

# RIT Space Exploration Project Design Document Standard Format and Sample Content

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**Abstract**—Conduct a feasibility study on the design and construction of a self driving rover. A rover would be an area of space exploration completely new to SPEX, because of this there are a lot of unknowns that need to be answered before starting this project. The study would look at the talent and skills of RIT Space Exploration and answer the question: what caliber of rover are we able to make. It would employ a multidisciplinary team to cover for construction and development. The study would lean directly into a rover project in the future. The rover would be extremely promotable and would look great at Imagine RIT.

## I. INTRODUCTION

Examples of proper formatting, organizational techniques and content make writing Project Design Documents as easy and painless as possible. Writing documentation such as design documents and reports is a lot of work, but it supports the continued growth of knowledge and experience in science and engineering for SPEX as a whole. In technical research and academia, communicating one's thoughts and ideas is arguably more important than the ideas themselves. For example, when applying to a grant from a scientific foundation, receiving funding to continue research impinges on how the motives and techniques of a research group resonate with the goals and objectives of the foundation.

In the case of SPEX, a PDD carries value in the act of documenting ideas and effectively communicating them with others within and external to RIT Space Exploration.

## II. PRIMARY OBJECTIVE

The goal of this study is to assess the technical ability and skills of RIT Space Exploration regarding the construction and implementation of a mock rover. This study will create a plan including answering unknowns about the rover, how the rover will be built and programmed, and what skills / resources are needed to build the aforementioned rover.

At the end of the semester these questions will lead to a well developed PDD for the following semester.

## III. SECONDARY OBJECTIVES

The study will also look into the University Rover Competition (URC) as hosted by the Mars Society as a potential long term goal. The competition is held annually and features 4 very intense competitions. Such a rover would need to be fully self navigating, perform scientific analysis on soil samples, and have a robotic arm capable of fine motor control. Such a

project would be among the most ambitious SPEX has ever attempted.

Table I lists questions the project will need to answer in order to make a PDD.

## IV. BENEFIT TO SPEX

Rovers are a huge part of space exploration. It is also an area that SPEX is not currently involved with. It would be beneficial to our members to get some experience in this area. A rover would look super good for SPEX at Imagine RIT. The rover would be rather large and would attract many eyes. We could even demo it outside if there is sufficient space. A rover would be very easy to get video and photos of for SPEX promotions. Having a rover is also another opportunity for SPEX to fundraise. There is plenty of space to place company logos on the body of the rover. It would also allow for SPEX to reach out to robotics companies.. The self driving component would be the heaviest computer science project SPEX would have attempted. This would help with retention of CS and SE majors. Machine learning and artificial intelligence are at the forefront of computer science right now. They are heavily desired in industry including space exploration. This study would figure out the capabilities of SPEX in regards to this goal. It will also eliminate many of the unknowns and answer many of the questions at the start of a project like this. This study will create a rough plan for building such a rover.

### A. Mindset

The purpose of this study is to eliminate unknown for a potential rover project. Because of this the team members must be in the mindset to analyze each part of the project and identify as many problem areas that need answers as possible. This means being specific on how we are going to accomplish our goals. What material, what algorithm, with what method will we be accomplishing this.

### B. Traceability

It is important that the team members document the sources they use to gather information. There will be a Google Drive folder that will hold notes with links to any books, articles, media or other sources that are relevant to the rover project.

TABLE I  
LIST OF QUESTIONS STUDY WILL ANSWER

Question	Area
Will the rover design be based on something else? If so, what design?	General
What hardware will be present on the rover? (Electronics + Structure)	Hardware
What type of software will be on the rover	Software
What libraries (if any) will the software be utilizing?	Software
How will the rover navigate terrain?	Navigation
Will the rover (ever) be self driving? If so, how will this be accomplished?	General
What will power the rover?	Electrical
How much will the rover cost?	Hardware
How will the rover be funded?	General
What driveterrain will the rover feature?	Locomotion
Will the rover feature any kind of robotic arm?	Hardware
How will the rover hardware be tested?	Testing
How will the rover software be tested	Testing
Is the University Rover Challenge a possibility in the future? What steps can be taken to participate?	Competition
How will the wheels/treads work?	Hardware
What suspension system (if any) will the rover feature?	Hardware
How can the rover be improved in the future?	General
How can this project be broken up into smaller sub projects / teams?	General
What are the next logical steps for the rover? (i.e. what work can be done in future semesters?)	General
What will the team aim to have present at ImagineRIT 2019?	General
Will the rover feature and special scientific equipment? (Drill, soil, etc...)	Hardware
Do any areas of the rover design overlap with other SPEX areas? What about other clubs at RIT?	General
To what spec will the rover be built?	Hardware
Could RIT SPEX partner with another organization for the URC	Competition
What are the navigation goals for this rover? (What gradient incline, etc...)	General
What elements of the URC competition should this rover be built to do?	General
What are the dimensions of this rover?	General

### C. Assessing Technical Skills

Building a rover, especially one built to URC specifications requires a large team with a diverse set of technical skills. This study will look at RIT SPEX and assess what areas are sufficient and what areas need to be developed in order to build a rover. It will also let us know to what spec we are currently capable of building such a rover.

### D. Accessibility

The study would require a handful (4-5) members each with different areas of expertise. The members would need that knowledge as well as LaTeX, notetaking, and good research practices.

## V. IMPLEMENTATION

This project would involve dividing out the different project areas to the different team members and each week meeting to discuss progress. The team would take this information, refine it and put it into the PDD draft. Approx 10 weeks into the semester the mechanical team should be able to build a rough CAD model and do any prototyping. The PDD would be finished by the end of the semester (or earlier) and the project would be free to shift to second semester work.

### A. Deliverables

The primary deliverable of this study will be a PDD for the spring. It is also noted that the materials that the team will come across or notes should also be saved in a Google Drive folder for future reference. The team will also present at SPEX design reviews and the weekly checkups at general

meetings with the areas the team members are studying that week. The team should have a rough CAD model for the PDD showing the spacing and layout of the potential rover. The team may decide to use said CAD model to prototype.

### B. Milestones

The largest milestones would be PDD draft and completion. This can also be expanded to include the CAD models and any prototypes.

## VI. EXTERNALITIES

### A. Prerequisite Skills

The study is going to require members that are knowledgeable in mechanical design and manufacturing, software engineering, machine learning, electrical engineering, and project management. These members will also need to be experienced in research and design document work. Though this seems simple, finding SPEX members to do this well

### B. Funding Requirements

The cost of this study is relatively minimal as it is a study. There may be physical prototype costs but these should again be very small. Physical prototyping can be done with cheap materials like cardboard or foamcore.

### C. Faculty Support

Support from faculty could greatly advance this study and what RIT SPEX is capable of robotically. The team should reach out to professors for advice and help.

#### *D. Long-Term Vision*

The long term vision of this project is to open RIT Space Exploration up to a new area of projects and development. Robotics and rovers are at the core of deep space exploration and most science missions. The University Rover challenge is also a worthy long term goal.

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