## 1.2 Customer Needs

### 1.2.1 Communication

The team met with representatives from NASA-MSFC to get a better understanding of what is expected of the project. Questions were generated to gather information in an unbiased way to determine the needs that the client would like to see in the final design.

After recording the answers our team received to each question, we then determined the need statements for each topic. The need statement is what the customer expects or wants to see in the final design. These needs may be physical requirements for the project or related to the function and efficiency.

To arrive at the final need statements, we looked at the provided answers from our project sponsor and determined what the technical need was for the final design. Many of these needs gathered during the meeting were expected, however this process was helpful in organizing and accurately defining the needs of this project.

### 1.2.2 Questions and Answers

| Team Question | Provided Answer | Interpreted Need |
|---|---|---|
| Are we expected to fabricate the storage container? | Yes, prototype a scaled model. | The prototype has the ability to scale to a larger size. |
| What improvements can be made to current products? | Extend the amount of time the fuel can be stored. | The container has the ability to increase time maintained at cryogenic temperature and pressure. |

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|---|---|---|
| Are we expected to perform experiments and present data to validate our design? | Yes, prototyping and testing are the main goal NASA has for this project. | The system has the ability to be validated for scientific calculations and design choices. |
| How long will the container be in space? | This factor is up to the group. | The system has the capability to be used on a hypothetical mission of a determined length. |
| Does NASA have a previous model that the group can improve? | NASA wants to see original ideas. It would be best to start from scratch. | The system has the capability to store cryogenic propellant with different materials and systems than previous models. |
| What type of fuel will be stored? | Liquid hydrogen or liquid oxygen. | Cryogenic container has the ability to hold liquid hydrogen or liquid oxygen and maintain them at the appropriate temperature and pressure. |
| What would be considered a successful project? | Improve how the container handles outside heat sources. | The container has the ability to decrease the rate of heat transfer more significantly in comparison to current state-of-the-art. |
| Are we designing for Earth, Mars, or the moon? | This factor is up to the group. | The cryogenic tank has the ability to store the propellant properly for the mission that the team decides to design for. |
| Does our design have to mount onto the ship in a certain way? | The storage container should work with existing state-of-the-art support structures. | Container has the ability to connect with other parts of the ship for structure. |

Table 1: Sponsor Questions and Answers

### 1.2.3 Interpreted Needs

Based on the answers provided by NASA, the main needs of this project are to increase the amount of time the cryogen is kept at the proper temperature and pressure and to reduce the

amount of heat transfer from the peripherals to the tank itself. Accomplishing these interpreted needs from our project sponsor allow us to have a successful design.

## 1.3 Functional Decomposition

### 1.3.1 Introduction to Functional Decomposition

A functional decomposition is created to simplify complex systems into smaller components and processes. This is accomplished by developing a list of major functions that the product must accomplish. The major functions for this project can be seen in the second column of the hierarchy chart (Figure 1). These major functions can be broken down further into individual actions that must be performed by each function. For this project we include store, insulate, communicate to user, and connect as the major functions to be performed.