Customer Needs

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Project Background

The Psyche Rover design team has been tasked with conceiving a robotic explorer to traverse potential terrains that may be encountered on the 16 Psyche asteroid. It is hypothesized that the asteroid is mainly metallic in composition, being comprised of metallic iron and nickel. Due to this composition, the asteroid is of significant interest, as scientists believe that Psyche may be the exposed core of an early planet. As the first investigation of a world of metal, the Psyche mission may provide insight on the history of planetary collisions and what may lie at the Earth's core (In Depth, 2021).

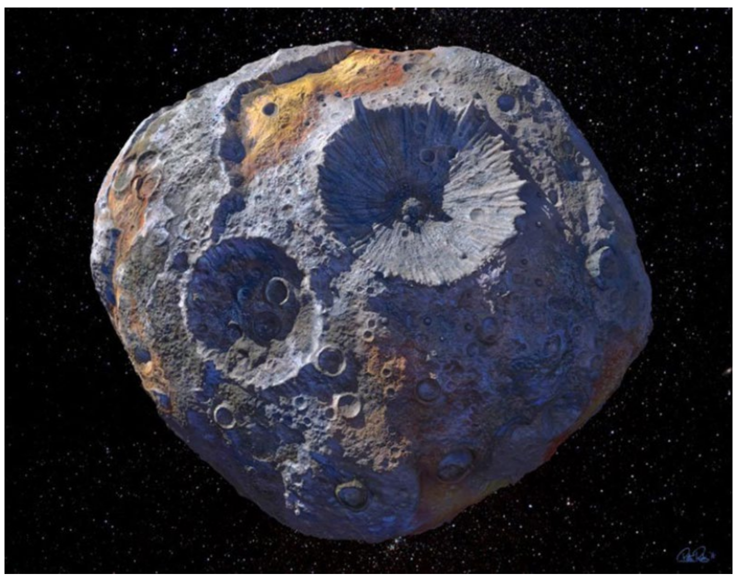

Figure 1 - Artist Concept of Psyche, Credit: Maxar/ASU/P.Rubin/NASA/JPL-Caltech

Customer Statement Development

Identifying customer wants and needs is an important aspect of the engineering design process and ensures a satisfactory end result is achieved. The customer statements for the Psyche Rover project were gathered through meetings with the Psyche mission sponsor, Dr. Cassie Bowman, and the faculty advisor, Dr. Damion Dunlap.

The meeting with Dr. Bowman was accomplished through Zoom video-conferencing on January 26, 2021. The design team listened and took notes as she overviewed the background, collaborators, and expectations for the Psyche mission. During the discussion, Dr. Bowman provided clarity on several posed questions, but also encouraged group members to find solutions through independent research and advisor consultation.

The design team posed previously unanswered questions to the faculty advisor, Dr. Damion Dunlap, during a lecture held on January 27, 2021. Final customer statements were developed through this dialogue, and the meeting was helpful in re-defining the project's initially broad scope.

After assembling the gathered information, customer statements and answers were translated into interpreted engineering needs. Although most questions were answered in sponsor and advisor meetings, the design team researched previous NASA missions and Psyche literature to help develop interpreted needs. The comprehensive list of questions posed, interpreted needs, and customer statements were tabulated for organization and readability, Appendix A.

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Appendix A – Customer Needs Table

Question	Customer Statement	Interpreted Need
What types of terrains have been encountered on previous missions?	Asteroids have been shown to be covered in craters.	The robotic explorer manuevers through various changes in surface topography, depression, and curvature.
	Boulder rocks and big stones have been seen on asteroid surfaces.	The robotic explorer detects obstacles.
	Different rock types with varying characteristics have been detected.	The robotic explorer works on varying material compositions.
	Basaltic materials were expected, but surfaces similar to hard snow were encountered.	The robotic explorer can travel on surfaces with variable hardness and roughness.
	Comet terrains were mostly flat with some steep cliffs.	The robotic explorer detects and avoids sudden changes in surface elevation.
	The surfaces were non-magnetic, contrary to what was expected.	The robotic explorer functions independent of a planetary body's magnetic characteristics.
What is the budget for this project?	The school has allowed for a $2,000 budget for Senior Design projects.	The prototype for the robotic explorer is designed and implemented for $2,000 or less.
What type of environment is expected on Psyche?	Psyche is expected to have a low gravity, approximately $0.144 m/s^2$.	The robotic explorer remains on the planetary body after landing.
	Psyche has no atmosphere.	The robotic explorer operates on an airless body.
	The temperatures on Psyche are expected to be extremely cold.	The robotic explorer withstands low temperatures.
What types of terrain are expected to be encountered on Psyche?	Fractures and porous space, possibly hidden under regolith.	The robotic explorer traverses both metal and rock surfaces.
	Metal tektites and blocks, but possibly no persistent or deep metal regolith.	
How long will the robotic explorer need to operate at a time?	Spirit and Opportunity robotic explorers were designed to operate for 90 days.	The robotic explorer functions for the duration needed to gather data samples.
	MASCOT was designed to last two asteroid rotations.	The robotic explorer withstands two asteroid orbits.
How will the robotic explorer be deployed?	The robotic explorer will be deployed from the Psyche spacecraft.	The robotic explorer can be housed on the Psyche spacecraft.
Should the robotic explorer be autonomous or remote operated?	Explorers on previous missions have been hybrids.	The robotic explorer has controlled and autonomous functionality.
Who is going to operate the robotic explorer?	The robotic explorer will be operated by NASA personnel.	The robotic explorer is capable of being operated by human personnel.
Are there sizing requirements (i.e. dimensions, weight)?	The Curiosity rover was as large an as SUV.	The robotic explorer is sized to fit its deployment apparatus.
	Previous robotic explorers were sized based on the equipment needed for the mission.	The robotic explorer capably carries mission-essential equipment.