ASME HPVC

Post-Mortem

ME 486C (Section 002)

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8/16/2020

Introduction

The Human Powered Vehicle Competition (HPVC) project is based on the intercollegiate competition hosted by the American Society of Mechanical Engineers (ASME). The competition includes events such as the endurance race, design event, and women/speed events. The main objective of the competition is to build a vehicle that runs completely by muscular strength. This competition gives an opportunity for students to implement engineering design principles learned throughout their college career to build a sound design that is innovative, sustainable, and safe. The purpose of the Human Powered Vehicle (HPV) is to provide inexpensive and safe modes of transportation solutions to people in inaccessible or underdeveloped parts of the world. This memorandum mainly covers content such as purpose and goals, ground rules, and coping strategies the team stated in the team charter that could help better team management and increase the team's performance. The postmortem also discusses the positive and negative aspects of project performance in terms of time management, product quality, the tools/methodologies, and practices that contributed to these positive or negative aspects, the problems team encountered. Lastly, the memo also goes into specific technical skills learned to make certain design decisions and organizational actions that can be applied in the future to increase the performance of the team.

The team did a great job of accomplishing the purpose and getting a great start on the first goal stated in the team charter of ME 476C. Under the conditions of virtual learning, the HPVC team was able to develop virtual models and prototypes of the human powered vehicle that will be constructed during this semester now that we can meet in person. We also worked very well together by splitting the project into important categories that need attention to detail. By staying as connected as we could through zoom meetings. Our ideas and progress were consistently shared to work closer to our team goals. The biggest area for improvement for the first semester of capstone was the lack of physical prototyping capabilities. Due to the virtual nature of the project's start, the team was only able to work through Solidworks and do virtual modeling instead of being able to build physical prototypes to aid in the final design and construction of the human powered vehicle. This is an area that will be worked on immediately during this semester to bring the team up to speed to where we would like to be on our progress.

Ground rules and coping strategies are taken very seriously by all team members of the HPVC team. We all know what it is like to have difficulty working with unproductive team members, so we all did our very best to contribute equally to the project and make sure that tasks get done on time and with quality standards that the team agrees on. During ME 476C, the HPVC team did not need to deal with any coping strategies because we made our work and communication of any issues a top priority. If any team members were going to be late or not be able to attend any meetings, communication through text or email was always done ahead of time. In those cases, our virtual meetings were recorded and uploaded to the team drive for the absentees to watch at a later time. What worked best for us in making sure we were true to our ground rules was communicating ahead of time when we are meeting and what is expected of us for that meeting. That way we each would know what needed to be done to ensure accountability. Also, checking up on each other through a group text chat helped immensely with quickly getting a hold of everyone with any questions or reminders. What didn't work for us was the virtual only environment. Our team was ready to begin prototyping a frame design for the human powered vehicle by week 3 and are barely now beginning to start that process. Overall, the team is in mutual agreement that the ground rules and coping strategies were followed very well in a way that satisfies every team member.

Some of the major contributors to project success in regard to positive project performance were time management, team communication, and drive. With the team starting this project during the summer semester, time management was a key aspect in accomplishing the required tasks as it was an accelerated class that is 6 weeks shorter than a traditional semester. This meant each team member needed to stay on top of action items, individual analysis, and helping with team reports and presentations so we would not fall behind. Tied to great time management was amazing team communication. Each member made sure they were available to attend each team and staff meeting even when travelling, as well as constant positive communication via text throughout the semester. If one member of the team had a question, needed clarification, or needed help, another member always stood up to help. Finally, this teams excitement and drive to build an innovative, successful, and competitive HPV can clearly be seen in each member. If COVID-19 related setbacks prevent the team from being able to build, test, and compete with our HPV it will be a huge disappointment to all.

Although there were plenty of positive aspects of project performance during the ME 476C summer semester, it did not end without some negative aspects. By far the biggest negative aspect of the project was the team's inability to be physically together. This made dimensioning and designing certain aspects of the HPV very difficult to visualize or move forward with. Since we are a team of vastly different body sizes aspects such as ergonomics, seating position, frame length, steering position, etc.… all would have been much easier if we could have been together, sitting in various seating positions and taking measurements of various members to ensure the design could be ridden by all members. Nonetheless, each member did their best to take their own measurements to bring input into these aspects of the design. The other negative aspect that the team ran into was the inability to begin prototyping some of the subsystems of the HPV. We feel if we were able to be together and had access to some supplies, we could have had some success starting the prototyping process.

The team utilized several programs for effective communication throughout the Summer 2020 semester. Those included are Microsoft Teams, shared Google Drive, Zoom and a text messaging group chat. The shared file programs allowed the team to work on reports, presentations and memos at the same as well as easily share their research. Individual assignments, research, meeting minutes and agendas were organized using the shared google drive. All recorded team and client meetings are also hosted within the Google Drive as well. The team used Zoom to meet weekly within our prospective areas. Recurring meetings were posted on a google calendar and sent out to the team members with every new meeting. The group text chat was effective when an individual member had a question or needed help on an assignment. This also helped when the team had to present through Zoom, we were able to talk to each other to make sure everything was running smooth. For this next semester, it would be beneficials to It would be beneficial for the team to continue using scheduled Zoom meetings throughout the next semester to meet when face-to-face meetings are not available. The team has transitioned to using Microsoft Teams more than Google Drive and by doing so has created a reliable source holder for all of the documents and assignments to be stored within the upcoming semester.

The team collectively encountered several problems concerning the COVID-19 pandemic. These included not being able to meet in person and physically start the project. Buying items for the vehicle as would have been done in a regular course semester. The team also found difficulty when preparing for the upcoming assignments. With less than a week notice on multiple large assignments, the team had to work last minute to turn in quality products. They had little feedback on assignments, no grades were posted, and only rubrics were uploaded with the assignments with no knowledge of how much the assignment would affect our overall class grade. To overcome this, the team emailed the professor multiple times asking about the upcoming assignments and how they would be graded. In the upcoming semester, the team will actively email the professor with questions about the assignments. They will also meet in person when available and start working on the testing of the project once materials can be bought.

Now that all team members are in the same physical location, it will be important to organize weekly (or more) in-person meetings. This will allow the development of a prototype physical model with all members present and able to contribute ideas. An important detail will be choosing locations where social distancing guidelines and preventative hygiene can still be followed to ensure the continuation of in-person meetings. Additionally, keeping an active list with goals for each meeting and build day will aid in keeping all members working and on task. This will also highlight important tasks that need to be completed by a certain time frame. Thus far, there has been little issue with keeping assignments and tasks organized so maintaining the current level of order in this uncertain time with new challenges should continue to serve the team well.

There are many aspects of the HPVC project that justify the use of some advanced analysis techniques in order to ensure a sound and optimized design. These skills have proven to be instrumental seeing as how there will only be one chance to build the vehicle and it must perform adequately the first time. In order to aid in structural design, finite element analysis (FEA) tools were learned in order to simulate stresses and deflections on any structural components of the frame or roll cage. Another benefit of FEA using Solidworks Simulation is that it clearly shows the location of stress concentrations and risers which will allow the team to determine if the current design is simply needs extra bracing/trussing or if the members need to be redesigned completely. The fairing of the vehicle is being evaluated using ANSYS Fluent to simulate air flow around the proposed or modelled designs. This allows relatively accurate evaluation of several fairing designs that will have the lowest coefficient of drag that is possible. It also reduces the need for a full-sized wind tunnel for testing. All team members have become familiar with advanced Solidworks modelling techniques and the use of built-in tools such as Weldments and Toolbox due to the complex nature of the project.

Conclusion

In all, the team has followed the team charter, ground rules, and purpose as stated in the team charter memo. The team utilized Zoom, Microsoft Teams, and Google Drive to communicate, research, and write reports. These tools proved to contribute to our success as we met virtually. However, one of the major areas of improvement are prototyping and creating proof-of-concepts. This relates to the team's biggest negative aspect is not being able to meet in-person to complete measurements and begin testing our design. Nevertheless, the team plans on getting a head start on purchasing materials and building the parts. In addition, we plan on preparing a calendar of deadlines in order to complete assignments at a better pace. We, also, plan on adjusting to the current situation as needed. Lastly, the team learned advanced Solidwork techniques, finite element analysis, ANSYS Fluent, and Solidwork modeling techniques.