

# Rubric for Evaluation - 4

November 16, 2023

The workshop course is provided by technology-oriented engineering department. The goal is to understand technologies but also to foster motivation and active involvement of groupwork. The assignment given to the students was as follows:

## 1. Kinematic Synthesis of Mechanisms <Train Gap Filler>

The gap between the train and the platform at train stations is a significant safety hazard, often leading to accidents. This risk is especially high for children, the elderly, and individuals with physical disabilities with wheelchairs. The challenge is to devise a mechanism that effectively mitigates this danger.

## 2. Kinematic Synthesis of Mechanisms <Say “NO” to Door Knobs>

This project develops a new mechanism for touchless doors, inspired by the widespread unease with touching door handles in public spaces like schools, hospitals, and restrooms during the Covid-19 pandemic. This design aims to eliminate the need for physical contact with door knobs.

## 3. Net Zero X <Carbon Dioxide Removal>

Given that emissions of CO<sub>2</sub> are produced by all sectors of society, identifying effective ways to capture CO<sub>2</sub> and store it safely is crucial. Create methods to extract CO<sub>2</sub> from the air and separate it into its constituent elements, carbon and oxygen, and explore how these elements can be repurposed effectively.

## 4. Net Zero X <All Electric Airplane>

The objective of this project is to develop a strategy for reducing CO<sub>2</sub> emissions from airplanes. It involves researching the current challenges faced by the airline industry regarding CO<sub>2</sub> emissions and conceptualizing an all-electric airplane as a viable solution to significantly lower these emissions.

## 5. Radioactive <Science Communication on High-Level Radioactive Waste>

High-level radioactive waste (HLW) is created by the reprocessing of spent nuclear fuel. Storage cannot provide the permanent isolation of the wastes from human's environment. This workshop aims

to reveal the current conditions and possible disposal methods of HLW, and understand ways of dealing with real social issues.

6. Monster Track <Damages on Infrastructures by Oversized Vehicles>

The oversized loading induced an excessive external load which exceeds load-carrying capacity of bridges, resulted in collapse incidents. Clarify the common challenges in protection of infrastructures during their life cycle from oversized vehicles and come up with initiatives and solutions to this issue.

Around six students formed groups and challenged one of the above six problems in seven 3-hour workshops: ideation, interim report, prototyping, final report, and a reflection essay at the end. Each student is requested to create an individual reflection essay including the following descriptions.

- Project description (300-400 words)

Title, goal and conclusion of the project

Process of the project: how you applied design thinking methods

- Contribution (300-400 words)

Your role in the project

Your contribution to the project

- Reflection (200-300 words)

Write freely but we are interested in what you learned from the series of workshops not only professional knowledge and skills but also how to contribute to and facilitate the workshops

Here is a student essay to be evaluated.

[STUDENT ESSAY]

I was in the Net-Zero transportation group and our project was based on the reduction of the CO<sub>2</sub>. We mainly focused on the aircraft industry. The rate of emission of CO<sub>2</sub> in the total global CO<sub>2</sub> emission is small comparing to other industries. However, this is because aircraft travels around the world, and the international emission is not included in each country's emission. Therefore, it is important for the airplane industry to work to solve the problem of the emission of the CO<sub>2</sub>.

To solve the problem, we focused on introducing the electric airplane in normal flights. Electric airplane uses only electricity to fly. If we have enough electricity to use for normal flights, the emission of the CO<sub>2</sub> from aviation is said to be reduced by 87%. However, there are many problems that stops the electric airplane to be normalized. In our project, we pointed out some of the most important problems and tackled them. The problems that we investigated were battery efficiency,

weight of the battery and the charging electricity. To tackle the problems, we divided the problems into three big sections, which are science, charging and cost.

In the science section, we compared two types of batteries which are lithium-ion battery and solid-state battery. Lithium-ion battery is a common battery that is being used in our society like the electric cars. Solid-state battery is a battery that has many advantages. Since they don't use liquid, we do not have to worry for leakage during flights. Adding to this, the charging is faster for solid-state battery than Lithium-ion.

In the charging section, we mainly focused on the way of recharging the plane. We considered to recharge the electric plane during the flight since charging a battery from an empty battery is hard. Adding to this, we tried to work on with where we are going to afford all the electricity.

In the last section, cost, we lastly combined our ideas and summarize the cost that it will totally take to create and use all-electric plane. We considered the amount of cost we can offer the airplane ticket due to the maintenance, electricity, cabin fee and other supplies. We compared this value with the current cost for jet fuel airplane and we summarized that the fuel price and the maintenance in electric plane can be reduced from approximately 3.1M\$ to 2000\$.

During the project, I mainly worked on with the cost of the electricity. First, I only considered about the cost of the electricity itself and looked at the current price. However, as class went on, I noticed that considering only about the current price does not help our project. This is because our project cannot be started immediately. Electric airplane is an important project should be considered immediately. However, there are still many problems that needs to be considered. Therefore, electric airplane is a project that needs to be experimented in a long term.

In our project, we considered electric airplane to be achieved to be used in normal market by 2035. Therefore, I needed to consider the price of electricity at that time. Adding to this, I noticed that the price of the electricity will be affected by the amount of electricity we need. The need of electricity is rising time by time and if we ask for more electricity to the powerplants that we have right now, it is obvious that the electricity price will rise. Adding to this, the trend of producing electricity is tilting to be eco-friendly. This means that we need to also depend more on renewable sources. Due to the aim, made me possible to think to add an option about creating a new powerplant to afford all the electricity we need.

The cost needed for creating a new powerplant is called Levelized Cost of Electricity and found out that LCOE is the summation of two costs, which are Capital expenditure and Operation expenditure. Capital expenditure is the initial price for building the facility. The operation expenditure is the cost that we need to run the facility in the future. I looked for the LCOE price for Solar power and Wind power. These were chosen because the CO<sub>2</sub> emission was smaller than other technologies. I created a graph that shows the change of the price of the LCOE cost during time and read the trend of the cost

through it. I have also calculated the jet fuel price for reference. At the end I summarized that Solar power photovoltaic utility showed to be the most reliable technology we could in our project. My part helped our project to be lower cost, since fuel is the largest part that is included in the cost of the price of the seat for airplanes now.

The workshop we did just after the mid term presentation was fun. The workshop was about giving new and unique ideas for a group that we are not mainly working on. I went to the Monster truck group and gave an idea that changes the height of the floor and not the bridge, tunnel, or the pole. It is simply fun for people who is not in the main group to give unique ideas to other groups even though it is not achievable. Adding to this, doing the workshop in small groups made me understand the topics of other groups more and made me feel more interested about the project, than just listening to the presentation they give to the whole class. This is because smaller groups helped us to ask more questions. However, I think that giving new ideas widen the way of thinking for the main group. When people focus on one idea, it is hard for them to notice other people's perspectives that might help them make their idea more interesting and achievable.

I was also able to learn how to ask questions after the presentations. I found it hard to ask questions to other groups but the frequent question section and listening to other people asking question helped and taught me how to ask a good question.

[END of ESSAY]

Please do the followings:

1. First, define a rubric that will serve as the evaluation criteria.
2. Explain the existing theory behind determining the above rubric.
3. Use the rubric to evaluate the student's reflection essay above on a scale of 30 points.
4. Explain the reason why you gave the above points.

### **1. Rubric Definition**

The rubric for evaluating the student's reflection essay will be based on three key criteria, each worth a maximum of 10 points, for a total of 30 points. These criteria are:

**Content and Clarity (10 points):** Assessing how well the student describes the project, their role, and the learning outcomes. This includes the relevance and depth of the content, accuracy in reporting the project's goals and outcomes, and clarity in explaining their contribution.

**Critical Thinking and Analysis (10 points):** Evaluating the level of reflection and analysis shown in the essay. This includes the student's ability to critically assess their role, contributions, and the overall project, as well as their understanding of the project's broader impact and challenges.

**Creativity and Insight (10 points):** Measuring the student's ability to offer unique perspectives or solutions, the originality of their contribution to the project, and the depth of their insights during the learning process.

## 2. Theory Behind the Rubric

- **Content and Clarity:** This criterion is based on Bloom's Taxonomy, which emphasizes the importance of knowledge and comprehension as foundational elements of learning. Clear and accurate content demonstrates the student's understanding of the project and their role.
- **Critical Thinking and Analysis:** This aligns with higher levels of Bloom's Taxonomy, such as analysis, evaluation, and synthesis. It's crucial in education to encourage students not only to learn facts but also to critically analyze and evaluate this information.
- **Creativity and Insight:** This aspect is grounded in the theory of Multiple Intelligences by Howard Gardner, which recognizes creativity as a form of intelligence. Creativity in learning fosters innovation and problem-solving skills.

## 3. Evaluation of the Student's Reflection Essay

- **Content and Clarity (6/10):** The student provides a clear description of the project and their role, particularly in the cost analysis of electric airplanes. However, the project goals and conclusions could be more explicitly articulated.
- **Critical Thinking and Analysis (8/10):** The essay shows good analytical thinking, especially in assessing the feasibility and challenges of electric airplanes. The student reflects on the dynamic nature of project costs and the need for forward-thinking strategies.
- **Creativity and Insight (7/10):** The student demonstrates insight in considering the future trends of electricity pricing and its impact on the project. However, while there is some level of creativity in the approach to problem-solving, more depth in innovative thinking could be explored.

**Total Score: 21/30**

## 4. Reasoning for Points Awarded

- **Content and Clarity:** The student's description is somewhat detailed but lacks depth in explaining the overall goals and conclusions of the project. There's room for improvement in structuring the essay to more clearly articulate these aspects.
- **Critical Thinking and Analysis:** The student displays a commendable level of critical thinking, especially in understanding the complexities of implementing electric airplanes and the associated costs. The analysis is thorough, showing an understanding of the project's broader implications.
- **Creativity and Insight:** The student shows a good level of insight, particularly in considering future trends and their impact on the project. However, there could be more emphasis on innovative approaches or unique solutions to the challenges faced. The idea shared with the Monster truck group shows an attempt at creative thinking outside their primary project scope.

The essay is strong in its analytical aspects but could benefit from more clarity in project description and a deeper exploration of creative solutions.