HEDGE: HYPERSONIC REENTRY DEPLOYABLE GLIDER EXPERIMENT CRITICAL DESIGN

THE ENVIRONMENTAL EFFECTS CAUSED BY CONTINUED SPACE EXPLORATION

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SOCIOTECHNICAL SYNTHESIS

As of now, only about 4% of apparent space has been explored. The spacecraft used to explore these areas of the unknown have to go through a design process that often does not include conditions on environmental factors. The technical project is designing a mini spacecraft, called a CubeSat, that will reconfigure into a reentry vehicle at hypersonic speeds named the Hypersonic reEntry Deployable Glider Experiment (HEDGE). The purpose of this project is to successfully collect and transmit temperature and pressure while the spacecraft is reentering the Earth's atmosphere at hypersonic speeds. The STS research discusses the environmental effects that are caused from space exploration. The environmental effects are both directly and indirectly resulting from space mission's successes and failures. The technical and STS research are tightly coupled as HEDGE will be a space mission that can cause environmental harm.

For this stage of the technical project, the goal was to reach the critical design review phase by the end of the semester. All of the design components have been chosen to meet all the design requirements and rationale is provided to prove that the mission will succeed safely. With a successful critical design review, the project can move forward to full scale prototyping. In order to have a successful critical design review, the project got separated into six teams, each focussing on a specific subsystem. Each team was tasked with researching the best possible components and design for this mission while remaining within a mass, and cost budget. Each team also had to verify that these selected components and design would lead to a successful mission.

As a result, the critical design review has been completed as a proposal suitable for NASA. This proposal describes the design choices and is a request for funding for the full scale implementation of HEDGE. Each team included their major subsystem components, rationale for

choosing the parts, calculations to back up the rationale, and how their subsystem will be assembled.

The STS research question examined was how continued space exploration has caused environmental issues. In order to research this question, effects of rocket emissions, reentry heating, and space debris were explored. Additionally, possible fuel alternatives were researched to reduce rocket emission harm. Furthermore, Pinch and Bjiker's Social Construction of Technology framework was adapted to provide a potential design process to mitigate the environmental risks with space missions.

In the STS thesis, one of the main topics discussed is the production of space debris from failed space missions. Space debris is constantly orbiting in close proximity with the Earth, and even pieces the size of a paint fleck can cause considerable damage to a satellite in space. This can result in a continuous rapid increase in space debris which could lead to a higher amount of space debris reentering the atmosphere which then releases harmful toxins that lead to global warming. Additionally, black carbon released from rockets has a longer effect than other vehicles' production because rockets burn fuel higher in the atmosphere which makes the particles last much longer. Some alternatives to rocket emissions are under development, including a bacteria based fuel and a fuel created by using recycled plastics.

The technical project will be ready to begin its full scale prototyping next academic year with the guidance of this year's critical design review. However, future students working on this project should focus on environmental factors surrounding this future mission, especially harm caused by the rocket used to put the CubeSat into space, and the reentry effects when the vehicle burns up in the atmosphere. Similar to the Social Construction of Technology framework used in the STS report, the future team for the technical report could follow that framework.

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