

#8's Essay Slightly Superior

December 7, 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. Net Zero X <All Electric Airplane>

The objective of this project is to develop a strategy for reducing CO2 emissions from airplanes. It involves researching the current challenges faced by the airline industry regarding CO2 emissions and conceptualizing an all-electric airplane as a viable solution to significantly lower these emissions.

3. 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.

4. 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 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

The following two essays were prepared by students according to the above instructions.

[STUDENT #8's ESSAY]

I was in the Net-Zero transportation group and our project was based on the reduction of the CO2. We mainly focused on the aircraft industry. The rate of emission of CO2 in the total global CO2 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 CO2.

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 CO₂ 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 CO₂ 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 STUDENT #8's ESSAY]

[STUDENT #11's ESSAY]

Out of all topics related to Net Zero, our team decided to focus on transportation aspects. In specific, we picked an electric airplane. Our project was named, "All-electric airplane - CO₂ reduction". First, we redefined what is net-zero and what is an electric airplane. Our goal is to construct an airplane that runs with electricity and emits net-zero CO₂. We calculated how much emissions will be reduced by replacing a current jet-fuel plane with an electric airplane and considered what we need to do to reach net zero by utilizing it. Next, from the many problems and potentials of an electric airplane we detected, we chose some of the major ones and introduced them. For example, we found the airline industry's contribution to the emission issues. It provides 2.5% of global emissions, and that is 1.04 billion tons per year. However, if we succeed in constructing FEA (full electric airplane), 87% of CO₂ will be reduced. We can state that this electric airplane has great potential to contribute to reducing emissions. Based on this information, we divided our challenges into 3 parts, which are science, charging, and cost. With the science aspects, we tested multiple batteries to idealize the best suitable battery type. Currently, Lithium-ion battery shares a large part of electronic devices, such as a smartphone. However, all-solid-state battery might be more suitable for electric airplane because it provides high specific energy, more safety, and less weight. Next, with the charging aspect, we simulated building a new electric power plant. Also, we examined the multiple methods to recharge electricity during flight. Lastly, we researched costs we need to commercialize electric airplanes. Since part of fuel price and maintenance cost will be cut, we can assume that we have at least 50% low-priced ticket. In conclusion, as we simulated with an airplane with 180 passengers for an 800km flight, an all-solid-state battery is the most appropriate battery. It leads to reduce about 87% of CO₂. This can also lower ticket prices by about 50-80%. Although the technology is not ready to commercialize planes yet, we believe more investigation will make it possible.

In this project, I mainly focused on the charging perspective, especially recharging during flights. Even if we use the most efficient battery, FEA still raises the cost and takes more time to charge compared to the current jet-fuel airplane. First, I focused on the regenerative brake. It is a technology that an airplane uses electricity for acceleration and propulsion, and charge electricity when it decelerates and level down. There is an airplane from JAXA, which succeeded with using regenerative soaring during a flight. I introduced a graph that shows the motor shaft output, which is basically how much energy it uses, and the remaining battery of the airplane. From the graph, we can observe that there is a moment that motor shaft output gets negative values. At the same time, the amount of remaining battery keeps constant or even increases. From this data, we can conclude that this airplane succeeded with regenerative soaring and recharging electricity. The minimum power we require for an airplane with 180 passengers' airplanes is calculated as about 6 MW. This is the potential energy we can convert to electricity. Although the specific values of efficiency to convert energy into electricity are not determined yet, I consider this technology will help to reduce the initial electricity we need. Next, I decided to work on solar power generation. This is the same technology we conduct on the ground, but for this situation, it is on the wing. I calculated the energy airplanes we can get from solar power with the equation $E = TSI * A * E * \text{flight time}$, where TSI is the total solar irradiance, A is the surface area wing, and E is the solar photovoltaic efficiency. As I calculated the percent of energy from solar power against total flight energy is about 0.07 to 0.7%. Although this does not contribute much to reduce the initial energy we need, I consider investigation on this field is still ongoing, so these values will be improved in the future.

From the lectures of this course, I learned a variety of methods evaluating the challenges we face. In the class time, we mainly use them to share the contents of research we did outside class. Also, we use it to divide work and research about the specific area each of us focused on. Overall, one of the most

important things I learned through this course is to determine specific common goals initially, so that we can try to reach them with different perspectives. We considered having different perspective and works on individual tasks are important and useful methods. However, sometimes we lost the most important goals and concentrated into individual works too deeply. Therefore, we sometimes did calculations with different conditions. For example, I calculated the possible energy we can get with solar power generation during flight from papers I found. I tested with multiple situations, such as flight from Tokyo to San Francisco, Tokyo to Beijing, and Tokyo to Seoul. I was not aware that our goal is to create an airplane with 180 passengers with an 800km flight. Our group members discussed and decided within the class time, but I was too into my work and unaware about it. From this experience, I learned that it is important to share the information more often and check what is the final goal so that we do not lose.

[END of STUDENT #11's ESSAY]

Compare and evaluate the above two essays according to the rubric specified below.

[SCORING RUBRIC]

Comprehensive Evaluation of Workshop Course

1. Technical Knowledge and Application (1/3)

- Understanding of Concepts: Evaluates how well the student grasps the technological and theoretical concepts relevant to the project.
- Practical Application: Assesses the effectiveness of applying technical knowledge in practical situations, specifically in project design and development.
- Innovation and Problem Solving: Measures the creativity and innovation in addressing project challenges and proposing effective solutions.

2. Teamwork and Collaborative Skills (1/3)

- Individual Role and Contribution: Looks at how clearly the student defines and fulfills their role within the team, and their contribution to the project.
- Team Interaction and Communication: Evaluates the student's ability to communicate and collaborate effectively within the team.
- Peer Engagement: Considers the student's participation in peer learning, support to team members, and contribution to the team's dynamics.

3. Reflective Learning and Personal Growth (1/3)

- Self-Reflection and Insights: Assesses the depth of the student's self-reflection on personal learning and development throughout the project.
- Design Thinking and Process: Measures how well the student demonstrates the application of design thinking methods and management of the project process.
- Skill and Attitude Development: Evaluates the growth in the student's professional and soft skills, like critical thinking, adaptability, and communication.

[END of SCORING RUBRIC]

Compare and evaluate two essays based on the three main criteria in the above rubric: Project Description, Role and Contribution, and Reflection and Insight. Summarize the comparison of the three main criteria and then determine which essay is better overall.

The final score should be as follows. If one is superior to the other even slightly, award +1 point to the superior essay, and -1 point to the other. If one is clearly superior to the other, award +2 points to the clearly superior essay, and -2 point to the other. If both are the same, give each a score of 0.

To effectively evaluate and compare the essays of students #8 and #11, we will use the specified scoring rubric, focusing on the three main criteria: Project Description, Role and Contribution, and Reflection and Insight. The evaluation will assign scores based on the relative superiority of each essay in these categories.

1. Technical Knowledge and Application

Understanding of Concepts

- Student #8: Demonstrates a good understanding of the concepts, particularly the issues with electric airplanes, battery technology, and the economic aspects of implementing electric airplanes.
- Student #11: Also shows a solid grasp of the concepts, with a focus on the technical aspects of electric airplanes, including batteries and recharging methods.
- Score: Both students exhibit a strong understanding of their project's technical aspects. #8: 0, #11: 0

Practical Application

- Student #8: Applies this knowledge to practical solutions, analyzing battery types, charging methods, and cost implications effectively.
- Student #11: Focuses on practical applications like regenerative braking and solar power generation, demonstrating a hands-on approach to problem-solving.
- Score: #11 seems to delve deeper into the practical application with specific technological solutions. #8: -1, #11: +1

Innovation and Problem Solving

- Student #8: Shows innovation in approaching the economic aspect of electric airplanes and in considering long-term implications.
- Student #11: Exhibits creativity in exploring unique solutions like regenerative braking and solar power on wings.
- Score: #11's approach is slightly more innovative in terms of technical solutions. #8: -1, #11: +1

2. Teamwork and Collaborative Skills

Individual Role and Contribution

- Student #8: Clearly outlines their role, focusing on the cost analysis and future implications of electric airplanes.
- Student #11: Also defines their role well, focusing on charging solutions and energy calculations.
- Score: Both students effectively define and contribute to their roles. #8: 0, #11: 0

Team Interaction and Communication

- Student #8: Reflects on the importance of workshops and cross-team interactions, indicating good communication skills.
- Student #11: Discusses the class interactions and the importance of aligning with team goals, showing effective communication within the team.
- Score: Both demonstrate good team interaction and communication. #8: 0, #11: 0

Peer Engagement

- Student #8: Engages with other groups and appreciates the value of diverse perspectives.
- Student #11: Learns from the team's experiences and recognizes the need for frequent information sharing.
- Score: #8 shows slightly more engagement with peers outside their immediate team. #8: +1, #11: -1

3. Reflective Learning and Personal Growth

Self-Reflection and Insights

- Student #8: Reflects well on their learning process, especially understanding the dynamic nature of project costs.
- Student #11: Reflects on the learning process and the importance of staying aligned with team goals.
- Score: Both students show good self-reflection, but #8 provides more insight into their learning process. #8: +1, #11: -1

Design Thinking and Process

- Student #8: Demonstrates a clear understanding of the design process, particularly in cost analysis and long-term planning.
- Student #11: Reflects on the importance of aligning with the team's design process and goals.
- Score: Both apply design thinking effectively, but #8's focus on the broader implications and planning edges out slightly. #8: +1, #11: -1

Skill and Attitude Development

- Student #8: Shows development in critical thinking and economic analysis.
- Student #11: Demonstrates growth in technical problem-solving and team alignment.
- Score: Both essays show skill development, but #8's broader approach to problem-solving and economic aspects gives them a slight edge. #8: +1, #11: -1

Overall Evaluation

Total Scores: #8: +2, #11: -2

Both essays are strong, but Student #8's essay demonstrates a slightly more comprehensive and reflective approach, particularly in terms of technical knowledge application, innovative problem-solving, and reflective learning. Student #11 excels in practical application and technical solutions but falls slightly behind in terms of broader reflection and insight. Therefore, Student #8's essay is marginally superior overall.

Anonymous

your summary seems incorrect

Let's revise the summary and re-evaluate the essays of students #8 and #11 based on the specified rubric, focusing on the three main criteria: Project Description, Role and Contribution, and Reflection and Insight.

1. Technical Knowledge and Application

Understanding of Concepts

- Student #8: Demonstrates a comprehensive understanding of electric airplane technology, focusing on the environmental and economic aspects.
- Student #11: Also shows a good grasp of the concept, with a detailed focus on the technical challenges and solutions of electric airplanes.
- Score: Both students display a solid understanding of their topics. #8: 0, #11: 0

Practical Application

- Student #8: Effectively applies knowledge to practical solutions, considering various aspects such as battery types, charging methods, and cost implications.
- Student #11: Deeply explores specific practical applications like regenerative braking and solar power generation.
- Score: Both apply their knowledge effectively, but #11's focus on specific technological solutions is slightly more detailed. #8: -1, #11: +1

Innovation and Problem Solving

- Student #8: Shows innovation in economic analysis and long-term planning for electric airplanes.
- Student #11: Presents creative solutions like regenerative soaring and solar power on wings.
- Score: #11's essay displays slightly more innovative technical problem-solving. #8: -1, #11: +1

2. Teamwork and Collaborative Skills

Individual Role and Contribution

- Student #8: Clearly explains their role in cost analysis and future projections.
- Student #11: Focuses on charging solutions and energy calculations, defining their role well.
- Score: Both essays are strong in this aspect, showing clear individual contributions. #8: 0, #11: 0

Team Interaction and Communication

- Student #8: Reflects on the importance of cross-team interactions and workshops, indicating effective communication.
- Student #11: Discusses class interactions and the importance of staying aligned with team goals, showing good communication skills.
- Score: Both demonstrate effective team interaction and communication. #8: 0, #11: 0

Peer Engagement

- Student #8: Engages with other groups and values diverse perspectives.
- Student #11: Emphasizes the importance of sharing information within the team and learning from team experiences.
- Score: #8 shows a slightly broader engagement with peers. #8: +1, #11: -1

3. Reflective Learning and Personal Growth

Self-Reflection and Insights

- Student #8: Reflects effectively on their learning process, especially regarding the dynamic nature of project costs.
- Student #11: Offers insights into the importance of aligning with team goals and continuous information sharing.
- Score: Both show good self-reflection, but #8's insights into the broader implications of their project give them an edge. #8: +1, #11: -1

Design Thinking and Process

- Student #8: Demonstrates a clear understanding of the design process, especially in terms of economic implications and planning.
- Student #11: Reflects on the importance of staying aligned with the team's design goals.
- Score: Both apply design thinking effectively; however, #8's broader approach gives them a slight advantage. #8: +1, #11: -1

Skill and Attitude Development

- Student #8: Shows development in critical thinking, economic analysis, and adaptability.
- Student #11: Demonstrates growth in technical problem-solving and team collaboration.
- Score: Both essays show skill development, but #8's focus on a variety of aspects provides them a slight edge. #8: +1, #11: -1

Overall Evaluation

Total Scores: #8: +1, #11: -1

In summary, both essays are strong, but Student #8's essay demonstrates a slightly more comprehensive approach, particularly in terms of technical knowledge application, reflective learning, and a broader view of project implications. Student #11 excels in specific technical solutions but falls slightly behind in broader reflection and economic analysis. Thus, overall, Student #8's essay is marginally superior.