# Technical Writing
## MCHE 201 – Spring 2019

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# Why should I care?

- If you can’t communicate your ideas, they are worthless.

- Those that can communicate become bosses.

# First Questions to Ask

- What is the purpose of this document?

- Who is the primary audience?
  - Technical competence
  - Expectations
  - Language skills
  - Interests
  - ...

} Who are the customers and what do they want?

# What are we reporting?

- Present accomplishments/results
  - A design, prototype, device, *etc.*
  - New method, theory, or plan for solving a problem

- Do ***NOT*** present administration
  - We did this... Then, we tried that... Finally, we found...
  - Information on team meetings, *etc.*

# General Guidelines

- Maintain consistent formatting
  - Fonts
  - Figure sizes
  - Margins
  - ...

**Your job is to make the reader's job as easy as possible.**

- Generally avoid 1st person
- Avoid chronological structure

  (We did this... Then, we tried that... Finally, we found...)
- Revise 10x more than you think you need to
  - Read aloud (or use computer speak-to-text)
  - Writing is a *very* small part of **WRITING**

# *It's a Team Effort!!!*

- Common mistakes:
  - Each person write a section, staple together = done
    - ✦Inconsistent "voice"
    - ✦Inconsistent formatting (fonts, spacing, etc)
    - ✦Inconsistent terminology
  - One person writes the report, others design/build
    - ✦Report won't match the design
    - ✦Clarity comes with writing
- The ***entire team*** is responsible for the resulting document, good or bad

# Typical Tech. Doc. Sections

- Abstract (or Executive Summary)
- Introduction
- “Main” Sections – Vary by document/presentation type
- Conclusion
- References

# Abstract

- Stand-alone document that summarizes the report

- An abstract:
  - Introduces the reason for the report (the problem being solved)
  - Presents high-level summary of the methods used
  - Summarizes *key* results

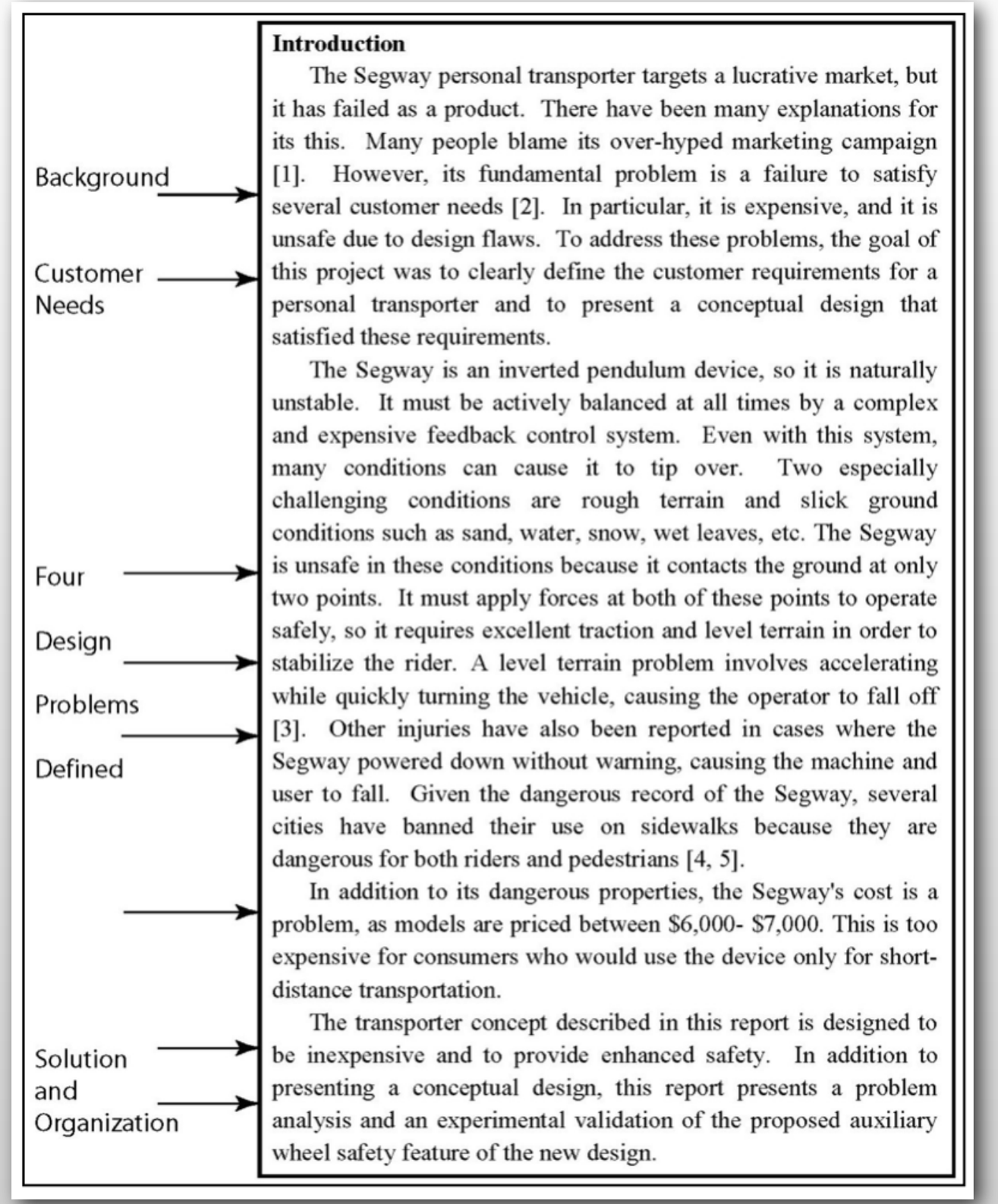
# Introduction

- What is the problem and why should your reader care?

- Includes
  - Introduction of the problem
  - Survey of relevant previous work
  - Why this prior work is insufficient to solve your problem
  - A “roadmap” for the remainder of the report

    ex) The next section discusses... Then, in Section 3, ... Section 4 describes... Finally, conclusions are presented in Section 5.

# An Example Introduction



Background →
Customer Needs →
Four →
Design Problems Defined →
→
Solution and Organization →

**Introduction**

The Segway personal transporter targets a lucrative market, but it has failed as a product. There have been many explanations for its this. Many people blame its over-hyped marketing campaign [1]. However, its fundamental problem is a failure to satisfy several customer needs [2]. In particular, it is expensive, and it is unsafe due to design flaws. To address these problems, the goal of this project was to clearly define the customer requirements for a personal transporter and to present a conceptual design that satisfied these requirements.

The Segway is an inverted pendulum device, so it is naturally unstable. It must be actively balanced at all times by a complex and expensive feedback control system. Even with this system, many conditions can cause it to tip over. Two especially challenging conditions are rough terrain and slick ground conditions such as sand, water, snow, wet leaves, etc. The Segway is unsafe in these conditions because it contacts the ground at only two points. It must apply forces at both of these points to operate safely, so it requires excellent traction and level terrain in order to stabilize the rider. A level terrain problem involves accelerating while quickly turning the vehicle, causing the operator to fall off [3]. Other injuries have also been reported in cases where the Segway powered down without warning, causing the machine and user to fall. Given the dangerous record of the Segway, several cities have banned their use on sidewalks because they are dangerous for both riders and pedestrians [4, 5].

In addition to its dangerous properties, the Segway's cost is a problem, as models are priced between $6,000- $7,000. This is too expensive for consumers who would use the device only for short-distance transportation.

The transporter concept described in this report is designed to be inexpensive and to provide enhanced safety. In addition to presenting a conceptual design, this report presents a problem analysis and an experimental validation of the proposed auxiliary wheel safety feature of the new design.

From: William Singhose & Jeffrey Donnell. “Introductory Mechanical Design Tools.”

# “Main” Sections

- For design reports
  - The chosen/recommended design immediately follows the introduction
    - Overview first
    - Then, details
  - Then, support the decision to choose that design

- For method, theory, problem-solving reports
  - Logically present the method
  - Typically begin with simple case, then work to edge cases

# Final Design Section

- Present functionality of final design
  - Start with high-level overview
  - Move to lower-level details
  - No pro/con discussion here

- Use figures!
  - Label parts according to function
  - Dimension to give scale
  - At least one figure of each sub-system is recommended

# Problem Understanding Section

- Provides support for the choice of final design
  - What are key customer requirements?
  - What are the key specifications that result from those?
  - What functionality must the design have?

This will mostly consist of discussion of the main design tools we'll learn about using in this phase of the design process:

- House of Quality
- Specification Sheet
- Function Tree

# Concept Evaluation Section

- Further support for the choice of your final design
  - At least two other viable alternatives
  - Support selection of your design over these

- First, introduce the alternative concepts
- *Then,* evaluate the alternatives

# Concept Evaluation Section

- Further support for the choice of your final design
  - At least two other viable alternatives
  - Support selection of your design over these

- Introduce the alternative concepts
  - “True” alternatives
  - Enough detail to understand functionality
  - Figures!
  - No pro/con discussion

# Concept Evaluation Section

- Further support for the choice of your final design
  - At least two other viable alternatives
  - Support selection of your design over these

- Introduce the alternative concepts
- Evaluate the alternatives
  - Include chosen design
  - Reference the Evaluation Matrix and relate all discussion back to points in it
  - The main idea of this section… “The final design was chosen because it was good at A, B, and C, even though other alternatives were better at X, Y, and Z.”

# Design Performance Evaluation

- Presents an analysis of design/prototype performance

- Evaluate the *design* and the *design process*.
  - What assumptions, specs, etc. did you get wrong?
  - Would getting those right change the design chosen?
  - Reference the design tools!
  - Separate the *design* from the implementation

# Conclusions

- Very “abstract-like”

- Summarizes what was presented
  - No new information!
  - Reiterate the reason for the report (the problem being solved)
  - Presents high-level summary of the methods used
    - ✦1-2 sentence overview of the design
    - ✦Summary of tools used and key cust. req.
  - Include a summary of *key* results

# Writing about the Design Tools

- Avoid parenthetical citation/reference. Use:
  - … as seen in Figure X.
  - … shown in Figure X.

- Present them as *fact*.
  - Not, “We believe…” or “We found…”
  - “The most important customer requirement is…”

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- Point out what’s important. What is unique to *your* design?

# Good or Bad?

The House of Quality (Figure 1) was filled in using properties of the tower as well as demands for and desired abilities of the tower and the instructions needed to build it. The requirements of the customer and the requirements of the tower to function where separated. Each of the customer requirements where given weight, a value of importance, and a value that shows how strongly each customer requirement and functional requirement correspond. From this the relative weight was calculated and the time and materials the team needed to invest in each functional requirement was determined.

This is ***way*** too general.

# Good or Bad?

The House of Quality in Figure 1 shows the relationship between customer requirements, their relative importance to the customers, and engineering characteristics. From the House of Quality, the primary areas of focus for this design are making a simple design to build, choosing the appropriate number of structure legs, and maximizing leg length. The top of the House of Quality in Figure 2 shows the relationship between the engineering characteristics. For example, while maximizing the number of legs would be beneficial to creating a more balanced structure, it had a strong negative correlation with tower weight, which was to be minimized.

Still not perfect, but much better.

# Writing about Designs

- Avoid parenthetical citation/reference. Use:
  - … as seen in Figure X.
  - … shown in Figure X.
  - Figure X is a drawing…
- *Exactly* match text to figure labels
- Avoid referencing other designs to explain the current one

# Matching the Text and Figure

1) Citation &
2) Objective

3) Description via citation of labels

4) Explanation

**Design Overview**

A sketch of the proposed human transporter is shown in Figure 2. The device rolls on two large powered wheels; a third stabilizing wheel is deployed from the front handlebar stem when the vehicle speed falls below a threshold value. This wheel travels up and down in a slot located in the handlebar stem. A seat is mounted between the wheels. Height adjustment controls give the user control over the seat and handlebar stem, and a width adjustor allows the user to modify the handlebars. The vehicle is stabilized by a controller using gyroscopic sensors [3], allowing the user to control forward motion by simply leaning forward.

This design offers several safety enhancements over the Segway. The forward stabilizing wheel prevents the vehicle from falling over in the event of a user error or a mechanical error resulting in sudden loss of speed. The use of a seated operator lowers the system's moment of inertia; any risk of injury due to falling forward is also reduced because the system potential energy is low. The seat height and the handlebar position can be adjusted by the operator; the adjustment knobs are represented on Figure 2, and two-sided arrows illustrate the potential motions.

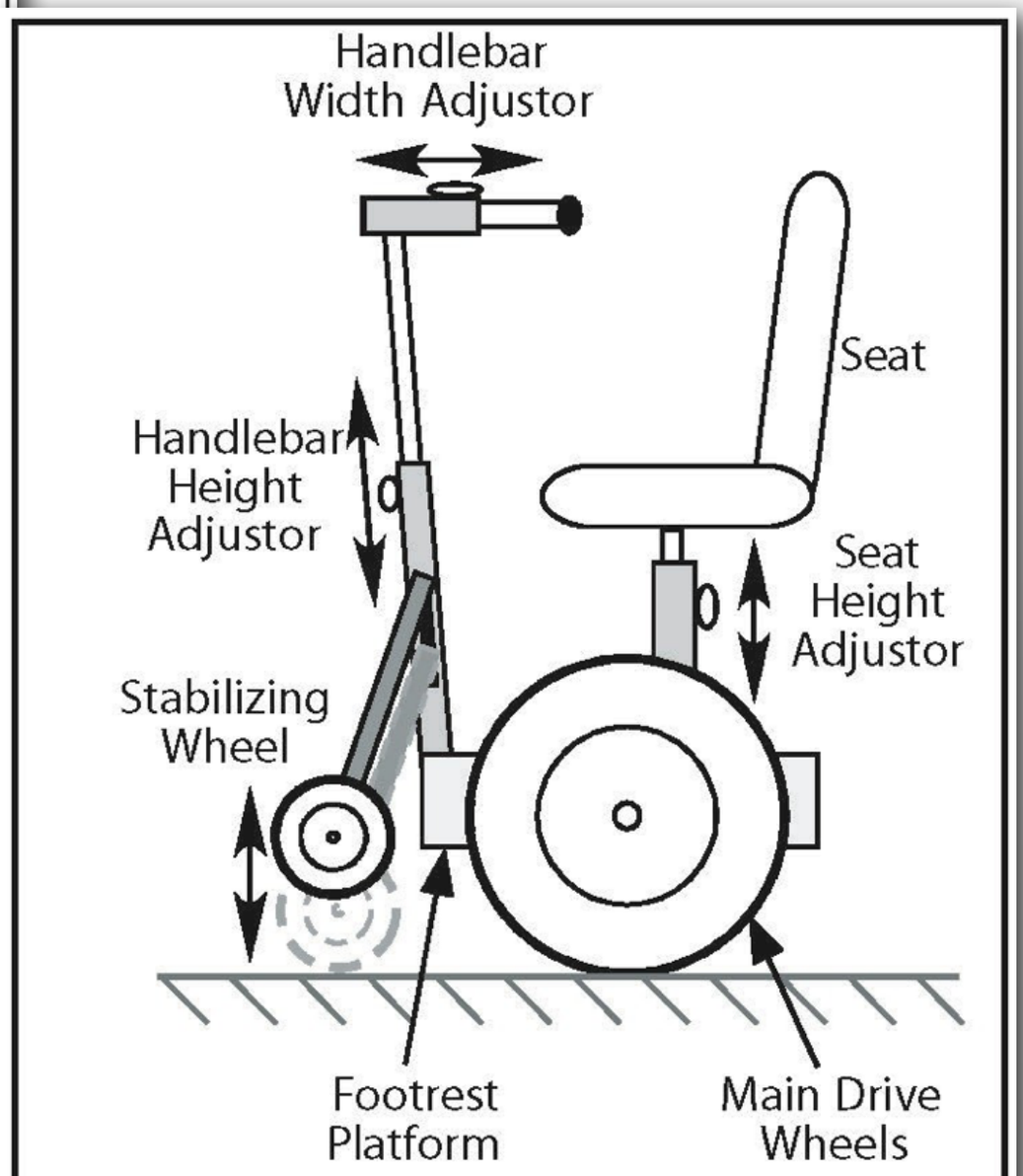

Figure 2: Human Transporter with Auxiliary Stabilizing Wheel.

From: William Singhose & Jeffrey Donnell. "Introductory Mechanical Design Tools."

# Writing Tools

- Template is provided on the course site
  - Example pdf
  - `overleaf.com` template
    - ✦Collaborative LaTeX document generation
    - ✦Has WYSIWYG mode
- Word, Google Docs, *etc.* all also work
- Pre-submission checklist also on the website