Communication in Science / I

March 2015

Samo Stanič

Univerza v Novi Gorici

Course structure

- Introduction
- Structure and process
- Language
- Illustrations
- How to publish in top journals, i.e. *Elsevier*

- **Practical work**

Why learn scientific writing?

- You will have to **write a thesis**
- You may have to write a **scientific article**
- You **will be judged by what you write** and what you present:

  - Content
  - Structure
  - Style

What Should You Learn?

Scientific writing is an essential skill for **anyone** wishing to pursue a career in **any scientific field**.

This course will prepare you to participate in professional scientific communication using **accepted format and style**.

Scientific writing is the process of researching or experimenting with a problem and then presenting findings in the context of current work. This type of writing has to be **easy to skim for important findings or conclusions**.

It is utilized in **peer-review journals, grant proposals, theses and dissertations**, lab reports and literature reviews.

Necessary Skills

- how to describe an **outline**, determine its value and then develop his/her own outline before writing a paper

- how to **format papers**, including the abstract, materials and methods, results, conclusions and works cited

- how to research literature using both **online** and traditional **hard copy** methods; how to evaluate literature for relevant content and incorporate it into the writing

- proper use of grammar, verb tense, active and passive voices and sentence structure; proper division of sentences and paragraphs, elimination of excess language and use of **concise, common, exact wording**

Writing is learned by writing

- **Practice, practice, practice**
- Choose good role models
- Study good examples

- Learn the rules and the techniques

Introduction

- Importance of precision
- Principles
- Structure
- Format
- *Introduction to **LaTeX***

How well you communicate affects your career

Survey (Richard M. Davis)

Successful engineers spent 25% of work week writing

Survey (Wisconsin)

Professional engineers found writing their most useful subject in college

Survey (Virginia Tech)

Recruiters claim that engineers need more work on their writing

How well you communicate affects the well-being of others


[*Report*, 1986]

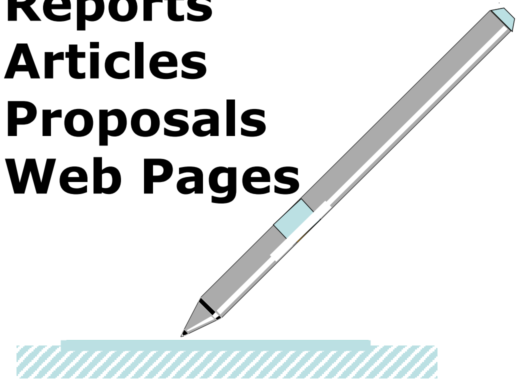
Space Shuttle Challenger (January 28, 1986)

Explosion was caused by failure of O-rings in the solid rocket boosters

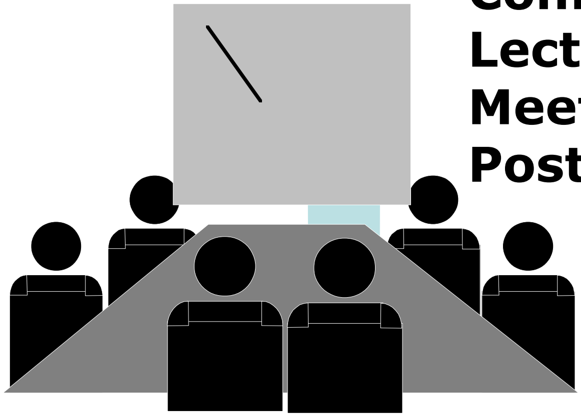
Engineers knew of O-ring problems well before fatal launch

Engineers failed to communicate seriousness of problem

Scientists and engineers are called upon to communicate in many different situations



Reports
Articles
Proposals
Web Pages



Conferences
Lectures
Meetings
Posters

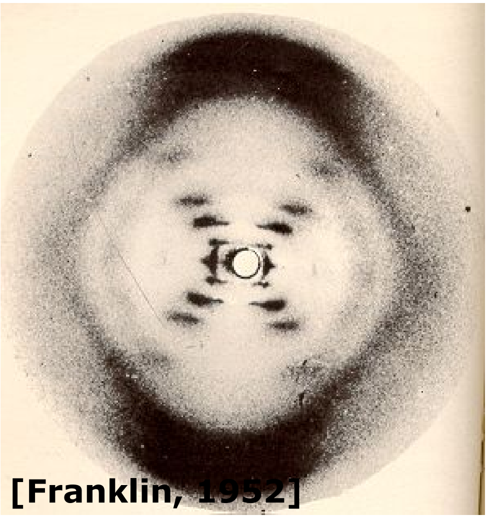
specific technical audiences

general technical audiences

non-technical audiences

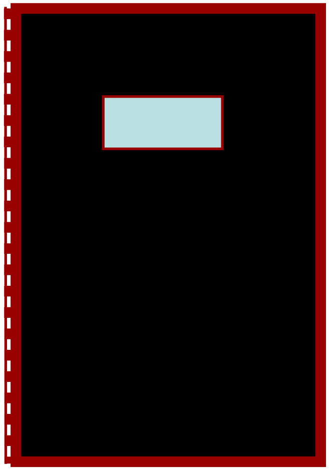
Scientific writing differs from other kinds of writing

Subject Topic



[Franklin, 1952]

Writing Constraints



audience

purpose

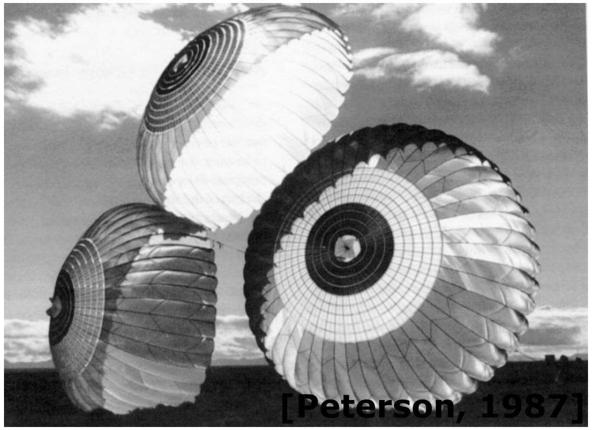
occasion

Purpose of Writing

To inform

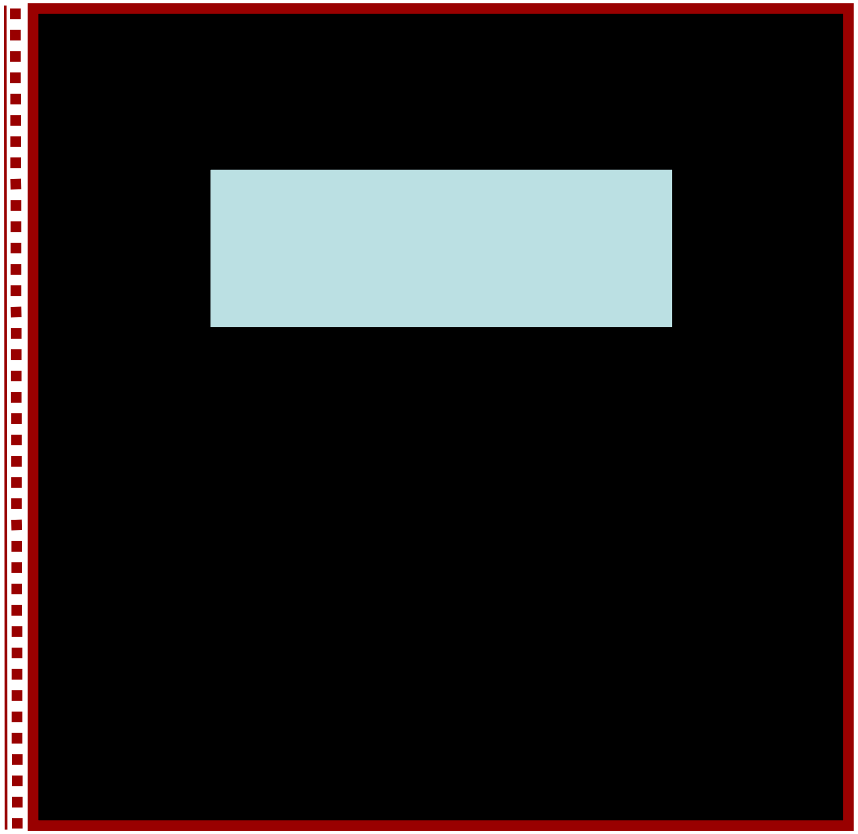
To persuade

Writing Style



[Peterson, 1987]

You should begin the writing process by analyzing your constraints



Audience

- Who they are
- What they know
- Why they will read
- How they will read

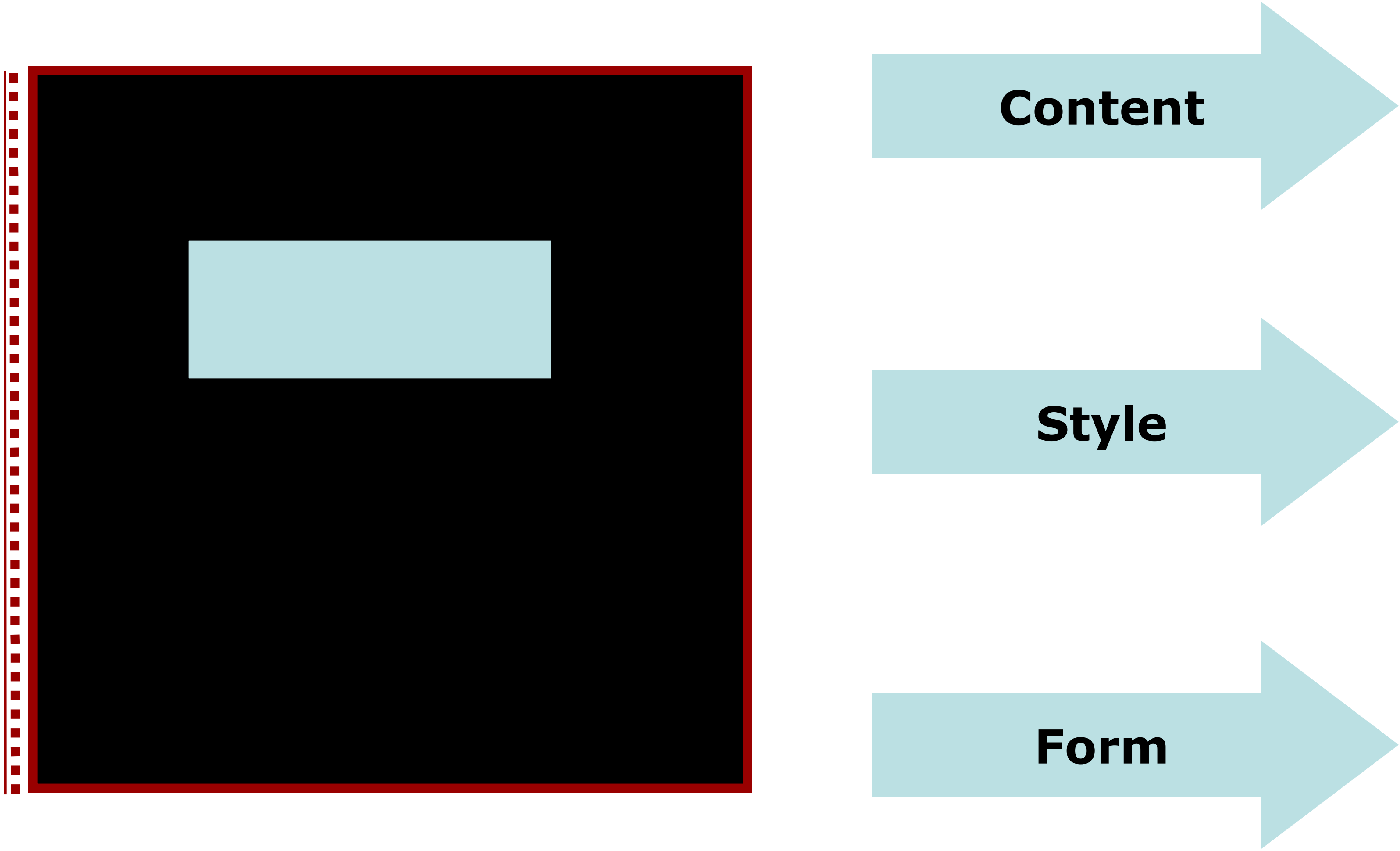
Occasion

- Format
- Formality
- Politics and ethics
- Process and deadline

Purpose

- To inform
- To persuade

Three aspects of writing affect the way that readers assess your documents

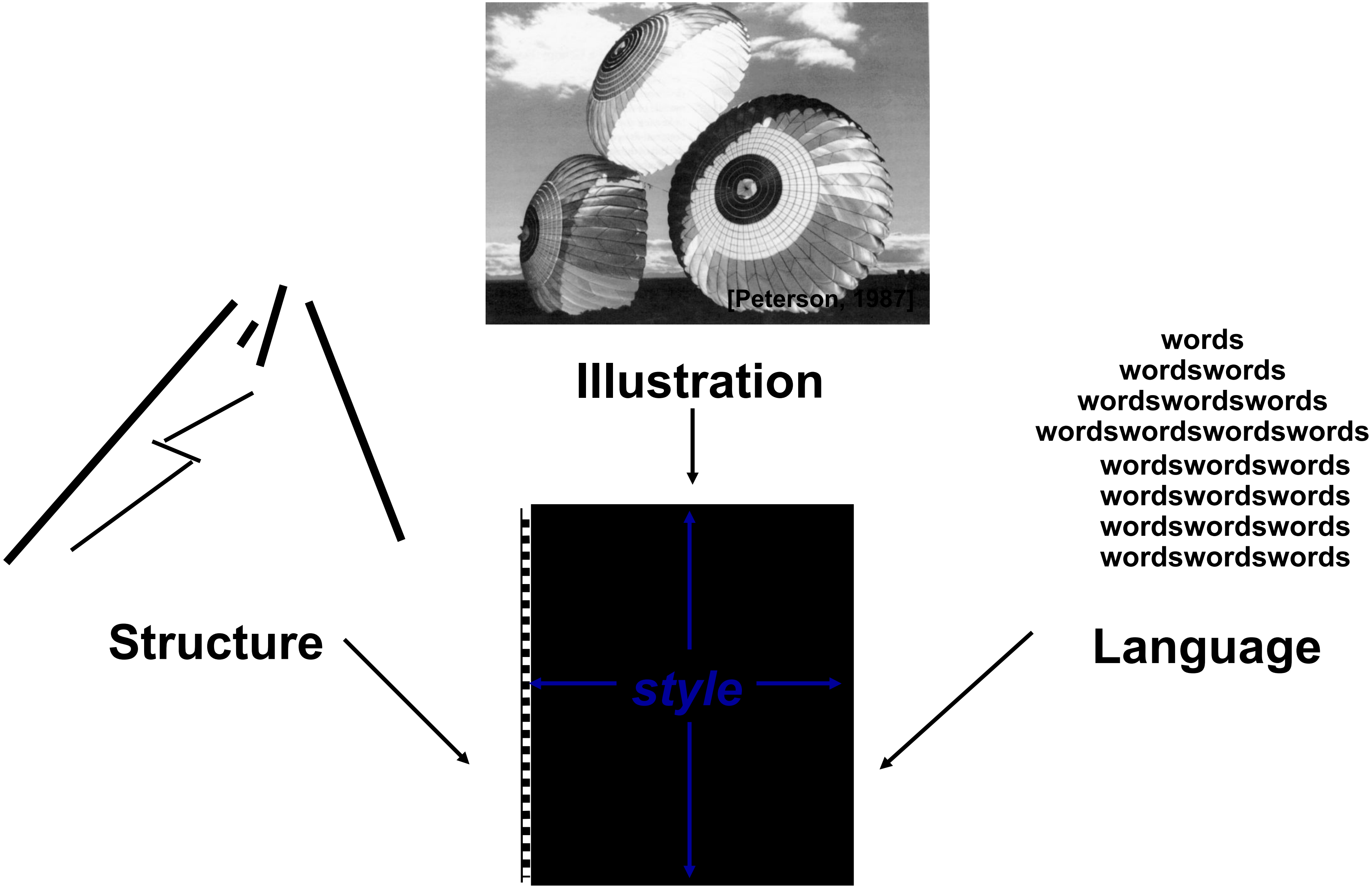


Content

Style

Form

Style is the way you communicate the content to the audience



[Peterson, 1987]

Illustration

words
wordswords
wordswordswords
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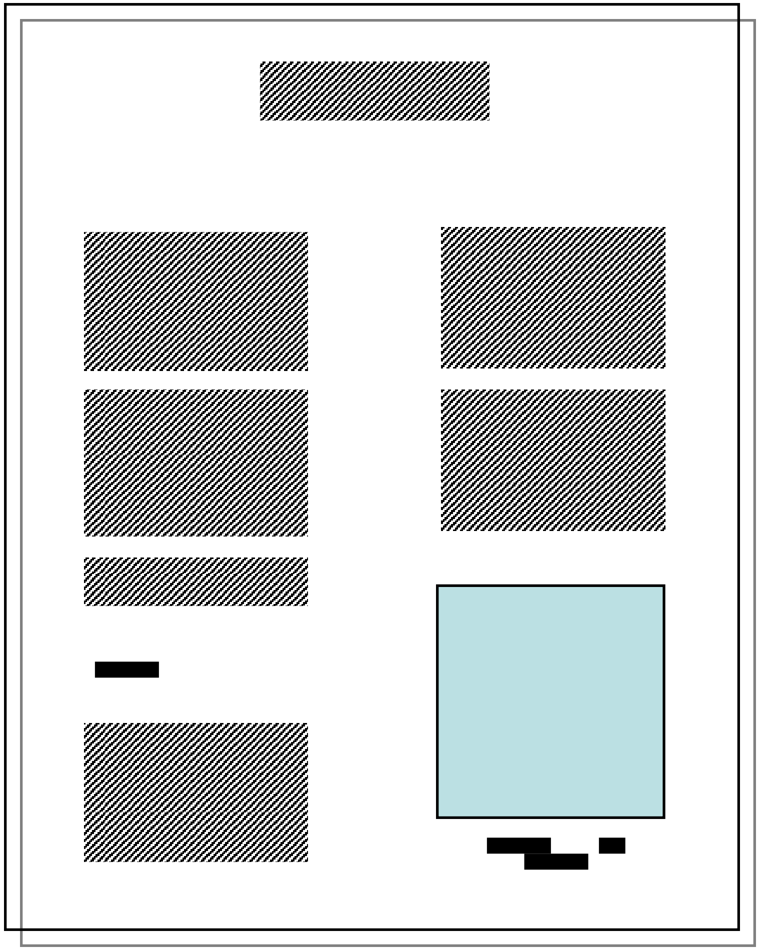
Structure

Language

style

Form embodies the format and mechanics of the writing



format

- typography
- layout

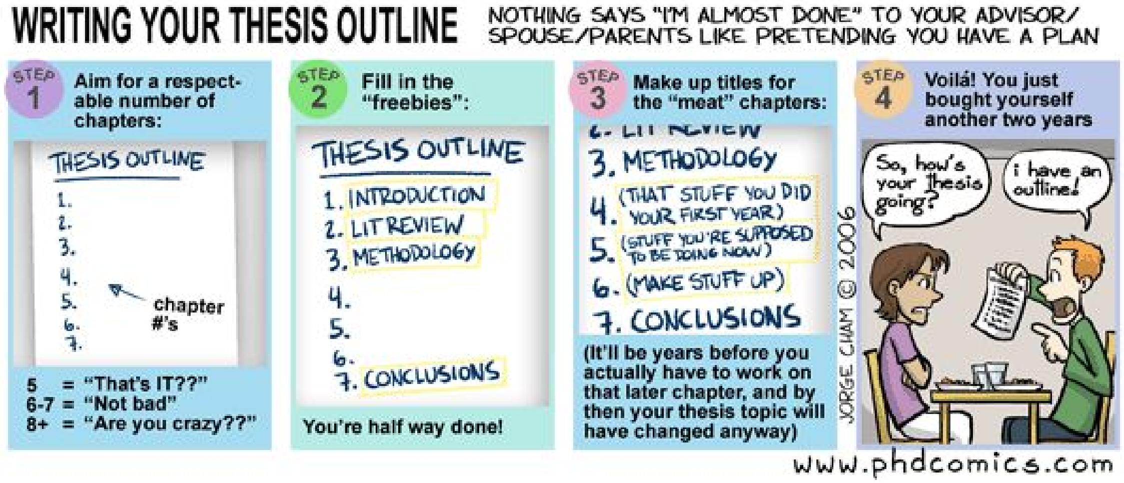
mechanics

- grammar
- usage
- punctuation
- spelling

We can split the writing process into stages

"Getting in the mood"

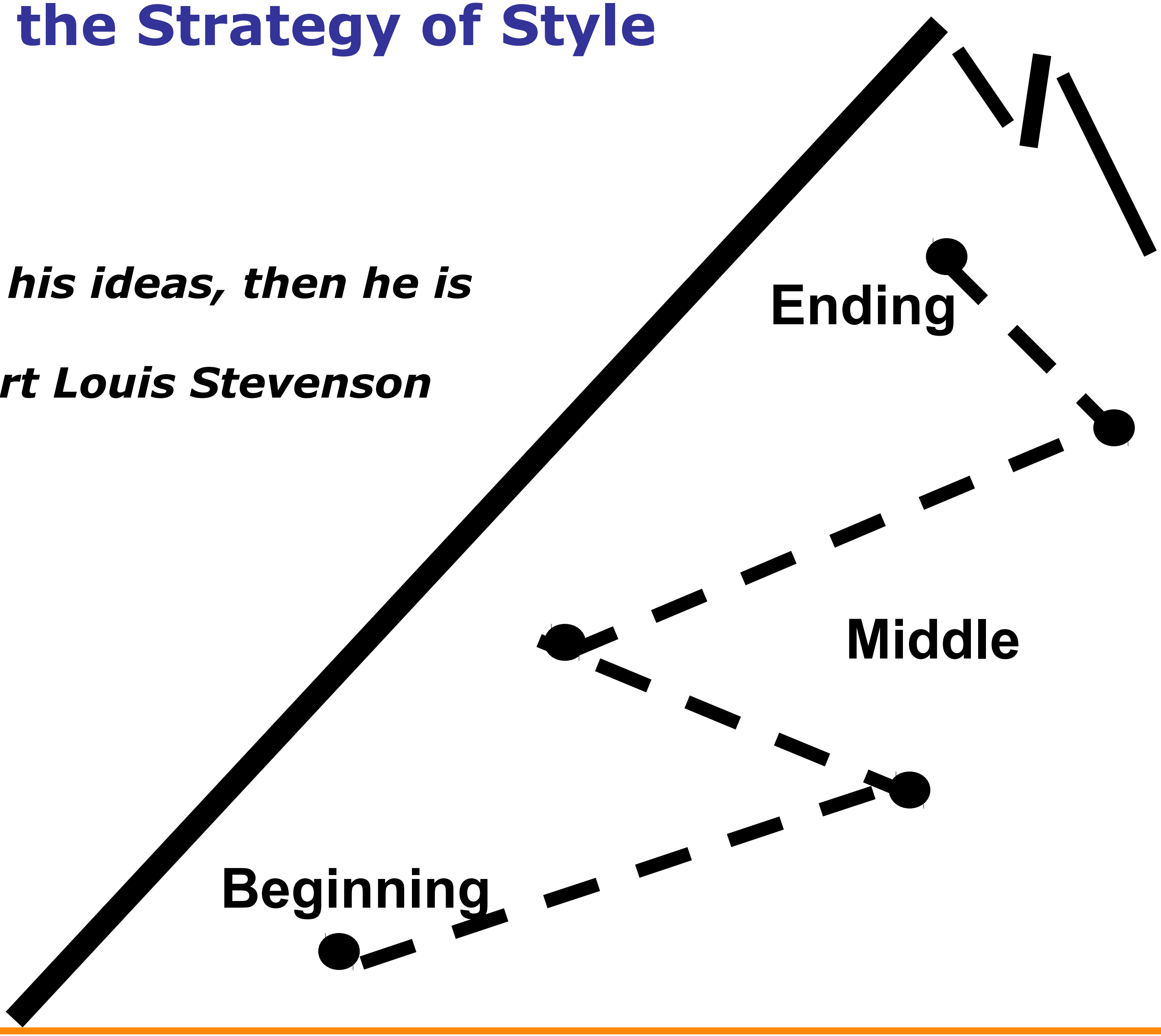
Wr



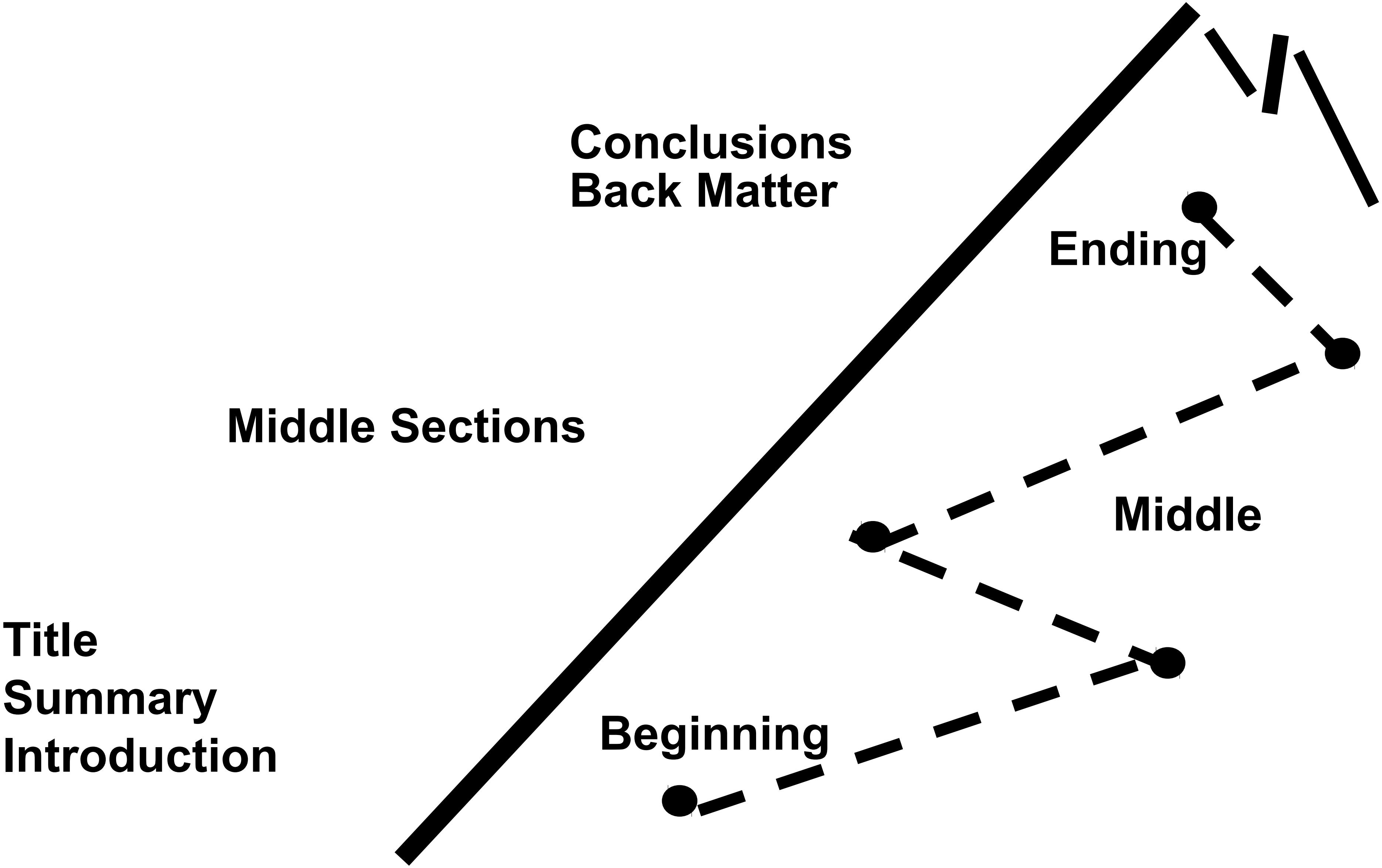
Structure:
the Strategy of Style

If a man can group his ideas, then he is a writer.

Robert Louis Stevenson



The organization of a scientific document can be viewed as a beginning, middle, and ending



Conclusions
Back Matter

Ending

Middle Sections

Middle

Title
Summary
Introduction

Beginning

Beginnings prepare readers for understanding the work

Title orients readers to document

Summary tells readers what happens in document

Introduction prepares readers for the middle

A strong title orients readers to your area of work

Effects of Humidity on the Growth of Avalanches

→

Effects of Humidity on the Growth of Electron Avalanches in Electrical Gas Discharges

A strong title also separates your work from everyone else's work

Studies on the Electrodeposition of Lead on Copper

→

Effects of Rhodamine-B on the Electrodeposition of Lead on Copper

Several names for summaries exist

Summary

Technical Abstract

Informative Abstract

Abstract

Descriptive Abstract

Executive Summary

Although several names exist for summaries, there are essentially two approaches

This paper describes a new inertial navigation system for mapping oil and gas wells. In this paper, we will compare the mapping accuracy and speed for this new system against the accuracy and speed for conventional systems.

Descriptive

This paper describes a new inertial navigation system that will increase the mapping accuracy of oil wells by a factor of ten. The new system uses three-axis navigation that protects sensors from high-spin rates. The system also processes its information by Kalman filtering (a statistical sampling technique) in an on-site computer. Test results show the three-dimensional location accuracy is within 0.1 meters for every 100 meters of well depth, an accuracy ten times greater than conventional systems.

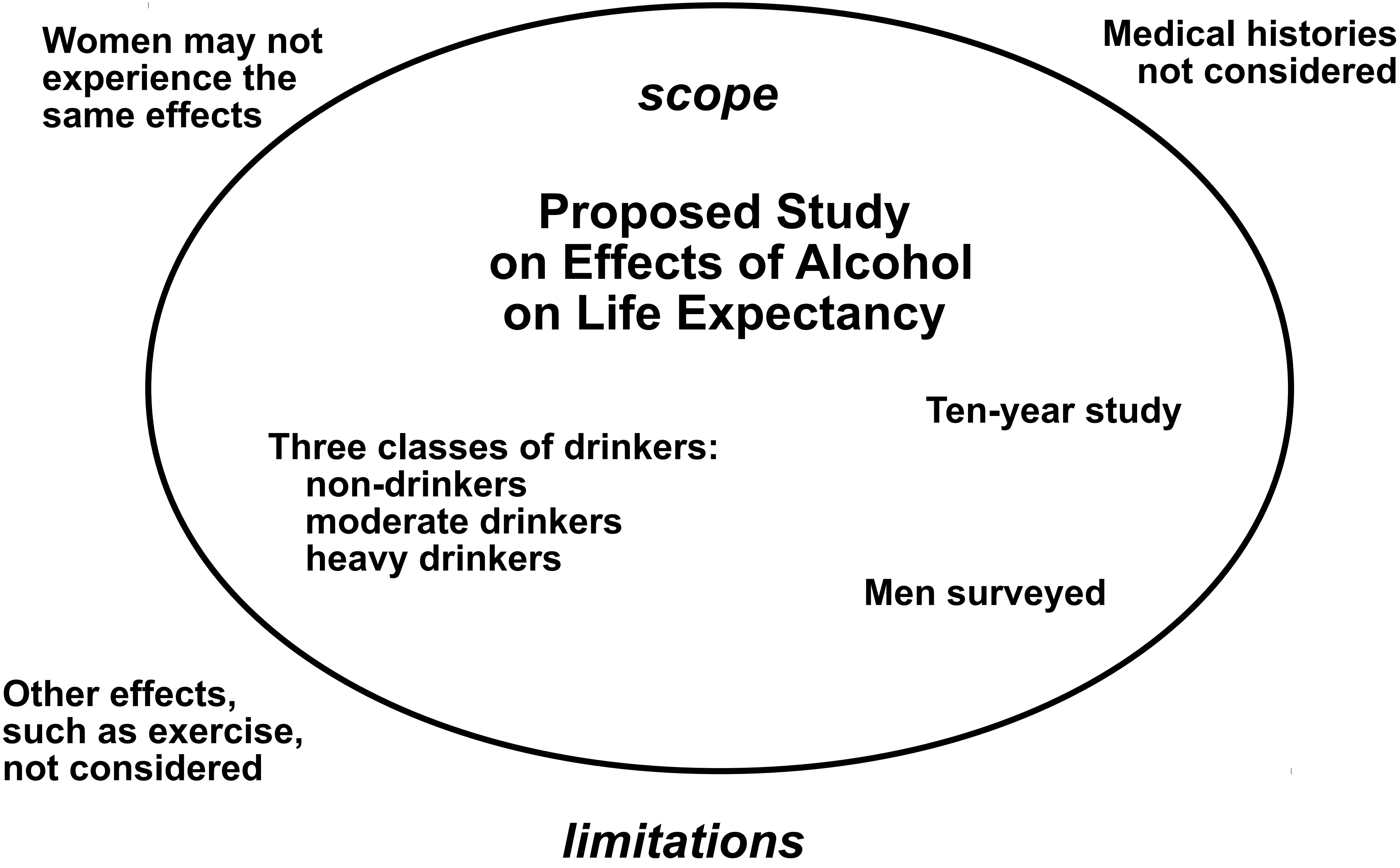
Informative

A document's introduction prepares readers for the discussion

Introduction

Topic?
Importance?
Background?
Arrangement?

The introduction defines the **scope** and **limitations** of the work



Women may not experience the same effects

Medical histories not considered

scope

Proposed Study on Effects of Alcohol on Life Expectancy

Ten-year study

Three classes of drinkers:
- **non-drinkers**
- **moderate drinkers**
- **heavy drinkers**

Men surveyed

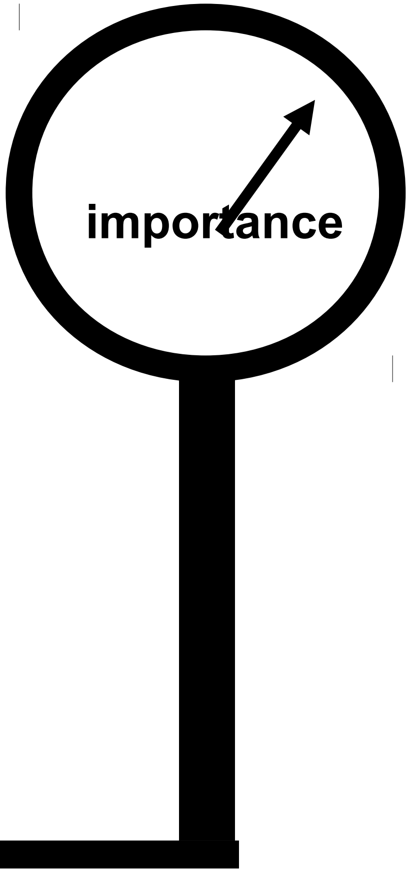
Other effects, such as exercise, not considered

limitations

A strong introduction tells readers why the research is important

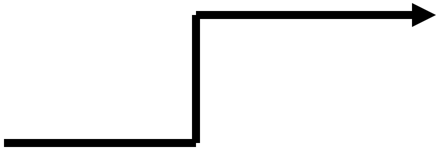
This paper presents a design for a platinum catalytic igniter in hydrogen-air mixtures. This igniter has application in nuclear reactors. One danger at a nuclear reactor is a loss-of-coolant accident. Such an accident can produce large quantities of hydrogen gas when hot water and steam react with zirconium fuel rods. In a serious accident, the evolution of hydrogen may be so rapid that it produces an explosive hydrogen-air mixture in the reactor containment building. This mixture could breach the containment walls and allow radiation to escape.

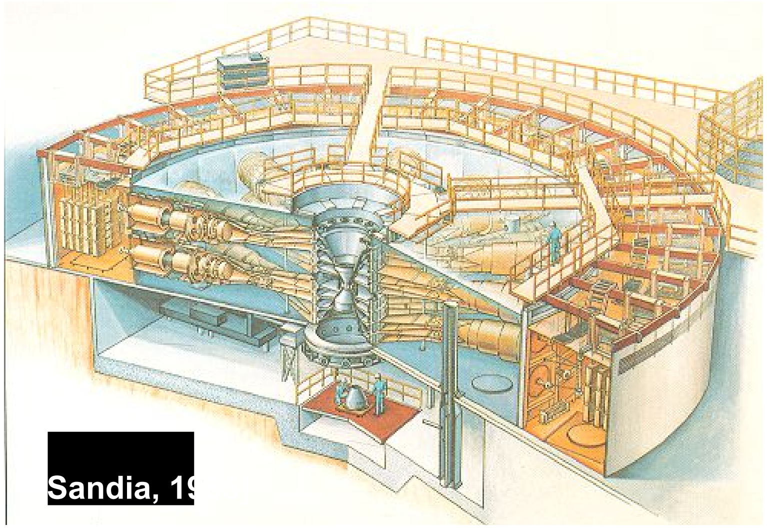
Our method to eliminate this danger is to intentionally ignite the hydrogen-air mixture at concentrations below those for which any serious damage might result.



In the middle of a report, you present your work

Choose a logical strategy





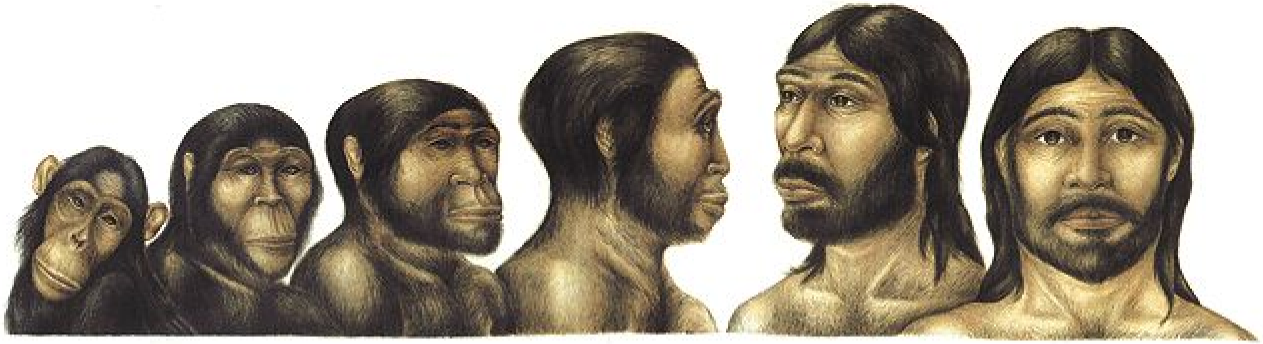
Sandia, 19

Make sections and subsections

- Heading
  - Subheading
  - Subheading
- Heading
  - Subheading
  - Subheading
  - Subheading
- Heading

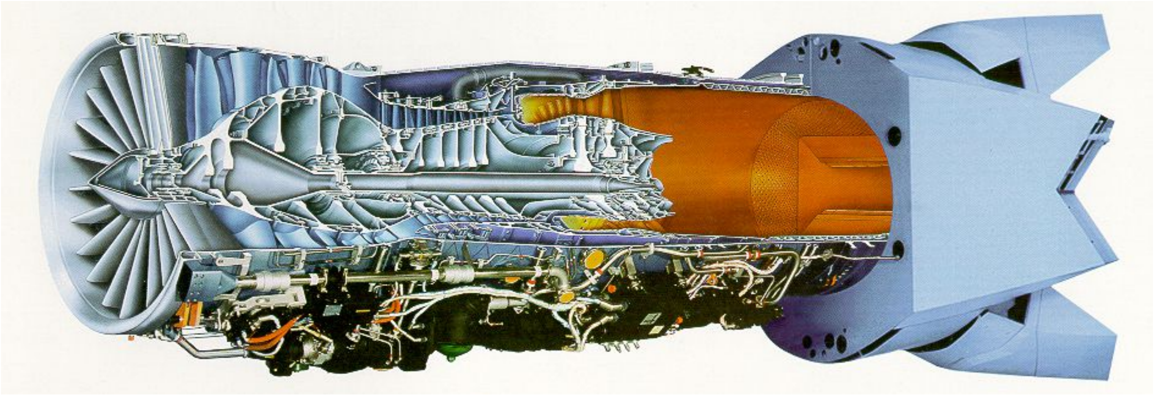
Common strategies exist for the middles of scientific reports

Chronological



[Maizels, 2001]

Spatial



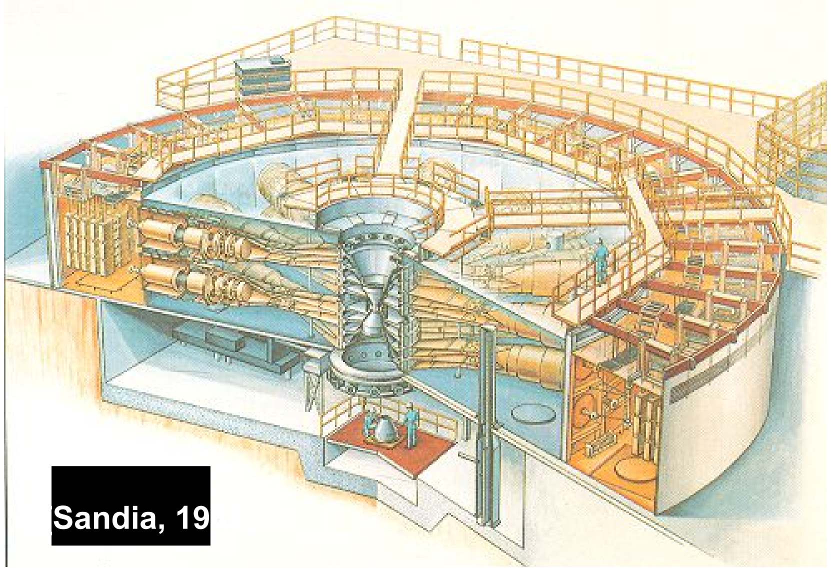
[Pratt & Whitney, 2000]

Common strategies exist for the middles of scientific reports

Parallel Parts

Corel Corporation

Flow



Sandia, 19

Section headings should be descriptive and parallel

Non-Parallel
Non-Descriptive

Introduction
Background
Marx Generators
Line Pulse
Beam Generation
Transporting Beam
Pellets
Results
Conclusions

Parallel
Descriptive

Introduction

Past Designs for Particle Beam Fusion

New Design for Particle Beam Fusion
- Charging Marx Generators
- Forming Line Pulse
- Generating Particle Beam
- Transporting Particle Beam
- Irradiating Deuterium-Tritium Pellets

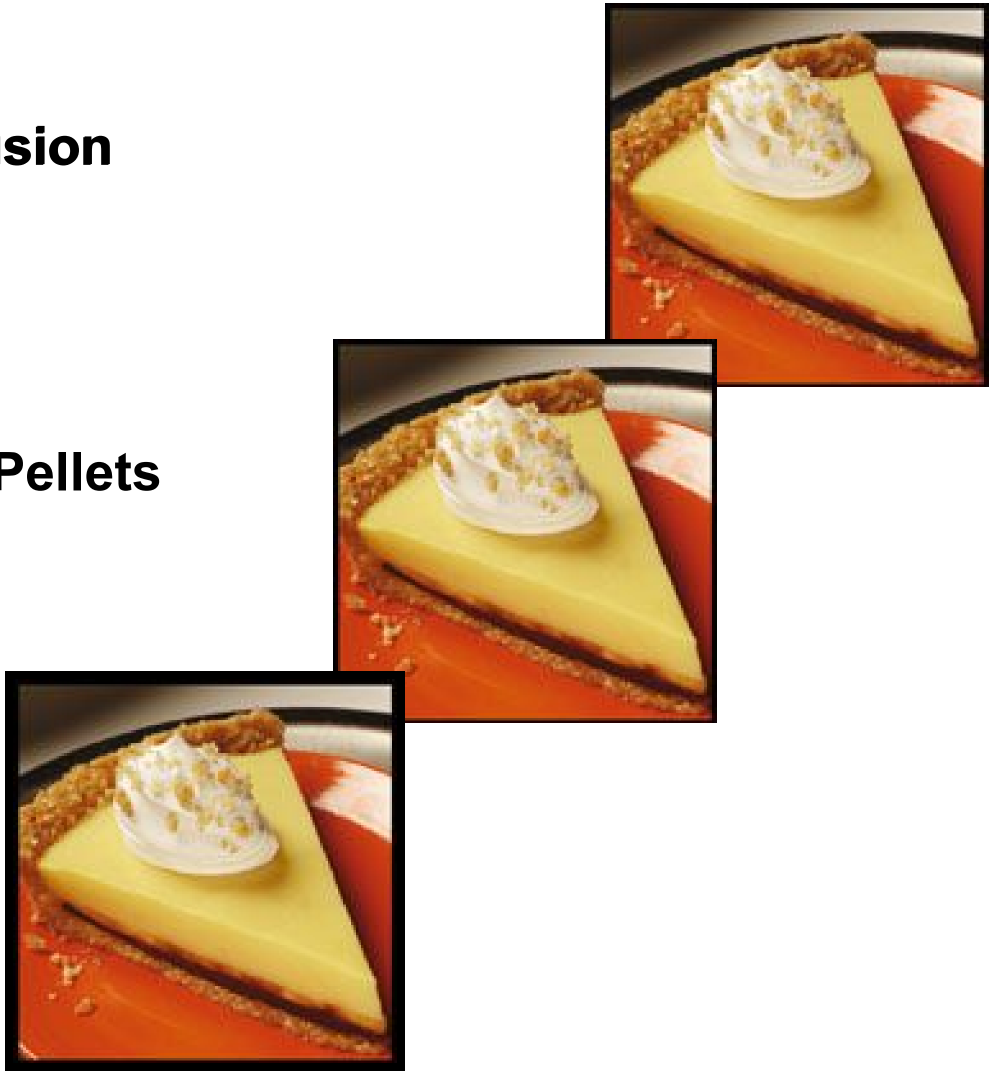
Results of New Design

Conclusions and Recommendations

When you divide a section into subsections, all the pieces should be of the same pie

New Design for Particle Beam Fusion

- **Charging Marx Generators**
- **Generating Particle Beam**
- **Pellets**
- Irradiating Deuterium-Tritium Pellets



Organization is hidden when headings occur in a long list without secondary headings

Performance of the Solar One Receiver

Introduction

Steady State Efficiency

Average Efficiency

Start-Up Time

Operation Time

Operation During Cloud Transients

Panel Mechanical Supports

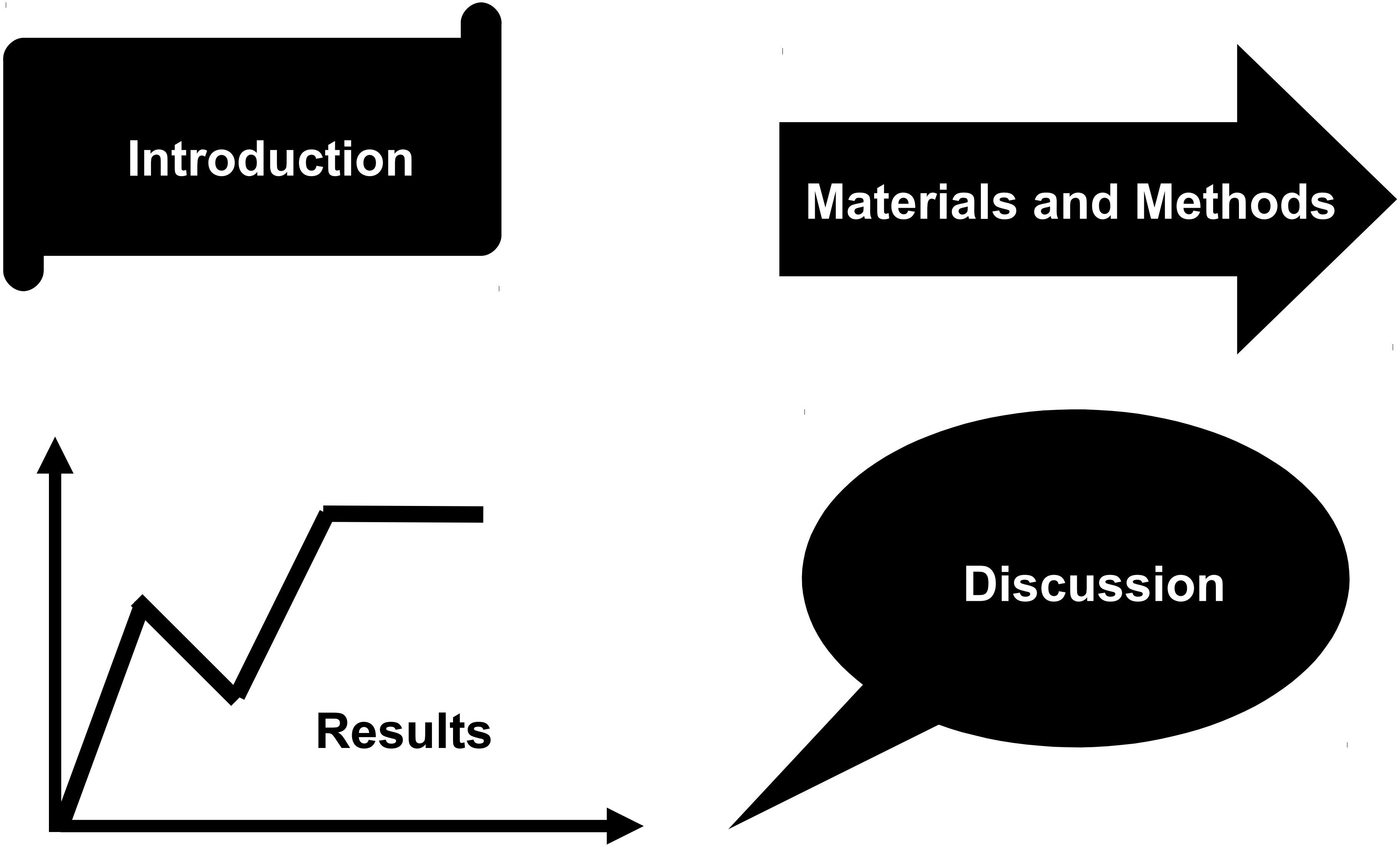
Tube Leaks

Conclusion

Performance of the Solar One Receiver

- Introduction
- Receiver’s Efficiency
  - Steady State Efficiency
  - Average Efficiency
- Receiver’s Operation Cycle
  - Start-Up Time
  - Operation Time
  - Operation During Cloud Transients
- Receiver’s Mechanical Wear
  - Panel Mechanical Supports
  - Tube Leaks
- Conclusion

Many journal articles follow a set organization named IMRaD



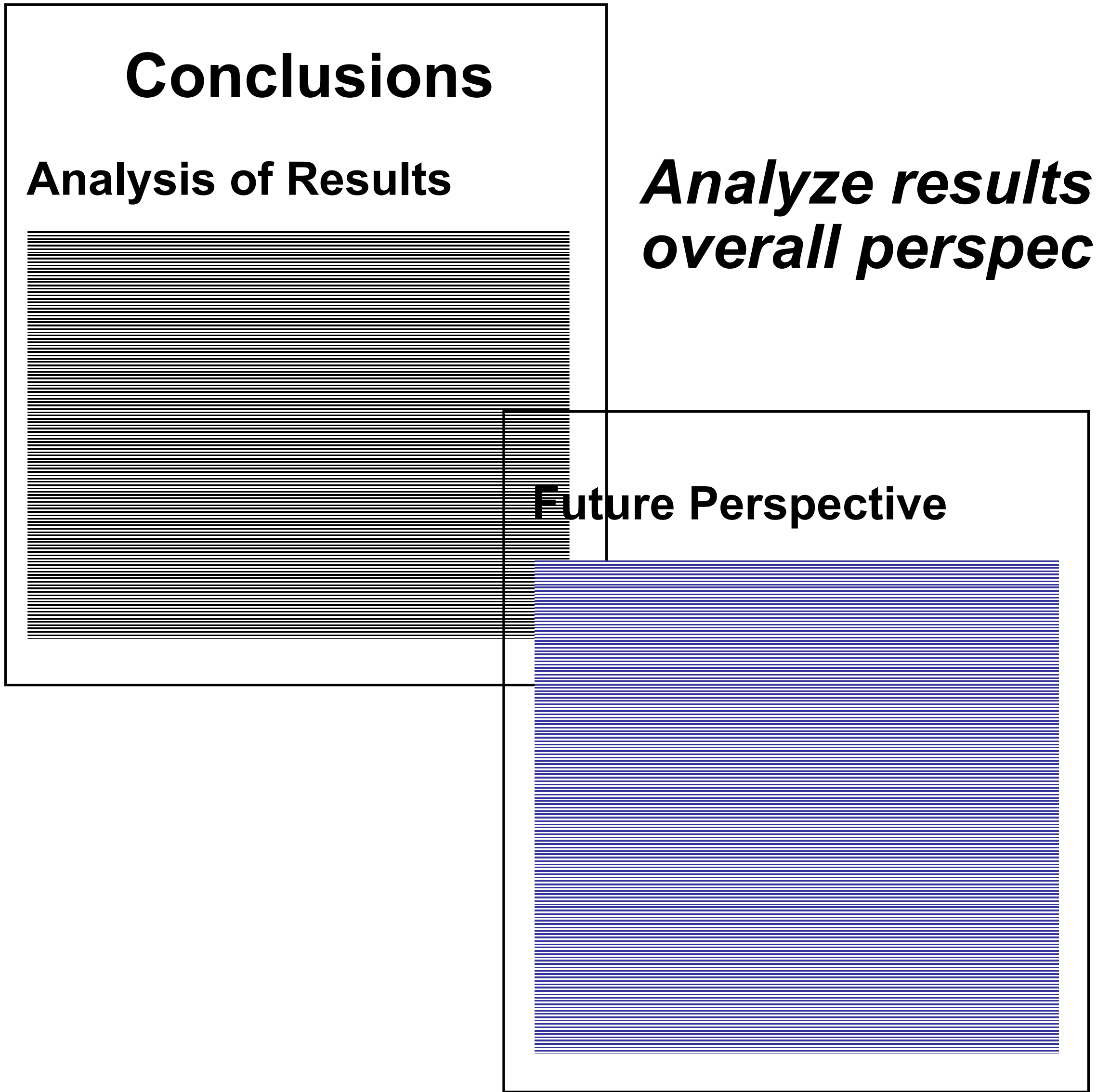
Introduction

Materials and Methods

Results

Discussion

In a strong ending, you analyze results
and give a future perspective



Conclusions

Analysis of Results

Future Perspective

Analyze results from overall perspective

Several options:
Make recommendations
Discuss future work
Repeat limitations

Use appendices to supply background
for secondary audiences

Appendix A
Concern About the Greenhouse Effect

For almost a hundred years, experts have been concerned with the increasing concentrations of gases such as carbon dioxide, methane, and nitrogen oxides in the earth's lower atmosphere. These gases are natural by-products of combustion. Figure A-1 illustrates the correlation between global temperature and carbon dioxide concentrations...

Use appendices to supply secondary or tangential information to primary readers

Appendix B
Project Stormfury

In 1961, the United States Weather Bureau and the Department of Defense (Navy) began a project to reduce the strength of hurricanes. The project, called Project Stormfury, uses cloud seeding, a process used to produce rainfall and reduce hail in thunderstorms. In Project Stormfury, silver iodide crystals, similar in structure to ice, are dispersed by airplanes in the upper reaches of cloud formations just outside the hurricane's eye where the winds are highest. Initial results showed that wind speeds decreased between 15–30% after seedings...

For secondary readers, use a glossary to define unfamiliar terms

Glossary

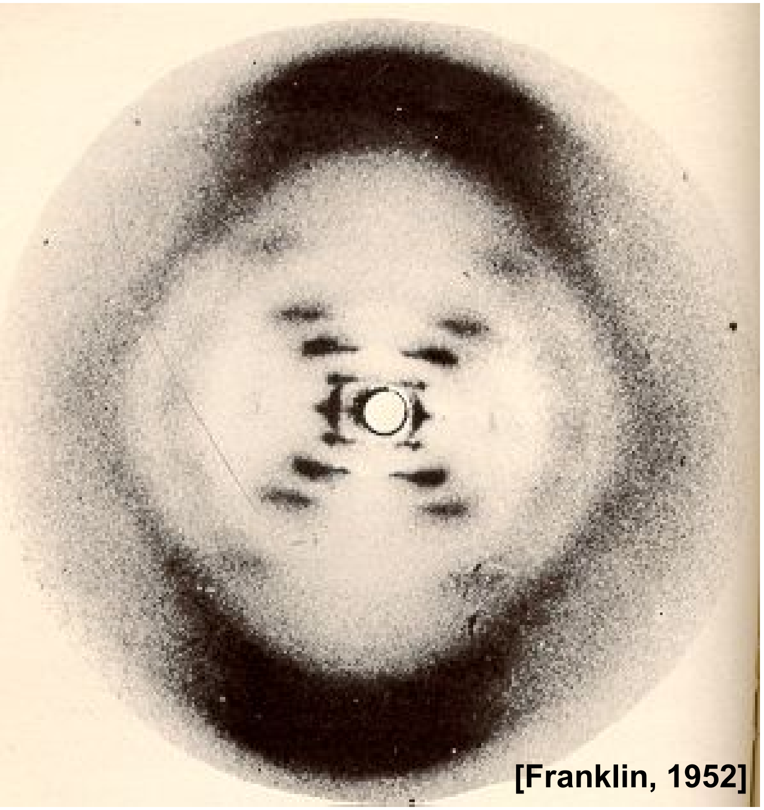
burst point: the exact point in space where an atomic bomb is detonated.

clear visibility: a viewing range of twenty miles.

fallout: the descent to the Earth's surface of radioactive particles from a cloud contaminated with the fission products of a nuclear explosion.

hypocenter: the point on the earth's surface directly below the burst point; also called ground zero.

Failing to cite the contribution of others can be a fatal flaw in your career



[Franklin, 1952]

James Watson surreptitiously looked at Rosalind Franklin's work

[Luzzati, 1950]

Watson did not give enough credit to Franklin

Formatting Scientific Documents

Proceedings of
ASME TURBOEXPO 2000
May 8-11, 2000, Munich, Germany

2000-GT-0201

HIGH FREESTREAM TURBULENCE EFFECTS ON ENDWALL HEAT TRANSFER
FOR A GAS TURBINE STATOR VANE

R. W. Radomsky* and K. A. Thole
Mechanical Engineering Department
Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24060

ABSTRACT

INTRODUCTION

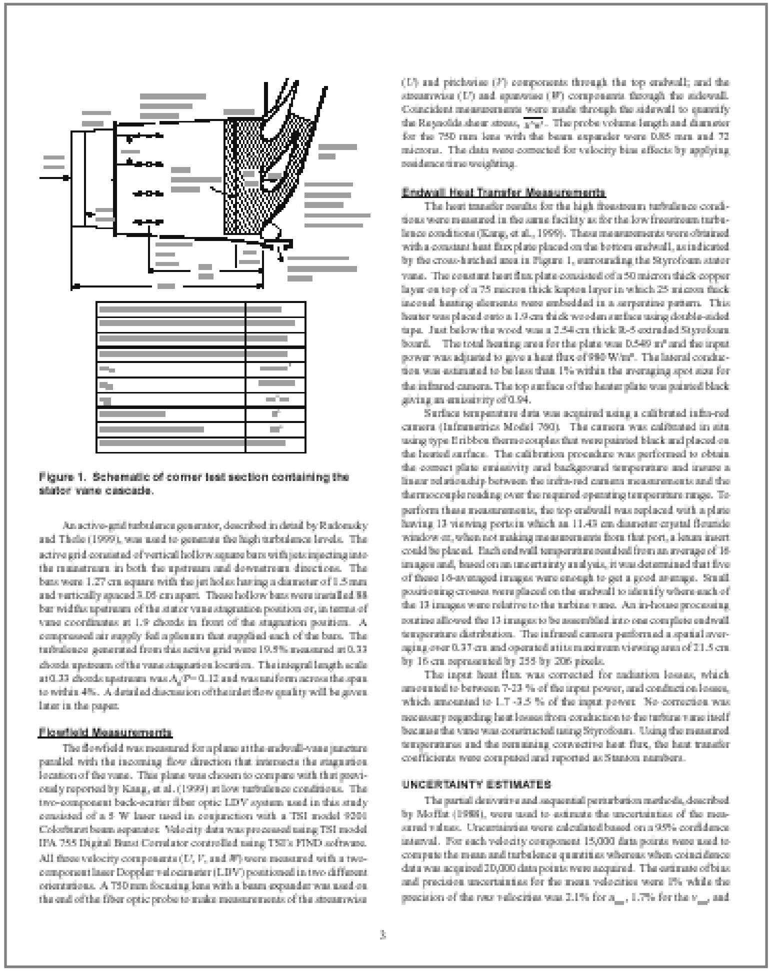


Figure 1. Schematic of corner test section containing the stator vane cascade.

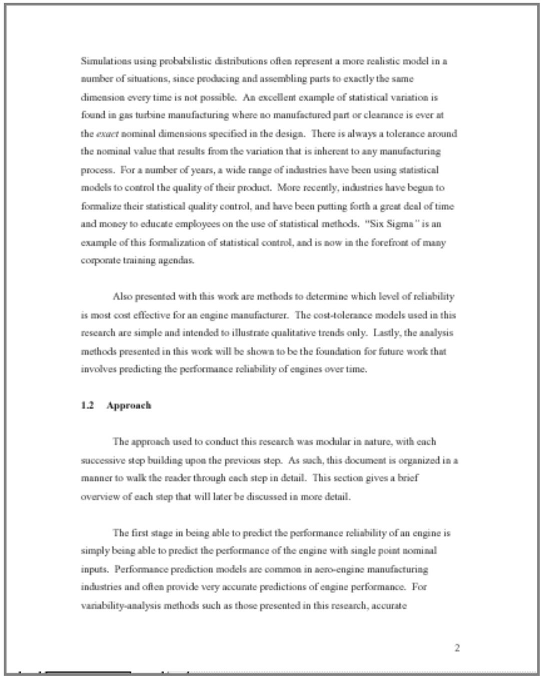
Flowfield Measurements

Endwall Heat Transfer Measurements

UNCERTAINTY ESTIMATES

In scientific writing, formats vary considerably to serve different situations

Follow the format that is expected or required for the situation



Simulations using probabilistic distributions often represent a more realistic model in a number of situations, since producing and assembling parts to exactly the same dimension every time is not possible. An excellent example of statistical variation is found in gas turbine manufacturing where no manufactured part or clearance is ever at the *exact* nominal dimensions specified in the design. There is always a tolerance around the nominal value that results from the variation that is inherent to any manufacturing process. For a number of years, a wide range of industries have been using statistical models to control the quality of their product. More recently, industries have begun to formalize their statistical quality control, and have been putting forth a great deal of time and money to educate employees on the use of statistical methods. "Six Sigma" is an example of this formalization of statistical control, and is now in the forefront of many corporate training agendas.

Also presented with this work are methods to determine which level of reliability is most cost effective for an engine manufacturer. The cost-tolerance models used in this research are simple and intended to illustrate qualitative trends only. Lastly, the analysis methods presented in this work will be shown to be the foundation for future work that involves predicting the performance reliability of engines over time.

1.2 Approach

The approach used to conduct this research was modular in nature, with each successive step building upon the previous step. As such, this document is organized in a manner to walk the reader through each step in detail. This section gives a brief overview of each step that will later be discussed in more detail.

The first stage in being able to predict the performance reliability of an engine is simply being able to predict the performance of the engine with single point nominal inputs. Performance prediction models are common in aero-engine manufacturing industries and often provide very accurate predictions of engine performance. For variability-analysis methods such as those presented in this research, accurate

2

Formal Reports

Proceedings of
ASME TURBOEXPO 2000
May 8-11, 2000, Munich, Germany

2000-GT-0201

HIGH FREESTREAM TURBULENCE EFFECTS ON ENDWALL HEAT TRANSFER FOR A GAS TURBINE STATOR VANE

R.W. Radomsky* and K.A. Thole
Mechanical Engineering Department
Virginia Polytechnic Institute and State University
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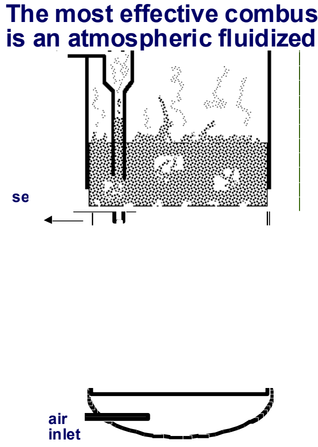
ABSTRACT

INTRODUCTION

Journal Articles



The most effective combustion method is an atmospheric fluidized bed

Presentation Slides

Not all formatting rules are constant

Reports	**Textbooks**	**Journals**
Sandia Laboratories	**Prentice-Hall**	**ASME**
Figure 1	**Fig. 1**	**fig. 1**
Table 1	**Table 1**	**table 1**
equation 1	**equation (1)**	**Eq. 1**

Format is the arrangement of text on the page

typography

Proceedings of
ASME TURBOEXPO 2000
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2000-GT-0201

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Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24060

ABSTRACT

INTRODUCTION

*Present address is United Technologies Research Center
411 Silver Lane
East Hartford, CT 06108

layout

Each typestyle has its own personality and power

Serif

Times New Roman
abcdefghijklmnopqr
stuvwxyz1234567890

Garamond
abcdefghijklmnopqr
stuvwxyz1234567890

Palatino
abcdefghijklmnopqr
stuvwxyz1234567890

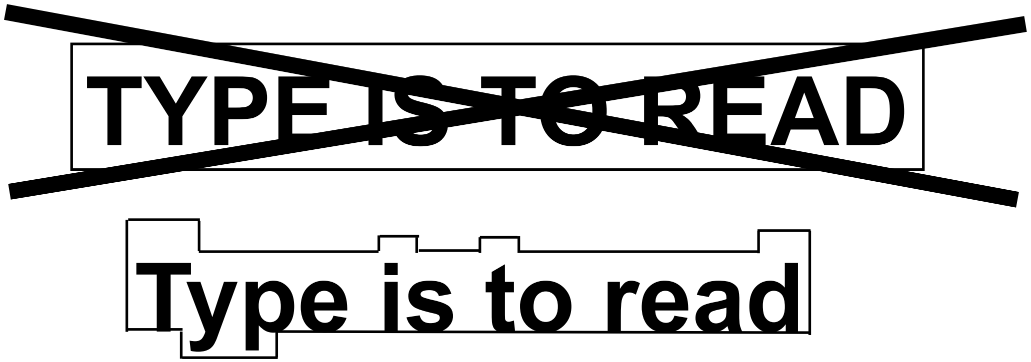
Sans Serif

Arial
abcdefghijklmnopqr
stuwxyz1234567890

Arial Narrow
abcdefghijklmnopqr
stuwxyz1234567890

Comic Sans
abcdefghijklmnopqr
stuwxyz1234567890

Avoid large blocks of capital letters



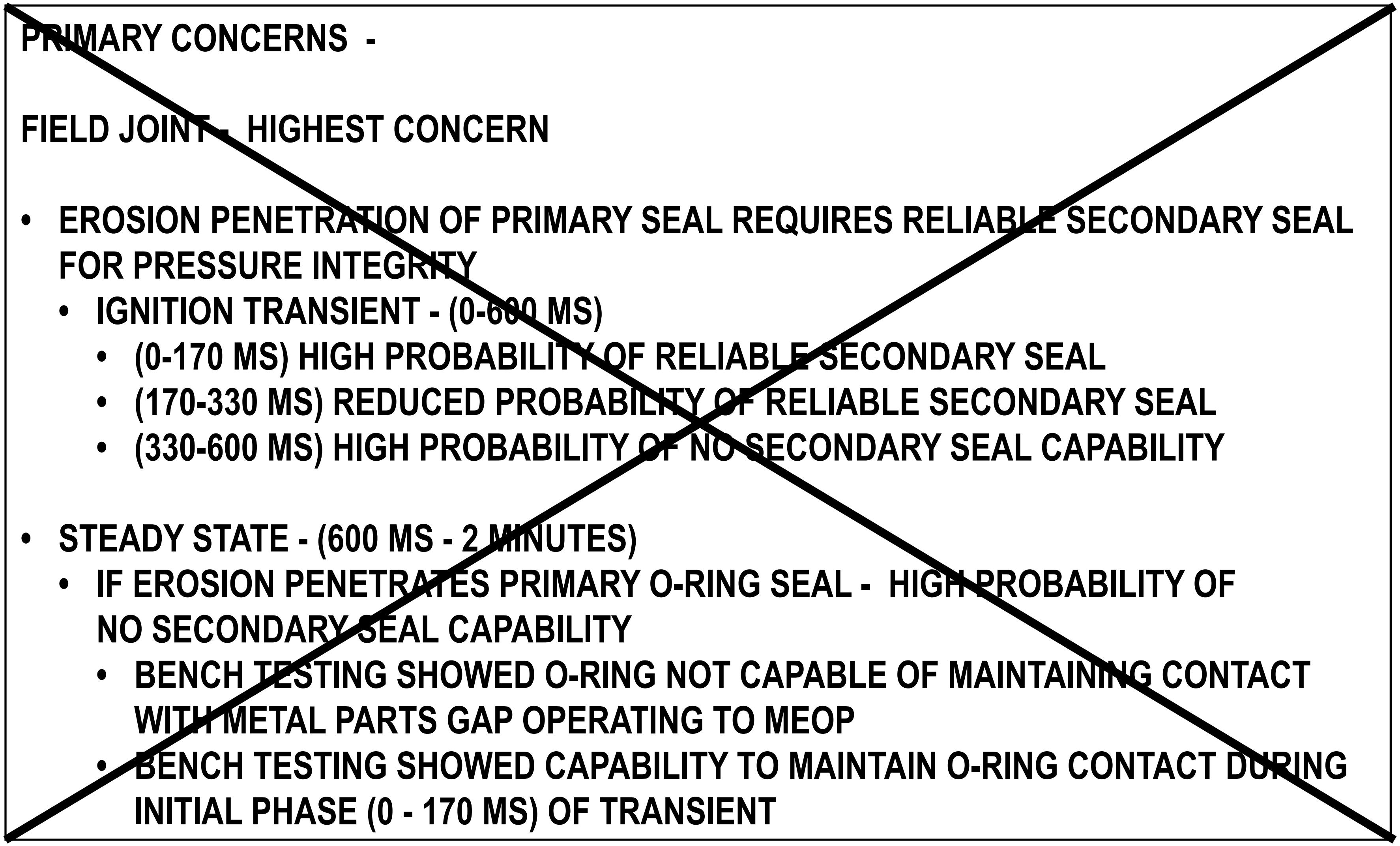
~~TYPE IS TO READ~~

Type is to read

~~WORDS SET IN ALL CAPS USE MORE SPACE THAN TEXT SET IN LOWERCASE.~~

Words set in all caps use more space than words set in lowercase.

Morton-Thiokol’s presentation to NASA suffered because of all capital letters on the slides



PRIMARY CONCERNS -

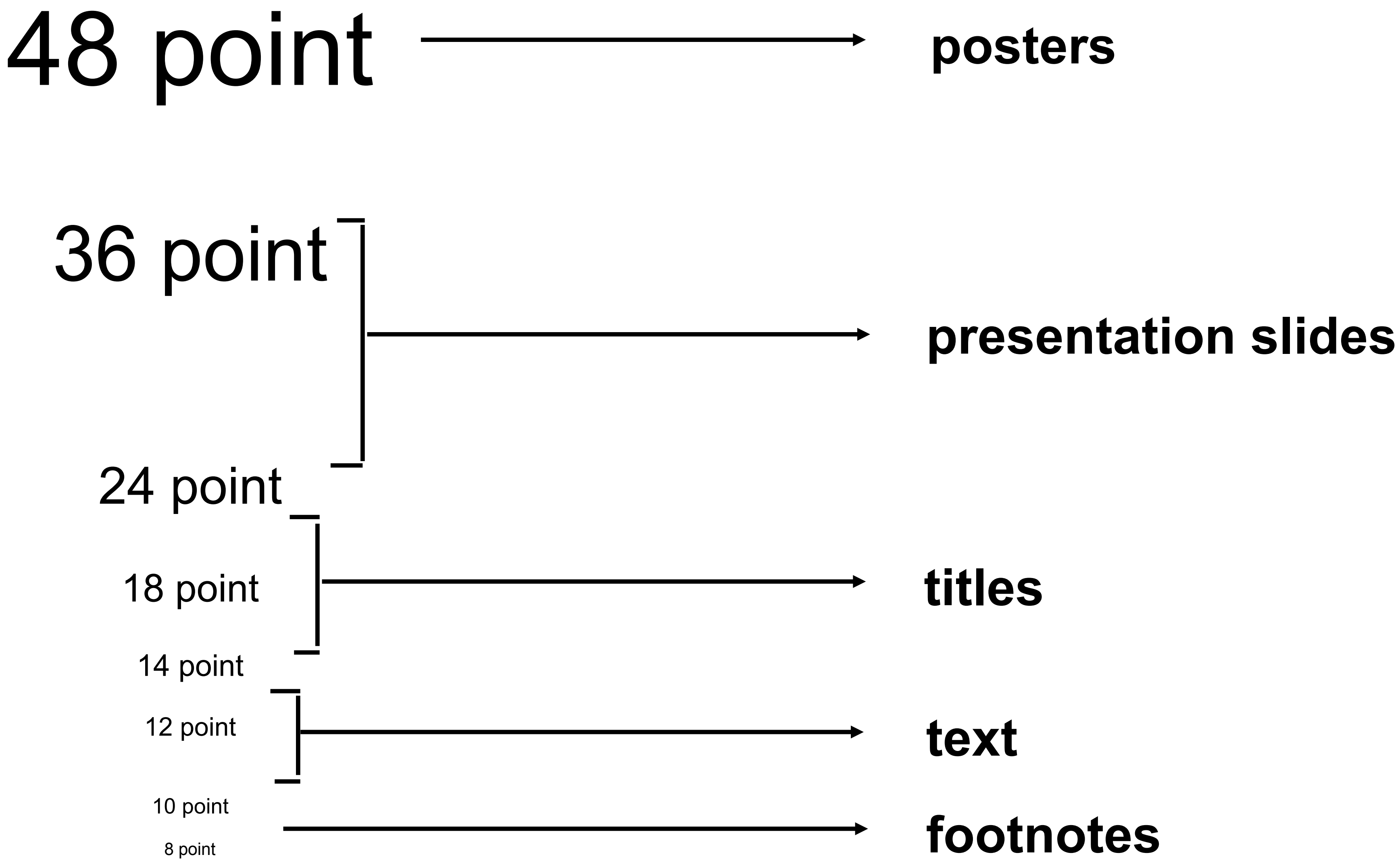
FIELD JOINT - HIGHEST CONCERN

- EROSION PENETRATION OF PRIMARY SEAL REQUIRES RELIABLE SECONDARY SEAL FOR PRESSURE INTEGRITY
  - IGNITION TRANSIENT - (0-600 MS)
    - (0-170 MS) HIGH PROBABILITY OF RELIABLE SECONDARY SEAL
    - (170-330 MS) REDUCED PROBABILITY OF RELIABLE SECONDARY SEAL
    - (330-600 MS) HIGH PROBABILITY OF NO SECONDARY SEAL CAPABILITY

- STEADY STATE - (600 MS - 2 MINUTES)
  - IF EROSION PENETRATES PRIMARY O-RING SEAL - HIGH PROBABILITY OF NO SECONDARY SEAL CAPABILITY
    - BENCH TESTING SHOWED O-RING NOT CAPABLE OF MAINTAINING CONTACT WITH METAL PARTS GAP OPERATING TO MEOP
    - BENCH TESTING SHOWED CAPABILITY TO MAINTAIN O-RING CONTACT DURING INITIAL PHASE (0 - 170 MS) OF TRANSIENT

Morton-Thiokol Presentation to NASA
January 27, 1986

Choose a type size that is easy to read



48 point → posters

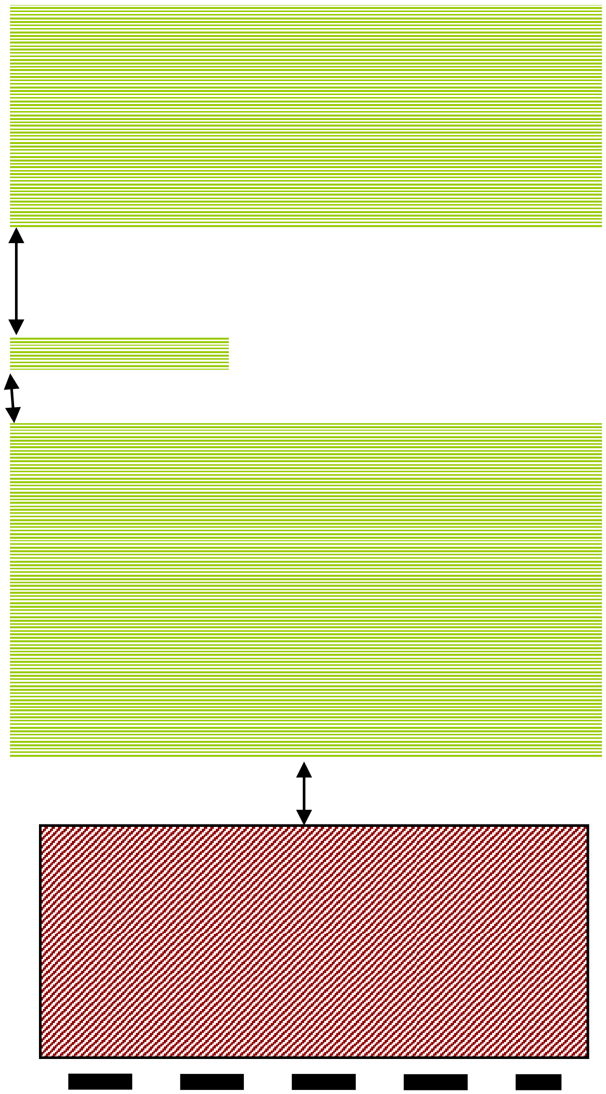
36 point
24 point
→ presentation slides

18 point
14 point
→ titles

12 point → text

10 point
8 point
→ footnotes

In your layouts, use white space for association, emphasis, and hierarchy



space for headings

space for margins

space for illustrations