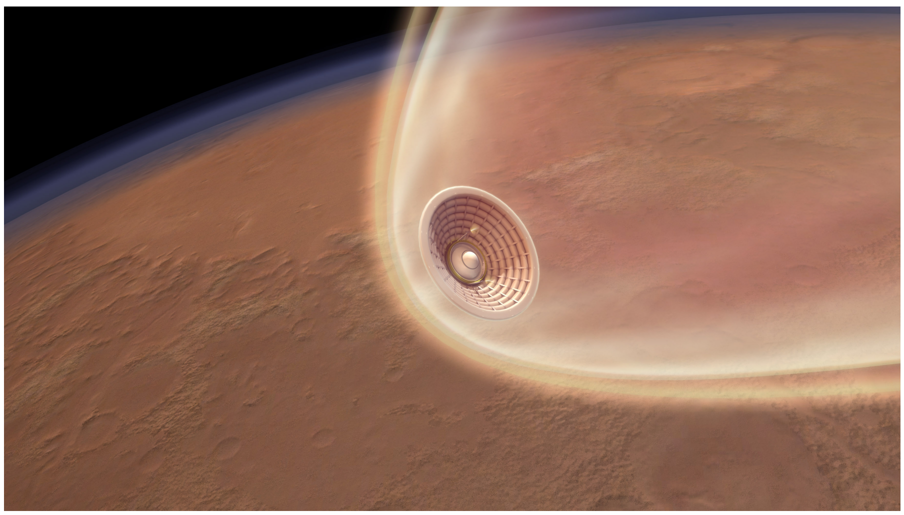
Delft University of Technology
Design Synthesis Exercise

Design of a Controllable Inflatable Aeroshell
Project plan



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Summary

-Requirements -Description of the entire system (the Global Picture)

0.1 Requirements

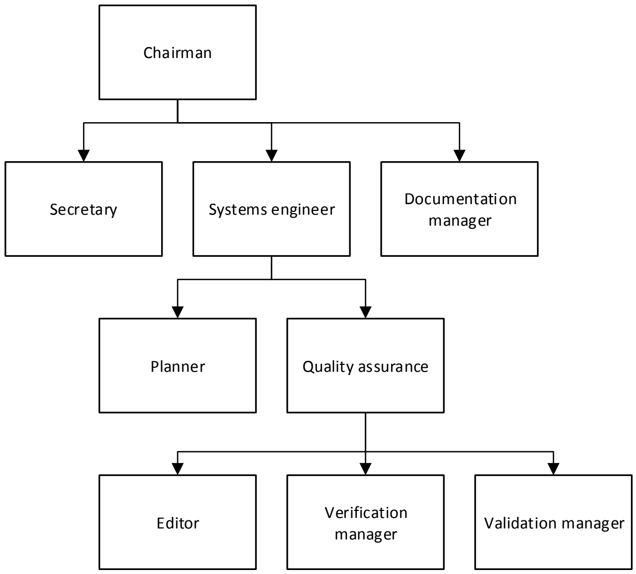
In this section the top-level requiremets are stated. They can be found in table **??**.

Table 1: Requirement

Code	Description
CIA-Sys-A01-1	The re-entry vehicle shall be able to cope with an entry velocity of seven kilometers pe
CIA-Sys-A01-2	The inflated aeroshall shall have a maximum diameter of 12 meters.
CIA-Sys-A01-3	The diameter of the launcher fairing shall be 5 meters.
CIA-Sys-A01-4	The maximum entry mass of the re-entry vehicle shall be 10,00 kilograms.
CIA-Sys-A01-5	The hypersonic deceleration system mass shall not be havier than ten percent of the to
CIA-Sys-A01-6	The control system shall have a maximum failure probability of 5.0e-4.
CIA-Sys-A01-7	The maximum allowable loads on the re-entry vehicle shall be 3 earth g's in each axis
CIA-Sys-A01-8	The re-entry vehicle shall have a maximal aerobraking duration of ten days.

0.2 System description

Contents



1 Organisational Breakdown Structure

1.1 Chairman

The size of the DSE project group, with 9 people, is too large to be self-organizing: if no organizational structure is apparent, people will not have a clear view of the required work, leading to inefficient time-management. The role of the chairman is to prepare team meetings and guide them such that the meeting itself is performed in an efficient manner, but also the goal of the meeting is achieved: at the end of the meeting, all team members should have a clear overview of the current status of the project, as well as their present responsibilities. It is the task of the chairman to guide meetings such that this information is conveyed between the team members including the members responsible for planning, documentation, and the system engineer. Concretely, this also encompasses making the agenda.

1.2 Secretary

The secretary shall minute during both project and customer meetings and keep track of design decisions and how they are made. This is done to assure that changes in the design process can be reviewed and remember why changes are made the way they are made. Furthermore, the secretary shall be responsible for all internal and external communication, to keep information flows controllable and easy to find.

1.3 Documentation manager

One of the tasks of the documentation manager is to maintain a structure in the file system used on the computer (i.e. keeping Dropbox and Github organized). The documentation manager is also the person to set up the initial files (like the LaTeX templates) and folder structures. The documentation manager should provide basic rules for the layout of the documents, communication with the editor is needed when the layout does not conform these rules. It is needed that this structure is maintained throughout the project and group members should make an effort to keep it this way, if not it is the documentation manager that will point out these problems towards the group and come with possible solutions.

1.4 Planner

The planner provides an overview for all the work packages as progressing through to time in the form of a Gantt chart. It is the function of the planner to frequently update and further detail this chart throughout the progress of the project. Furthermore more the planner is required to communicate all deadlines to the group members. Interactions between different tasks are provided and planning is made accordingly to allow all tasks to be finished before the set deadlines or milestones. Progression is recorded throughout the process to ascertain that all deadlines are met.

1.5 Systems engineer

The systems engineer is responsible for the overall technical progress of the project. He keeps track of the project requirements and manages the interfaces between different design disciplines. His responsibilities can be summarized as follows:

- Track project requirements and overall technical progress
- Manage design interfaces between design disciplines
- Resolve design conflicts due to conflicting requirements

1.6 Risk Engineer

Risk management is a central part of systems engineering; without proper risk management the chance for cost or time overruns or even worse, eventual product failure, is increased. In order to properly address the risks involved in developing an inflatable aeroshell one person is responsible for possible hazard management: The risk engineer. The task of this risk engineer is to manage the various risks encountered during the design process. This will be done by using technical budgetting to manage the performance risks during the various design phases. Performance margins can be defined for each system and subsystem that influence the performances of other systems. In addition to this risk mapping will be used. By identifying critical components of each proposed concept and allocating the available resources accordingly the project risks can be minimized.

1.7 Quality assurance

Editor Primary function is assuring consistent and high quality of all written communication, by means of proof-reading and correcting of pieces submitted by all group members. In addition, the lay-out and structure of reports and presentations is scrutinized and egalized. Strong interaction takes place with all group members with direct contributions to the written work, while open communication with documentation manager is maintained to resolve issues with the formatting of reports. In case of repeated errors by group members, the editor makes an effort to enter conversation with the repeaters in order to identify the origin of the problem and if need be to take pre-emptive action against future occurrences.

Verification Verification shall occur at multiple stages of the design. For example, in the initial stages it can be used to verify the requirements. At the end, the final product should be verified to check whether the developed product meets the requirements. Another definition given by NASA is that verification should proof that the product complies with design solution specifications and descriptive documents. Thus the responsibility is to have the product meet the specified requirements.

Validation IEEE defines validation as "The assurance that a product, service, or system meets the needs of the customer and other identified stakeholders. It often involves acceptance and suitability with external customers."(ref. "IEEE V&V.pdf") The person in charge of validation is thus responsible for the compliance of the product with the requirements imposed by the costumers and stakeholders.

2 Work Breakdown Structure

3 Project planning

3.1 Risk mitigation plan

During the course of this project several risks are present. The risk of a certain occurrence is defined as the product In order to prevent schedule overruns and guarantee the technical performance of the system to be designed these risks will have to be identified and managed properly. This will be done with the methods discussed in the subsequent sections.

3.1.1 Risk mapping

During the conceptual design phase the elements of each of the concepts to be considered will be included in a risk map. From this risk map a comparison between the risks involved in the different conceptual designs can be made. First the elements of each concept will be identified. Secondly these will be included into the risk map. This risk map consists of a table with on the X-axis the consequence of failure of each element. These are rated qualitatively from low to high as 'negligible', 'marginal', 'critical' or 'catastrophic'.
Negligible consequences barely influence the functioning of the system. Marginal consequences present inconveniences in performing the design mission, possibly with a small reduction in technical performance. However, the system will still be able to complete its primary mission with some (minor) adjustments. System performance is only severely compromised when a critical or catastrophic failure occurs. Critical failures strain the capabilities of the system and make mission succes questionable. A degradation in technical performance is to be expected. Catastrophic failure causes immediate mission failure or severely compromises the technical performance of the system. On the Y-axis the current state of the technology of each element is presented. It is assumed during risk identification that this technology state is interchangeable with the probability of failure of the element. The technology states are rated as either 'feasible in theory', 'working laboratory model', 'based on existing non-flight engineering', 'extrapolated from existing flight design' or 'proven flight design'. Elements and technologies that have only been proven as 'feasible in theory' have an inherently higher probability of failure than a component that has already been proven to function during flight. From this risk mapping table it can be seen that the elements that present the greatest hazards for mission completion are those whose failure is either critical or catastrophic and whose technology has not matured enough yet, e.g. has only been proven in theory or has not functioned outside of a laboratory situation yet. To mitigate the risks these elements pose during the different design phases the fraction of resources allocated to

3.1.2 Technical budgetting

4 Project logic diagram

5 Approach with respect to sustainable development

Sustainable development in engineering means that the design, production, operation and disposal of a product should be done in a sustainable way. In this case sustainable means that energy and resources are used in a manner that does not threaten the environment or the needs of future generations. In this chapter the general approach with respect to the sustainable development of the controllable inflatable aeroshell is briefly discussed.

Even though sustainability is becoming more important in engineering, it is of less importance in these kind of space missions. The reason for this is that the proposed mission is a single mission and therefore its total impact will be relatively small. For example, it is acceptable that the production of the space vehicle is less sustainable than the production of one small passenger aircraft, since the the aircraft is produced in large numbers where only one space vehicle is produced. It can therefore be said that sustainability will not be a design driver for the controllable inflatable aeroshell. Of course, sustainable methods are preferred when they do not add much costs

1-of-mission, impact small not the design-driver

6 Conclusion