

Design Reports

Suggested Outline

Title Page, with authors in alphabetical order

Table of Contents (Word will do this for you if you use Heading Styles correctly)

Each page in the report should be numbered. I prefer sequential numbering rather than number-by-chapter. The prefatory material should be numbered using lower case Roman numerals (title page is *i* but not actually numbered; first page of ToC is *ii* and is numbered). First page of Chapter 1 is page 1.

List of Figures (Word might do this, but you'll probably need to do it manually)

This List begins on a new page and should be formatted as follows:

List of Figures

| Figure No. | Caption | Page # |
|------------|---|--------|
| Figure 1 | Interactions of Needs, Alterables and Constraints | 4 |
| Figure 2 | Mission Concept Alternatives | 10 |

Each figure in the report should have a caption and a figure number (*below* the figure, numbered 1 through *N* in order of appearance in the report). The caption should have a short part and possibly a longer description. The short part is what appears in the List of Figures. For example,



Figure 1. Cylinder. This cylinder represents an oblate axisymmetric rigid body, such as might be used to model a spin-stabilized satellite.

List of Tables (ditto as per List of Figures)

This list begins on a new page. Each table in the report should have a caption and a table number (*above* the table, numbered 1 through *N* in order of appearance in the report). Tables should be as simple as possible. I prefer the "Simple1" style in Word rather than the default style that has horizontal and vertical lines between every "cell" of the table. The caption should have a short part and possibly a longer description. The short part is what appears in the List of Tables. For example,

Table 1. Typical Temperature Ranges for Selected Spacecraft Components. Adapted from Table 11-40 of Ref. 1

| Components | Typical Temperature Range, °C |
|-------------|-------------------------------|
| Electronics | 0 to 40 |
| Batteries | 5 to 20 |

List of Abbreviations (make this as you go, alphabetical order)

This list begins on a new page. Each abbreviation in the text should be defined where first used, and included in this list. For example,

| | |
|------|---|
| ADCS | Attitude Determination and Control System |
| NiCd | Nickel-Cadmium batteries |
| SMAD | <i>Space Mission Analysis and Design</i> (Ref. 1) |

List of Symbols (ditto)

This list begins on a new page. Each symbol in the text should be defined where first used, and included in this list. Alphabetize with *a-z*, *A-Z*, α - ζ , *A-Z* (uppercase Greek). For example,

| | |
|----------|--|
| <i>a</i> | semi-major axis |
| <i>e</i> | eccentricity |
| <i>A</i> | cross-sectional area |
| I_{sp} | specific impulse |
| β | angle between sun vector and normal to spacecraft face |
| Ω | orbital frequency |

Chapter 1: Introduction

This and all chapters and appendices begin on a new page. Introductory paragraph (not numbered), Sections (1.1, 1.2, etc.) and Subsections (1.1.1, 1.1.2, etc.), Summary and Overview (of rest of the report)

Documents the Problem Definition. This chapter should provide a description of the problem and the relevant issues. The “12 products of problem definition” are a good place to start. Typically include some references to what others have done in this area (using past tense), and conclude the chapter with an overview of the report.

Chapter 2: System Objectives

Introductory paragraph, Sections and Subsections, Summary (and transition to next chapter)

Documents the Value System Design. This chapter should describe the system objectives. You might want to take the *needs*, *alterables*, and *constraints* (NACs) from Chapter 1 and put them here instead, then develop

the objective hierarchy. Chapter should develop the interactions between the objectives and the “NACs” as well as the objectives’ self-interactions. This chapter should also include the measures of effectiveness.

Chapter 3: Design Alternatives

Introductory paragraph, Sections and Subsections, Summary (and transition to next chapter)

Documents System Synthesis. The design alternatives should be developed and described here. Use present tense.

Chapter 4: Modeling

Introductory paragraph, Sections and Subsections, Summary (and transition to next chapter)

Documents System Analysis and perhaps Optimization. This chapter tells how the systems are modeled to obtain the measures of effectiveness.

Chapter 5: Optimization

Introductory paragraph, Sections and Subsections, Summary (and transition to next chapter)

Documents Optimization (unless it’s in Chapter 4).

Chapter 6: Decision-Making

Introductory paragraph, Sections and Subsections, Summary (and transition to next chapter)

Documents the decision-making process and the resulting decisions.

Chapter 7: Summary, Conclusions, and Recommendations

Okay, you did all this work. What did you learn? This chapter should **summarize** the report: as a group decide what the major important points are and summarize those. It should draw **conclusions**: as a group, what can you conclude about what’s important in designing the subsystems described in this report? It should make **recommendations**: as a group, where do you think you’ll need to do more research, where do you think you might run into difficulties, what steps can you take to ensure success?

In all of these, if you have more than one or two major points to make, put them in a bullet or numbered list rather than running them together in a long paragraph. (This applies throughout any technical writing.)

References

The bibliography begins on a new page. A simple bibliography, numbered, in alphabetical order by first author's last name. Here are examples of book, book/website, conference paper, journal article. Note that *italics* are used to identify book titles and journal titles, instead of underlining.

1. V. V. Beletsky and E. M. Levin, *Dynamics of Space Tether Systems*, Univelt, Inc., San Diego, 1993
2. M. L. Cosmo and E. C. Lorenzini, *Tethers in Space Handbook*, Third Edition, December 1997. Available at the NASA Marshall Space Flight Center website:
<http://infinity.msfc.nasa.gov/Public/ps01/ps02/space.html>
3. M. R. Long and C. D. Hall, "Attitude Tracking Control for Spacecraft Formation Flying," in *Proceedings of the 1999 Flight Mechanics Symposium*, Goddard Space Flight Center, May 18-20, 1999, pp. 319-332
4. J. D. Thorne and C. D. Hall, "Minimum-Time Continuous Thrust Orbit Transfers," *Journal of the Astronautical Sciences*, Vol. 45, No. 4, 1997, pp. 411-432

Appendices

These should include information that supports or amplifies the material in the main text. You may have no appendices, or you may have several. Usually these are "numbered" using capital letters A, B, C, etc.