water pollution. The quieter new system also reduces noise pollution in these sensitive areas which will positively impact marine life and create a better environment for travellers.

With these improvements overtime the environment impacts will be very noticeable, especially in sensitive ecosystems such as coral reefs and marine protected zones. The emission reduction will also impact the villages and nature nearby providing both locals and animals a better toxic free ecosystem.

Lower fuel consumption, with a minimum decrease of 35%, directly decreasing hazardous oil waste into lakes. The switch to hybrid optimizes engine loads, directly helping battle global warming.

8. Function and block diagram

The system will operate as a hybrid propulsion setup along with the current engine, in which the existing petrol engine will be the primary source of high power for high speed situations and heavy loads in order to ensure reliability along with an electric motor connected to the propulsion system and can independently drive the boat at low speeds along with a pedal powered energy generation unit to improve efficiency. The pedal powered generator is incorporated to allow passengers to be involved in helping produce energy in a fun and practical way which is then used to charge the onboard battery. Although the contribution from human power is relatively small in comparison to the petrol engine, its main contribution is to provide supplementary energy and promote sustainability practices while preserving nature and reducing pollution. A central control unit will monitor other key parameters also such as speed, battery level and automatically select the most efficient mode of operation, electric, hybrid or engine only. This approach enables less fuel consumption and lower emissions while helping maintain the boats performance.

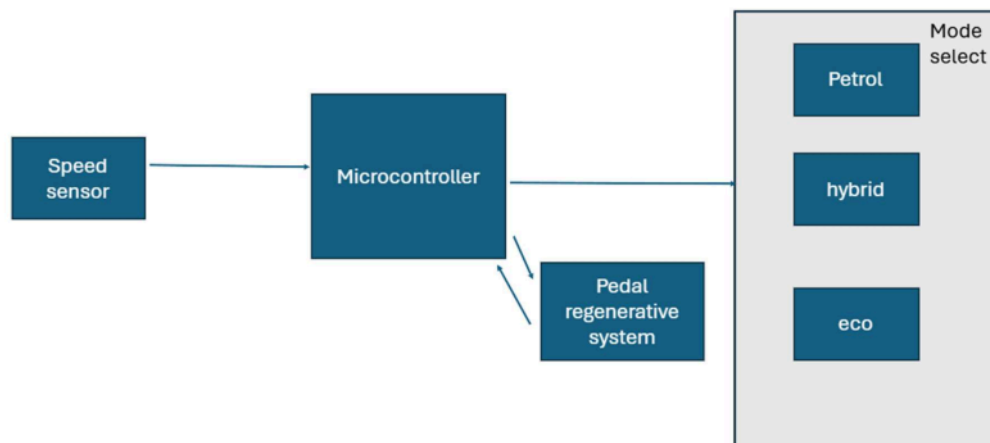


Figure 3: Shows the block diagram for system

Name	7 smart hybrid propulsion system
Purpose	Chose a more efficient mode for transport and reduce waste
Input	Speed sensor input, Pedal generation
output	Relevant power mode
Functions	Uses sensor to detect the speed selects relevant mode
Performance	Detects state change within 1s
Manufacturing cost	£4,200
Power	Approximately 20kW
Physical weight	Approximately 40kg

9. Deliverables

The primary deliverable will a detailed report, ensuring to cover all aspects of the project, this will include background research, a problem analysis, system design, evaluation and conclusion. The report will in cooperate relevant engineering principles and present findings in a structured format.

In addition to a written report, a series of technical diagrams will be produced to support the design and explanation of the system, these will include block diagrams and flowcharts to demonstrate the architecture and system operation.

Furthermore, a Gantt chart and work breakdown structure will also be included as deliverables, providing a clear overview of the project planning, task and time management. This task will demonstrate a structured approach taken throughout the entirety of the project.

A performance analysis and evaluation estimation test will also be included in order to estimate efficiency, fuel savings and assessing the environmental impacts. These results will be supported by calculations, predictions and clear scientific estimations.

Finally, a presentation and summary will be produced to present the key outcomes and priorities of the project in a concise format. This will highlight the key need and significance for this project with its potential in real world applications.

10. Calculations

Battery

Given that the system will use a 48V, 50Ah lithium-ion battery:

- $48 \times 50 = 2.4\text{kWh}$

Therefore, to work out the time that it would take to charge the battery, only with the use of pedal generation

- $2400\text{Wh}/150\text{w} = 16 \text{ hours}$

However, with the addition of more pedals this time could be reduced, a reasonable number of pedal sets would be a minimum of 4 for a small boat:

- $2400/600 = 4 \text{ hours}$

This would increase the battery runtime for an extra 1.2 hours a day.

- $\text{Runtime} = 2400/2000 = 1.2 \text{ hours}$

Fuel

A petrol system on its own consumes around 10 Litres per hour. However, with the new system, Eco (electric) mode would be engaged for around 35% of total trip times, with hybrid mode being engaged around 50% of the time and full petrol mode engaged at the remaining 15%.

- $(0.35 \times 0) + (0.50 \times 5) + (0.15 \times 10) = 4 \text{ Litres per hour}$

Therefore, reducing the fuel consumption by around 60%

10.1 Cost benefit analysis

The Approximate cost of the system is £4,200.

Before the system, the cost of fuel alone would be £22,000/year

- Based on 10L perhour, 5h/day for 300 days

After system installation, fuel cost would be £10,000/year

- Based on the improved performance of 4L/hour, 5h/day for 300 days

Therefore, the installation of the £4,200 system will save £12,000 per year on fuel

- $\text{Cost benefit ratio} = 12,000/4200 = 2.8$

This shows the high economical value along with environmental benefit of this system to marine life and nature, further strengthening its overall value.

11. Component List

Existing Engine

- Main propulsion at high speed

Electric Motor (1-5kW range)

- This assists engine in hybrid mode
- Type: 2.5kW Brushless DC motor. Price: £2,045

Pedal generator system

- Pedal crank mechanism- The use of this converts human energy into mechanical energy, charging the battery
- Lithium-ion battery, 48V, 50Ah
- Battery management system to monitor voltage, current and temperature
- Microcontroller: to process sensor data and control switching between modes
- Sensors: such as speed, power usage, battery level and user input.
- Lcd Display unit: output battery level, power mode

12. Risk assessment and mitigation

1. Risk – System Complexity

The integration of multiple energy sources such as engine, electric motor and pedal increases complexity, increasing difficulties in design and explanation

Mitigation:

- Break the system into clear subsystems

- Focus on core functionality than other unnecessary features
- Risk transfer, outsource to specialist if required

2. Risk – Delay in component delivery

Delays in the timeline could cause major/minor setbacks which would have an impact on overall system

Mitigation:

- Use multiple suppliers
- Identify alternative components that can be used for same task

3. Risk – Battery disposal

Improper disposal of a lithium battery may lead to pollution and safety hazards

Mitigation:

- Identify and use certified recycling system appropriate for lithium batteries
- Design for easy battery removal and replacement
- Include and recommend regulations for safe disposal in such regions

4. Risk- Time constraints

Limited time may affect depth and quality of project

Mitigation:

- Follow a clear and structured timeline
- Prioritise key sections
- Monitor progress to ensure all work is complete

Ranking Of Risks:

	Negligible	Minor	Moderate	Major	Catastrophic
Rare					
Unlikely		Power calculation error		Power instability	Interlock system
possible	Document error		System alignment	System integration error	Software Failure/ Mechanical failure
likely					
Almost certain		Delay in Delivery			

13. Ethical concerns

The proposed hybrid propulsion system for tourist boats raises some ethical considerations, these concerns not only relate to environmental responsibilities but also social norms and transparency with results.

One of the primary ethical concerns are the result transparencies, as there is a risk of misrepresenting the benefits of the given propulsion system. While the proposed design reduces fuel consumption and emissions, it does not entirely remove emissions and pollution as the original petrol engine will also remain part of the system. Therefore, an ethical concern would be, as operators could potentially market their boats as 'fully eco-friendly' which could lead to vendors charging a premium price, for however that is misleading.

In addition, the main ethical concern would be related to the production and disposal of lithium-ion batteries. This includes the extraction of lithium and cobalt which endanger many workers and potentially degrade the environment around these mining regions. Moreover, the improper disposal of these batteries will contribute to soil and water contamination. Therefore, it is important to consider the full lifecycle and impact of this system and not just operational benefits.

The cost of refitting boats with this upgraded hybrid system may create a financial barrier for small business vendors. This raises inequality between vendors who can afford to

upgrade and to those who cannot, therefore leading to potential loss of income for those smaller businesses.

14. Conclusion

This project addresses the environmental impact of a petrol-powered tourism boat with an integrated hybrid propulsion system as a feasible solution for outdated and polluting boats in high tourism regions such as Thailand.

A future improvement for this system could include the use of a turbo to achieve more power and have better distribution of energy to improve petrol use and have optimal performance.

The report highlights the importance and practical use of this system with its smart initiative design, reducing fuel consumption by 60% also reducing waste and pollution by 40%. The detailed description of the projects ethical concerns and challenges are outweighed by the importance and impact of this system, therefore creating a feasible and desirable project.

15. Appendix

Certificates:

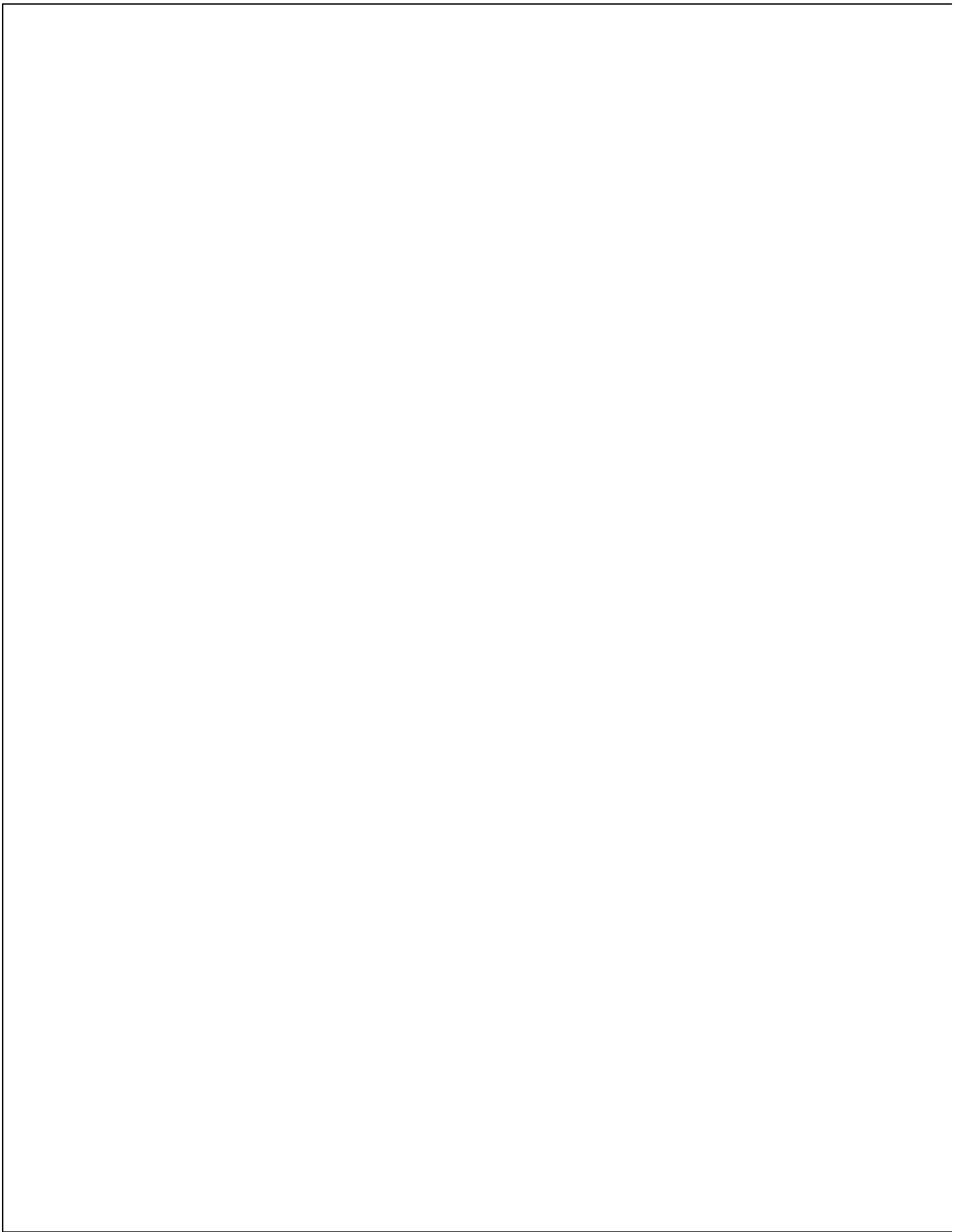


Figure 4: EQUILITY certificate



Figure 5: PREVENT certificate

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GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

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Comment 4

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Comment 5

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GRADING FORM: ENGINEERING PROJECT MGT

ENGAGEMENT WITH LITERATURE

Marks for this section will be awarded for your engagement with literature evidenced through relevant, credible sources cited throughout your report



Engagement with a wide range of literature. The literature review is relevant to the project. Some sources are not strongly academic, so the report would benefit from more peer-reviewed journal papers, technical standards, and manufacturer datasheets. Referencing needs to be more consistent, with proper formatting and in-text citations throughout the report.

2.7

KNOWLEDGE AND UNDERSTANDING

Marks for this section will be awarded for your identification and ordering of the tasks, identification of the risks to your project, identification of any environmental and societal impacts of the project.



Excellent, detailed knowledge and understanding of the well-established concepts and principles of Engineering and project management. The report shows a clear understanding of the environmental problem caused by petrol and diesel tourist boats. The device purpose is explained well, especially the idea of combining an existing engine, electric motor, and pedal generator. The technical

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specification is too limited and needs more detail on motor rating, battery sizing, controller selection, operating modes, and safety features. It is evident that the environmental and societal impacts of solutions to broadly defined problems have been considered.

COGNITIVE AND INTELLECTUAL

Marks for this section will be awarded for your risk mitigation techniques and the ethical considerations for your project.



Excellent critical evaluation and analysis of concepts and principles of Engineering and project management. The report demonstrates sound analytical thinking through its consideration of cost-benefit factors, risks, environmental impacts, and ethical issues. The ethical discussion is a strong aspect, highlighting concerns such as greenwashing, battery lifecycle impacts, and financial accessibility. However, the analysis would benefit from a more detailed evaluation of costs, stronger evidence to support conclusions, and comparison with alternative solutions to strengthen the overall argument. It is evident that the need for quality management systems and continuous improvement has been recognised through the identification of system limitations, implementation of risk mitigation measures.

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PRACTICAL SKILLS

Marks for this section will be awarded for your use of the available tools and techniques in the identification of risks and milestones and in

14.1



An advanced application of a range of established methods and tools. The report includes useful project planning tools, such as a work breakdown structure, critical path diagram, risk matrix, and cost-benefit calculation. The critical path analysis needs improvement because the activity names are missing, making it difficult to understand the project sequence. The required PREVENT and Equality, Diversity and Inclusion certificates are included in the appendix. It would have been better with Gantt chart. It is evident that the responsibilities, benefits, and importance of supporting equality, diversity, and inclusion have been recognised

TRANSFERABLE SKILLS FOR LIFE

Marks for this section will be awarded for the structure, coherence, presentation and overall quality of your reports.



22

Can communicate professionally confidently and consistently. The report has a clear overall structure with relevant sections such as introduction, background research, problem statement, aims, calculations, risks, ethics, and conclusion. The presentation needs improvement because there are several grammar, spelling, and sentence structure errors. The report would benefit from a more professional academic tone, clearer paragraphing, and better formatting of tables and figures.