HOW TO WRITE A TECHNICAL REPORT

AND

HOW TO USE A TEXT TEMPLATE

Presented by: Mike Bertin

mikesbertin@gmail.com

+1 (505) 220-4589

USA Mountain Time (+6)

General Guidance

- Technical reports are <u>scored</u>, not read–this is not a creative writing exercise

- If the instructions say "shall," it MUST be in the report

- If you don't say it in your report, then I don't know it – assume I know nothing about your university or project

- Simple sentences: subject-verb-object

- Say it once then move on

- Use the active voice
  - "We chose the Cesaroni M1770SK-P because…"   not
  - "The Cesaroni M1770SK-P was selected because…"

- Use the terms in the instructions
  - The paper provides adequate discussion of all key <u>design decisions</u>, including relevant <u>trade space</u> descriptions, <u>constraints</u>, and overall <u>rationale</u>.
  - Have headings for "<u>design decisions</u>," "<u>trade space</u>," "<u>constraints</u>," and "<u>rationale</u>"
  - Don't use, for example, "<u>design choices</u>," "<u>comparisons</u>," "<u>limitations</u>," or "<u>reasons</u>"
  - Yes, I can probably find it but I won't find it if I do a word search

- Make it easy for the judges to score you highly – follow the scoring outline

- Be efficient in your writing – longer is not better; shorter is not better; better is better!

Technical Report "Systems Engineering"

- Set the basic outline (from the template)
- Flesh out the outline from the R&R text descriptions
- Integrate the scoring criteria
- Integrate the DTEG requirements
- Post the outline pages on the wall
- Write in ideas for each outline page
- Describe a graphic to covey the point
- Walk the reader through the graphic
- External review of the outline and ideas to date
- Write
- External review of the completed writing
- Edit
- Desktop publish
- Submit!

Outline per Instructions–Report Body

- Project Technical Report (2.7.2)
  - Each team <u>shall</u> submit a Project Technical Report
  - The Project Technical Report <u>shall be formatted</u> according to the style guide of the American Institute of Aeronautics and Astronautics (AIAA), using a provided Microsoft® Word document template.
  - The Project Technical Report's main title is left to the team's discretion
  - The paper <u>shall be subtitled</u> "Team <Your Team ID> Project Technical Report to the <Year> Spaceport America Cup"

- **Abstract** (2.7.2.1)

- **I. – Nomenclature**

- **II. – Introduction** (2.7.2.2)

- **III. – System Architecture Overview** (2.7.2.3)
  - Top-level overview of the integrated system, including a cutaway figure
  - Propulsion Subsystems
  - Aero-structures Subsystems
  - Recovery Subsystems
  - Payload Subsystems

Outline per Instructions–Report Body

- **IV. – Mission Concept of Operations Overview** (2.7.2.4)
  - Mission phases
  - Include a figure
  - Describe the nominal operation of all subsystems during each phase
  - Define what mission events signify a phase transition has occurred (they will be used to help organize failure modes identified in a risk assessment appendix

- **V. – Conclusions and Lessons Learned** (2.7.2.5)
  - During the design, manufacture, and testing of the project, both from a team management and technical development perspective
  - Strategies for corporate knowledge transfer from senior student team members to the rising underclassmen

Outline per Instructions–Appendices

- **Appendix A – System Weights, Measures, and Performance Data** (2.7.2.6) (satisfied by appending the Third/Final Progress Report)

- **Appendix B – Project Test Reports** (2.7.2.7)
    - Minimum tests prescribed in the IREC Design, Test, & Evaluation Guide
    - Shall appear in the following order
    - In the event any report is not applicable to the project include a page marked "THIS PAGE INTENTIONALLY LEFT BLANK" in its place)
    - Recovery System Testing: In addition to descriptions of testing performed and the results thereof, teams shall include in this appendix a figure and supporting text describing the dual redundancy of recovery system electronics.
    - SRAD Propulsion System Testing (if applicable)
        - descriptions of testing performed and the results thereof
        - SRAD hybrid or liquid propulsion systems shall include in this appendix a fluid circuit diagram
        - identify nominal operating pressures at various key points in the system – including the fill system.
    - SRAD Pressure Vessel Testing (if applicable)

Outline per Instructions–Appendices

- **Appendix C – Hazard Analysis** (2.7.2.8)
    - Hazardous material handling
    - Transportation and storage procedures of propellants
    - Any other aspects of the design which pose potential hazards to operating personnel
    - A mitigation approach – by process and/or design – shall be defined for each hazard identified

- **Appendix D – Risk Assessment** (2.7.2.9)
    - Summarize risk and reliability concepts
    - All identified failure modes which pose a risk to mission success shall be recorded in a matrix, organized according to the mission phases identified by the CONOPS
    - A mitigation approach (by process and/or design) shall be defined for each risk identified

Outline per Instructions–Appendices

- **Appendix E – Assembly, Preflight, Launch, and Recovery Checklists** (2.7.2.10) (detailed checklist procedures for
    - Final assembly
    - Arming
    - Launch
    - Recovery operations
    - Alternate process flows for dis-arming/safeing the system based on identified failure modes. These off-nominal checklist procedures shall not conflict with the IREC Range Standard Operating Procedures
    - Teams developing SRAD hybrid or liquid propulsion systems shall also include in this appendix a description of processes and procedures used for cleaning all propellent tanks and other fluid circuit components)

- **Appendix F – Engineering Drawings** (2.7.2.11) (revision controlled technical drawings necessary to define <u>significant</u> subsystems or components–especially SRAD subsystems or components)

Simple Example–The Abstract

2.7.2.1 ABSTRACT

The Project Technical Report shall contain an Abstract. At a minimum, the abstract shall identify the launch vehicle's mission/category in which the team is competing, identify any unique/defining design characteristics of launch vehicle, define the payload's mission (if applicable), and provide whatever additional information may be necessary to convey any other high-level project or program goals & objectives.

Source: Spaceport America Cup Intercollegiate Rocket Engineering Competition Rules & Requirements

The Project Technical Report <u>shall</u> contain an Abstract.

At a <u>minimum</u>, the abstract shall
- Identify the launch vehicle's mission/category in which the team is competing
- Identify any unique/defining design characteristics of launch vehicle
- Define the payload's mission (if applicable)
- Provide whatever additional information may be necessary to convey any other high-level project or program goals & objectives

Requirement 1

- Identify the launch vehicle's mission/category in which the team is competing

"We will compete in the 10,000 ft AGL apogee with commercial-off-the-shelf (COTS) solid rocket propulsion system mission/category."

- Source: Rules & Requirements Document, Section 2.0.

Requirement 2

- Identify any unique/defining design characteristics of launch vehicle

    - Example Design Characteristic 1 – Active flight control
    - Example Design Characteristic 2 – SRAD motor with black, sparky exhaust
    - Example Design Characteristic 3 – Exhaust nozzle tuned to middle "C"
    - …
    - Design Characteristic n –

Requirement 3

- Define the payload's mission (if applicable)

  - Example mission 1 – Detect muons

  - Example mission 2 – Validate detector mounting design

  - …

  - Mission n –

Requirement 4

- Provide whatever additional information may be necessary to convey any other <u>high-level</u> project or program goals & objectives

    - Example point 1 – validate design changes resulting from last year's failure of the drogue system

    - Point 2 –

    - …

    - Point n –

Another Example–The Introduction

2.7.2.2 INTRODUCTION

The Project Technical Report shall contain an Introduction. This section provides an overview of the academic program, stakeholders, team structure, and team management strategies. The introduction may repeat some of the content included in the abstract, because the abstract is intended to act as a standalone synopsis if necessary.

Source: Spaceport America Cup Intercollegiate Rocket Engineering Competition Rules & Requirements

The Project Technical Report <u>shall</u> contain an Introduction.

This section provides an overview of the

- academic program,
- stakeholders,
- team structure, and
- team management strategies.

The introduction <u>may repeat</u> some of the content included in the abstract, because the abstract is intended to act as a standalone synopsis if necessary.

Requirement 1

- Overview of the academic program

  - Example Point 1 – Academic department
  - Example Point 2 – Academic credits for participation or successful rocket performance

  - …

  - Point n –

Requirement 2

- Overview of the stakeholders
  - But first, what is a stakeholder?
    - A stakeholder is an individual, a group, or an organization that is impacted by the outcome of the project
    - Stakeholders have an interest in the success of the project
    - Stakeholders can be within or outside the organization that is sponsoring the project
    - Stakeholders are important because they can have a positive or negative influence on the project with their decisions
    - There are also critical or key stakeholders, whose support is needed for the project to exist

  - Example stakeholder 1 – Faculty advisor
  - Example stakeholder 2 – Flyer of record
  - …
  - Stakeholder n –

Requirement 3

- Overview of the team structure

    - Point 1 – team organization chart
    - Point 2 – what each of the organizational entities does
    - Point 3 – who is in each entity
    - Point 4 – roles and responsibilities
    - …
    - Point n –

Requirement 4

- Overview of the team management strategies

  - Strategy 1 –
  - Strategy 2 –
  - …
  - Strategy n –

How Will You be Scored?

SCORING PROJECT TECHNICAL REPORT (2.8.1.2)

Timely project technical reports will be awarded as many as 200 points – 20% of 1,000 points possible – for their correctness, completeness, and analysis. Only timely Project Technical Reports will be evaluated and scored. A project technical report is considered timely if it is received no later than 72 hrs. after the deadline specified in the Spaceport America Cup Integrated Master Schedule document.

Source: Spaceport America Cup Intercollegiate Rocket Engineering Competition Rules & Requirements

- Timely project technical reports will be awarded as many as 200 points – 20% of 1,000 points possible – for their
  - Correctness (40 points)
  - Completeness (20 points)
  - Analysis (140 points)

- Only timely Project Technical Reports will be evaluated and scored.

- A project technical report is considered timely if it is received no later than 72 hrs. after the deadline specified in the Spaceport America Cup Integrated Master Schedule document.

Correctness (40 points)

- (4 – 40 points) A rating of 4 indicates exemplary quality. The paper requires no substantial correction of grammatical mistakes, misspellings, mistyping, incorrect punctuation, inconsistencies in usage, poorly structured sentences, wrong scientific terms, wrong units and dimensions, inconsistency in significant figures, technical ambivalence, technical disambiguation, statements conflicting with general scientific knowledge, etc... Furthermore, the paper contains no stylistic errors deviating from the prescribed style guide.

- (3 – 30 points) A rating of 3 indicates at least average quality. The paper requires minimal correction of grammatical mistakes, misspellings, mistyping, incorrect punctuation, inconsistencies in usage, poorly structured sentences, wrong scientific terms, wrong units and dimensions, inconsistency in significant figures, technical ambivalence, technical disambiguation, statements conflicting with general scientific knowledge, etc... The paper may contain minimal, insubstantial deviations from the prescribed style guide.

- (2 – 20 points) A rating of 2 indicates no greater than average quality. Overall the paper's quality is symbolic of the proverbial "first draft". The paper requires some substantial correction of grammatical mistakes, misspellings, mistyping, incorrect punctuation, inconsistencies in usage, poorly structured sentences, wrong scientific terms, wrong units and dimensions, inconsistency in significant figures, technical ambivalence, technical disambiguation, statements conflicting with general scientific knowledge, etc... The paper deviates significantly from the prescribed style guide or is formatted in accordance with another style guide entirely.

- (1 – 20 points) A rating of 1 indicates poor quality. The paper requires numerous substantial corrections of grammatical mistakes, misspellings, mistyping, incorrect punctuation, inconsistencies in usage, poorly structured sentences, wrong scientific terms, wrong units and dimensions, inconsistency in significant figures, technical ambivalence, technical disambiguation, statements conflicting with general scientific knowledge, etc... The paper makes little or no attempt at cohesive formatting in accordance with either the prescribed or any other style guide.

Comparison of Ratings

Score	Writing Errors*	Adherence to Style Guide
40	requires **no substantial** correction	contains **no** stylistic errors **deviating** from the prescribed style guide
30	requires **minimal** correction	may contain **minimal, insubstantial deviations** from the prescribed style guide
20	requires **some substantial** correction	**deviates significantly** from the prescribed style guide **or** is **formatted in accordance with another style guide** entirely
10	*requires **numerous** **substantial** corrections*	makes **little or no attempt at cohesive formatting** in accordance with either the prescribed or any other style guide

* Writing Errors
- Grammatical mistakes
- Misspellings
- Mistyping
- Incorrect punctuation
- Inconsistencies in usage
- Poorly structured sentences
- Wrong scientific terms
- Wrong units and dimensions
- Inconsistency in significant figures
- Technical ambivalence
- Technical disambiguation
- Statements conflicting with general scientific knowledge, etc.

How Will You be Scored?

Our Score Sheet for This Year

- Analytic Rigor (assumptions noted, sensitivity analysis)
- Key Design Decisions (all, most, some, none)
  - Trade space descriptions
  - Constraints
  - Overall rationale
- Verification & Validation Tests
- Conclusions
- Use of Tables, Figures, & Appendices

TEXT TEMPLATES

What Are They

- Probably the most useful feature of Microsoft Word
- Incorporate all the formatting and layout instructions and outline into a single document
- Define styles for headings, body text, tables, captions, etc.
- To open the styles window: "Shift-ctrl-alt-s"

How Are They Used

- Two methods that are quite similar. Recommend method 2 with our template.

- Method 1
  - Start with a blank document by opening the template ("*.dotx" file)
  - Save it as a standard Word file ("*.docx" file)
  - Use the ribbon or styles window to select the style for each element

- Method 2
  - Start writing your material in any old document using the standard "Normal" template
  - Open the provided template, which is a ("*.docx" file)
  - Leave the provided headings alone
  - Copy your text from its original document
  - Paste in the template, replacing the text below the headings, as "TEXT ONLY"
  - Manually add in your graphics

- In either method, NEVER paste anything except as "TEXT ONLY" otherwise you will corrupt the template styles.

QUESTIONS

MIKE BERTIN

MIKESBERTIN@GMAIL.COM

+1 (505) 220-4589