

NASA Psyche Mission: Sampling System

ME 486C-06 Post Mortem

NAU Psyche Sampling Team (B7):

Andrew Acosta
Sultan Almarzouqi
Sam Armstrong
Karissa Barroso
Scott Sprauer

Project Sponsor: National Aeronautics and Space Administration & Arizona State University's School of Earth and Space Exploration

Sponsor Mentor: Dr. Catherine Bowman

Instructor: Dr. David Trevas

DISCLAIMER

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During the last semester, Fall of 2019, the NAU Psyche Sampling Team was tasked with designing and creating a sampling device that is operable on the surface of the Psyche asteroid. The Psyche asteroid itself is hypothesized to have a composition similar to an iron-nickel metal and is located within the asteroid belt between Mars and Jupiter. It is important to note that the Psyche surface is the first of its kind to be explored, therefore the true composition and topography of this asteroid is still unknown. This project, sponsored by the National Aeronautics and Space Administration (NASA) and Arizona State University's (ASU) School of Earth and Space Exploration, allows the team to work together in developing a sampling system that is capable of operating under the environmental conditions of this asteroid. Therefore, the efficiency of this sampling system is vital for a successful final product that will be created by the end of the Spring 2020 semester. This allowed the team to work closely with their client, Dr. Bowman, the Psyche Mission Co-Investigator, to develop a unique design and prototype that met all customer and engineering requirements developed by the team. Through prototype building and testing, the team was able to analyze how effective their original design was and how this design can further be improved during this upcoming semester. This report will outline the successes that the team had with their device and working as a team as a whole. The team will also discuss areas in which there could be some improvements to ensure the creation of a successful project.

At the beginning of last semester, the NAU Psyche Sampling Team created a team charter that outlined the project purpose and the team's project goals. The primary project purpose of the Psyche Sampling System is to design and create a sampling system that will collect samples from the surface of the asteroid. The goals developed by the team focused around creating a working device that meets all the requirements provided by our client and stakeholder, Dr. Bowman. By the end of the semester the team was able to accomplish their purpose and goal by creating a fully functional sampling system prototype that was presented to Dr. Oman. The key factor that contributed to the success of the team completing the purpose and goals was the communication between the team members and the client. Each and every team member was able to finish their parts of every assignment while also being able to communicate their problems to other team members. This helped each member be successful by allowing each other to be accountable for other members and further accomplish their project goals. An opportunity to improve this project for the upcoming Spring 2020 semester is to take all the mistakes and knowledge obtained from the prototyping process and applying it to the final design to ensure the goals of the team and client are met.

Within this team charter, the team had also created ground rules that were to be followed by all team members in order for the team to succeed in their projects. The ground rules that the team has set was around following guidelines: having respect for each other, the importance of communication, having respect for others ideas, holding each other accountable for the work, and having a fair and equal amount of work distributed between each team member. The team also agreed on a ground rule that they will have a weekly meeting and that every member must attend. It was crucial for all members to be on time and actively present on group conversations. Creating these ground rules and expectations of each member contributed to the success of the team's ability to work well with one another and to be accountable for each other. An opportunity for the team to keep the success going for the semester is to set the same ground rules and follow them as strictly as they did last semester. To ensure success during this semester of final productions, the team will need to improve on gaining manufacturing skills through provided

training so that all members can contribute and not a single person is doing all the work. This will ensure that all members have a fair and equal amount of work during the entirety of the semester.

While researching and developing prototypes for the Psyche Sampling System last semester, the team had to manage multiple different project guidelines. From this, the team had to manage many different aspects such as budget, time, material selection, testing, and research. From the past four months of work the team has honed many skills that proved to be beneficial. The most successful aspect for the team was time management. The team did well with completing everything on time in concurrence with the Gantt chart that was created. This positively affected the performance of the project because the team was able to get second opinions and proofreading/iterations completed before any hard deadlines set by the instructor. Success during the project was also due to the strong teamwork the team showed. Every team member was able to do what was asked and to a high standard of work. The team was also able to bring in new help from the client and instructors to contribute to the ideas and projects effectively. Lastly, the team was able to successfully be under the budget going into the final manufacturing of the project. This will contribute to the final success of the design greatly.

On the other hand, the team ran into some conflicts during the process that negatively contributed to the project performance. During the fall semester, the team was not able to manufacture a design that was up to the expectations of the team from the beginning. Unfortunately, the team does not have an experienced electrical or machining background. This proved to negatively affect the functional prototype that was presented. Along with this aspect, the team was unable to acquire the wanted quality of products which produced a less than impressive first prototype. However, all of these negative aspects that were discovered from the first half of the project are room for improvement and opportunities to learn more and spend ample time on these areas. The team is able to identify the negative aspects learned from the first half of the project and apply better methodologies or bring in extra help where it is needed. Overall the team learned how to positively impact the project performance, and the negative impacts are learned from and will become positive impacts when manufacturing the final design.

During this last semester the team was able to also utilize multiple practices and tools that lead to project success. Creating a set schedule had an incredibly positive impact on the workflow done by the team members. The team strictly met once a week unless the team found need for multiple meetings. The physical attendance made synchronicity between students more effective and the ability to easily communicate with one another was incredibly ideal. The subject for each meeting was decided one week prior in the previous meeting (referencing the Gantt chart of course). This allowed the team to be proactive and on task as each member knew what to work on prior to the meeting. As well, progress was improved by assigning tasks to each member at the end of meetings. This ensured the team accomplished the necessary tasks as all work could not be completed in a single session as a group. Lastly, a division of work where each member chose their assigned tasks was utilized. This allowed the members to work on sections that they felt most proficient in, creating the best quality work from each member. Not all methods were successful, however, and must be addressed. One area for improvement would be the time slot chosen for the weekly meetings. The team found that working late in the day had affected each member, making them not entirely focused. This had led to the team working at a level below what they are capable of. At the

time, the team struggled to find a suitable meeting time that did not conflict with any one schedule. The team members schedules for this semester promise a more suitable meeting time, where everyone can be working in an ideal and efficient environment. Making these changes should help to avoid any problems the team confronted last semester.

During the development stages of this initial functional prototype, team did encounter some problems that could be improved this semester. The team struggled mostly within manufacturing the prototype last semester. The technical and manufacturing knowledge of the team has shown to be lacking. Taking the theoretical design and manufacturing it was a difficult task. The methods required to bring the assembly to a physical device were either not understood or the team was unaware of the required process. Some elements of the prototype were not yet incorporated due to both a lack of time and understanding of the production process. Due to the limited knowledge when prototyping, the team found that there were more engineering related issues that the product would face, like rapid vibrations and power drainages. Understanding the problems that arose with the development presents outlined changes and improvement that the team has already begun looking into. The upcoming semester shows to have another self-learning assignment. The previous semester showed the team's ability to self-learn, however, the skills required for the build were not yet understood. This will further be a chance for the team to take into consideration the techniques lacking in the prototype build, and better prepare for the production of the final deliverable through this self-learning assessment.

Despite the manufacturing obstacles, the team was able to stay on track with all the deadlines because of the organizational skills the group has. As a result of each member being diligent and hard-working, staying up to task was not an issue among the group. One of the main contributors to the team's success last semester was the organization of the Gantt chart. With this diagram, the team imposed soft deadlines for each of the assigned roles in a required deliverable to make sure the hard deadline was met. This also allowed the team to break up work evenly so that work was completed equally by the set deadlines. The team also found that they were very organized in terms of filing and recording all deliverables. By keeping the documents on a shared server where each group member has access, the team organized the deliverables by its type so that every file is with its respective assignment. However, this does not go without saying there could be room for improvement. There are some organizational actions that should be taken to improve performance. One action will be to make sure the documents that are allowed to be on the website are approved with the client weeks in advance, so that way the team is not waiting on the client if the deliverable is due soon. Another improvement that could be useful for the team will be to organize emails with the client so the members are not looking for certain emails for a period of time. These are just the few actions the team can enact on to improve our performance.

Lastly, within the last semester the team learned many technical skills. For example, Sultan Almarzouqi learned how to code an Arduino, as well as build a working circuit so that the functional product can function. Scott Sprauer and Karissa Barroso took a manufacturing classes to learn what manufacturing entails and the skills that it will require to create the final product. Sam Armstrong worked to take more tutorials on SolidWorks to improve the CAD design and make it up to par with industry standards. Lastly, Andrew Acosta took the machine shop training and is certified to use many of the machines that are

available for student use. All of these skills helped improve and ensure the success of the project for the fall semester. However, there are still areas for improvement. For example, the team made the prototype out of wood, and the final product needs to be made out of metal, and be able to run and execute programs instead of just going up and down. The skills the team has must be improved on so that the final product can function and meet its finalized requirements. Therefore, each team member must have their skills improved.

Overall the team worked very well together in creating the initial functional prototype and completing assigned tasks by their predetermined soft deadlines during the Fall 2019 semester. This allowed the team to involve their client more by incorporating her feedback and using her previous research and knowledge to guide them to success. Although there are many areas for improvement for this upcoming semester, the team was able to identify the problems and develop solutions on how they plan to implement problem solutions. This will further ensure success during the final development stages of the Psyche Sampling System.