Your Audience

• At the very beginning… think about your likely audience.

• The level of motivation, and background required for a presentation depends greatly on the background of the intended audience.

• For this class – assume your audience has a similar technical background but has never seen the particular lab experiment that you are conducting.
Your Purpose

- Why am I presenting this work? What do I want the audience to get out of this presentation or paper?

- It's a good idea to formulate one or two simple "take-home messages" that you will try to impart to your audience.

Structure

- The structure of your presentation - either written or oral - is often dictated by others.

- With respect to oral presentations, you will often find yourself up against a strict time limit. In such a case it is important to rehearse your talk with a stop-watch in hand. Be sure that you can get your take-home message across without hurrying.
Word Selection

• Word choice is important. Project yourself as someone who has something important to say.
• Within the confines of your own personality you must strive to keep your words at an appropriate level for your audience.
• Do not use fancy or stilted language. At the same time, however, do not restrict yourself to simple and mundane modes of presentation.
• Choose your words such that they represent the most effective mode of communication for the intended audience.

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• To facilitate optimum results in technical writing, endeavor to utilize uncomplicated phraseology.

Hmmmm....

• To help you get the best results in technical writing, try to use simple language.

or...

• Use simple language to get the best results in technical writing.

Prof. Sailor
Phrases

Don't include a lot of unnecessary words! Keep things simple and short so that your readers can understand them easily. In the following list, replace the wordy phrase with the simple word or phrase that follows.

- with regard to ➔ about
- by means of ➔ by
- in the event that ➔ if
- until such time ➔ until
- subsequent to ➔ after
- an adequate number of ➔ enough
- an excessive number of ➔ too many

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http://lbpe.wikispaces.com/tech.writing

Style

- There are several schools of thought on technical communication.
- Third-person past tense is generally accepted as the most formal grammatical style for technical reports. More recently, however, it is common to see 1st person.
- In the case of this class, I am willing to accept either first or third person documents. Just be consistent in your writing.
- When you start working for a company you should try to determine the accepted format for internal reports.
- If you are writing for journal publication consult both the “Guide for Authors” and past issues.

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More on Style

- Use of appropriate tense is often an area of confusion for students.

- There can (and should) be some mixing of past and present tense within a report.

- It is generally not a good idea to mix tense within a single paragraph or sentence.

Mixing Tenses

- The introduction section will focus on established theories and research that has been conducted in the PAST. This section is written mostly in the past tense. Near the end of the introduction you may decide to motivate the need for your research (and future research) and slip into present or future tense. Also, if you discuss an established fact it should be stated in present tense. For example consider the following statement:
1. “Smith (1989) conducted a similar drag force experiment using glycerin as the working fluid. He found that the velocity of an object falling through a gravitational field increased until there was a balance between the drag force and the gravitational force. When this balance point was reached the object continued to fall at a speed known as the terminal velocity.”

OR…

2. “Smith (1989) conducted a similar drag force experiment using glycerin as the working fluid. He found that the velocity of an object falling through a gravitational field will increase until there is a balance between the drag force and the gravitational force. When this balance point is reached the object will continue to fall at a speed known as the terminal velocity.”

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Mixing Tenses

- The methods and results sections, on the other hand, will be almost completely in the past tense. This is work that you have completed. Exceptions include sentences where you simply give a "present tense" fact such as, "These results are shown in Figure 3," ... or in an active present tense voice ... "Figure 3 shows the results from...".

- The methods/procedures section of your reports should not be written as a step-by-step list of tasks. Rather, it should summarize the methods within the context of a paragraph of complete sentences.

- Your discussion and conclusions will start with a presentation of your findings (past tense) and may conclude with current observations (present tense) as well as a discussion of probable future work (future tense).

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### Common Report Formats

- There are a number of accepted formats for any type of document that you write.
- The commonly accepted standard for engineering reports is IMRaD - Introduction - Methods - Results - and Discussion.
- Your reports do not necessarily need to follow this format strictly, but should use this as a guideline, and contain all of the information discussed in the following slides.

### Contents of a Lab Report for ME411

- **Title page**
  - Title – the name of the experiment or a slight variation that is representative of the content of the report
  - names of all team members (with affiliation – ME 411, PSU)
  - If discrete roles were assigned to each team member, indicate that in parentheses after the names
  - date
- **Report (see following slides)**
  - Sections contain: introduction, objectives, theory, methods, apparatus, results, and conclusions
- **Bibliography (references)**
  - List all references in a standard format.
  - All references should be referred to at the appropriate location in the report using a (name, year) format.
- **Appendices**
  - Detailed derivations and calculations
  - Error/uncertainty analysis
  - Original data
Format Example 1

• The following outline is good (although a little simplistic)
  – 1.0 Introduction
  – 2.0 Methods and Apparatus
  – 3.0 Results
  – 4.0 Discussion and Conclusions

Format Example 2

– 1.0 Introduction
– 2.0 Theory
– 3.0 Methods and Apparatus
  • 3.1 Description of Models Tested
  • 3.2 Wind Tunnel Apparatus
  • 3.3 Calculation Procedure for Drag Coefficients
– 4.0 Results
  • 4.1 Data analysis procedures
  • 4.2 Drag Coefficients for the Hummer
  • 4.3 Drag Coefficients for the New Beetle
– 5.0 Discussion and Conclusions
  • 5.1 Comparison of aerodynamics of the vehicles tested
  • 5.2 Implications for fuel economy
  • 5.3 Implications for top speed
**Titles**

- The report title is more important than most people think.
- If you are interested in researching a particular topic, you will learn to appreciate authors who take care in crafting the title of their reports and articles.
- Your task in choosing a title is to use as few words as possible to clearly describe the content of the report.
- Very few good titles can be expressed in fewer than 5 to 8 words. You should, however, seek to keep the total number of words in your title to a relatively small number - say less than 20.
- It is also a good idea to read through your title and think about how it might be interpreted. More often than not titles are too broad, suggesting the authors did a more comprehensive study than they actually did.

**Abstracts and Executive Summaries**

*not needed for short reports*

- The title is the first level at which a potential reader can filter out reports that he is or is not interested in reading. The abstract is the second level.
- The abstract is generally limited to 250 words (or so). It must be a self-contained description of the experiment.
- Generally, the abstract will discuss the reason for and methods behind the study.
- It will also include a short summary of the most important results and conclusions of the paper.
Introduction and Background

- Provide your reader with background information on the topic of your paper.
- This section helps to get the reader "up to speed" if necessary.
- Readers who are very familiar with the general subject matter may often skip this section.
- If your study builds upon work of others or requires the use of accepted formulae, this information should be provided in the introductory section of your paper.
- Theory may be introduced here, in a separate theory section, or in the methods section, depending upon your writing style.

Methods

- The methods section is used to discuss the specific approach (methods) used in your study.
- Discussion of an experimental apparatus is often included in this section in which case the section heading becomes something like "Methods and Apparatus".
- If the apparatus is sufficiently complex, a separate section is devoted to the apparatus.
- Also, there may be several distinctly different approaches used in your paper. In this case, you might have section headings such as "Experimental Methods" and "Computational Methods".
Apparatus and Procedures

• While the discussion of the apparatus and procedure are sometimes lumped together, this is not a necessity.
• Rule of thumb for level of detail: provide sufficient details so that a competent researcher could reproduce the significant aspects of your results.
• You'll often hear this referred to simply as "reproducibility".
• Produce and include one or more original schematics or diagrams of the apparatus.
• If you use images from others you MUST give them credit.

Results

• Take time to investigate trends with your results and to look at many ways of presenting your results
• Often, a simple plot of Y vs. X will miss the important features of your experimental results.
• However you choose to present the data, limit yourself to presenting the results in the "Results" section, and reserve comment and insight for the Discussion section.
• If you have few data to present then it may be appropriate to combine the Results, Discussion, and Conclusions sections.
• Likewise, if you have a great deal of data, you may choose to create subheadings.

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Discussion and Conclusions

• If you simply present your results without providing any insight you are missing out on an important feature of technical report writing.
• You must interpret the results. How do the results compare with expectations (past research, literature, common sense...)?
• Also, are there any limitations in your apparatus or methods?
• What are the implications of your findings?

References

• Okay to quote or extract information from other sources … as long as you give proper credit
• Citation within text: (author, year)
  – “… This phenomenon was first noted by Smith (1988) who found…”
  – “… most such facilities operate at efficiencies of 80% or lower (Smith, 1988).”
• Reference list at end of document
  – Must have complete citation … for example:
  – avoid web references where possible – best to use permanent documents (peer-reviewed literature and text books)
Figures and Tables

- Figures and tables are the heart of your report. Don’t sell the data short.
- Be sure your figures are carefully crafted and convey the right information.
- All figures must have figure captions.
- Provide axis labels.
- Use a descriptive figure caption or table heading.

Which city’s residents use a lower thermostat setting?
Cumulative Distribution of Thermostat Temperatures

- 1. Do the experiment
- 2. Plot the raw data
- 3. Investigate trends and explore various data presentation possibilities.
- 4. Write an appropriate outline
- 5. Write the paper fairly quickly
- 6. Let the paper sit for at least ONE DAY!
- 7. Read the paper again with a critical eye. Edit as necessary.
- 8. Skim through the paper looking ONLY at the figures and tables. Do they tell the story?
- 9. Ask someone else to review your paper.
- 10. Do a final spell check (just before you print).
Technical Writing – common issues

• Title pages
  – Descriptive titles
  – Names, affiliations, who did what, dates (for individual reports make YOUR name stand out)
• Numbering
  – Pages, figures, tables, equations
• Introduction
  – Provide some context – when/why are strain gages used?
  – Overview of theory for gages – strain → resistance change → circuit
  – Overview of theory for beams
• Apparatus
  – Figure can include picture, but defining dimensions is rather important especially for the beam expt.
  – Pictures of every little item (e.g., weights, strain gage mounting supplies) not needed

Technical Writing – common issues

• Procedure section
  – Not a list of tasks to be done
  – Use past tense (what DID you do?)
• Figures
  – Figure #s with descriptive captions
  – Key figures in body of report not in appendix
  – Axis labels with units
  – Referenced in text: look for interesting behavior!
  – Measured vs. theoretical → 2 sets of data (strain vs. load) or 1 set (strain_m vs strain_t)
  – Font sizes in figures should be similar to those in text. If smaller, must be readable!
Technical Writing – common issues

• Equations
  – Number at right side – e.g., (1)
  – Eqn editor, Mathcad, Matlab…
  – Font size similarity
  – Within body of paper do not include long-hand expansions of equations (including data values in intermediate steps)

Original:
“Our first process with the results we obtained was to organize the data and calculate the actual head that the pump produced at each flow rate and motor speed. The head was calculated by determining the difference between the inlet and the outlet pressure.”

Revised:
“The pressure head produced by the pump at each flow rate and motor speed was calculated.”
Original:
“The head coefficient vs. flow coefficient plot in Figure 9 shows that all three pumps converge on a single line.”

Revised:
“As shown in Figure 9, the results for the three pump speeds converge when plotted in non-dimensional form (head coefficient vs. flow coefficient). In fact, the data are consistently within 5% of the corresponding best fit line through the consolidated data set.”

Original:
“The graph indicates a large discrepancy between the calculated and theoretical values.”

Revised:
“Figure 3 indicates an average discrepancy of 16.5% between the calculated and theoretical values. This discrepancy, however, is within the estimated measurement uncertainty of +/- 20% (see appendix).”
Original:
“Once we determined the power output and input of the motor, calculating the efficiency was easy.”

Revised:
“The efficiency of the pneumatic motor was calculated as the ratio of power output (eqn. 1) to power input (eqn. 2).”

Original:
“From these equations and data collected during the experiment tables and graphs were created to relate the motor speed (RPM) to the horsepower at that corresponding speed.”

Revised:
“Equation (2) was used to relate motor speed to horsepower for the 30 and 40 PSIG data sets. These results demonstrate the existence of a peak in the relationship between horsepower and motor speed (see Figure 4). For the 30 PSIG case this peak is 0.25 HP at 2000 RPM. For the 40 PSIG case the peak is 0.34 HP at 2400 RPM.”
Original:
“Wearing ear protection, the fan was turned on and set to the proper flow rate.”

Revised:
“The wind tunnel fan was turned on, and the maximum possible flow rate was achieved by setting the flow-restriction device in the “full open” position.”

ME 411/511 Final Project Options

– Outline goals for final projects
– Suggest project ideas
– You should leave here today with some sense of what you might do for a final project and should confirm the idea when we revisit the issue next week…”
Requirements

- Define your own hypothesis or research question
- Design an experiment to test hypothesis or answer research question
- Conduct experiment
- Analyze results
- Write report (10 pages for final project)

Prof. Sailor

- You do not need to use LabView
- You can create new lab groups.
  - design and conduct experiments in groups from 2 – 4. We’d prefer group sizes of 3. Be advised that expectations and grading are influenced by group size.
  - conduct, analyze, and write the final report in GROUPS
- Final reports can be up to 10 pages and should generally follow the same format as reports for Experiments 1 & 2.
- Final reports are 30% of your grade
ME 411 - FINAL PROJECTS

• Available equipment/supplies
  – Data Acquisition setup – DAQ cards, amplifiers, protoboards, Labview
  – Individual experiment facilities available in the lab – air motor, water pump, heat exchanger, compressor/tank.
  – Heaters (hot plates, silicone rubber heaters)
  – Scales
  – Lab air supply
  – Thermocouples, and heat flux sensors
  – Datalogging temperature/humidity sensors (~10)
  – Datalogging power meter
  – Handheld temperature/humidity sensors (~1-4?)
  – Light sensors (~4)
  – Strain gages (various sizes & rosettes), strain indicators
  – Compression load cells
  – Accelerometer
  – Other ??? $$$??

• Resources from faculty labs… your work facilities…

Some ideas…

• Measurements to support your capstone project
• Measurements related to a project at work
• Test a theory or correlation from your coursework
• Measure material properties (thermal or mechanical)
• Projects from faculty
• Variation/extension on thermocouple or beam expts.
• Other large experiments available within EB 360 lab
Mechanical Engineering Laboratory

Pressure Tank Stresses and/or tank draining measurements

PRESSURE TANK TEST APPARATUS
STRAIN GAGE SWITCH & BALANCE

Strain Gage Selector Balance Potentiometers

STRAIN INDICATOR

Strain Readout
Datalogging Strain Indicators

- We have two new 4-channel data logging strain indicators from Vishay (P3 units) that can be used in experiments.

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PUMP PERFORMANCE and FAN LAWS
PUMP PERFORMANCE APPARATUS

Flow Control Valve

Storage Tank

PUMP CONTROLS

Flow Rate Readout

Speed Control
Mechanical Engineering Laboratory

HEAT EXCHANGER PERFORMANCE
WATER FLOW RATE METER

MANOMETER
Mechanical Engineering Laboratory

Solar Thermal Panel Performance Study
Mechanical Engineering Laboratory

SAE Formula Race Car Expts.
Impact attenuators

Prof. Sailer

http://www.youtube.com/user/PSUVMS
Mechanical Engineering Laboratory

AIR MOTOR PERFORMANCE

Prof. Sailor

AIR MOTOR APPARATUS

Measure speed using non-contact tachometer pointed at reflective tape on coupling.

Prof. Sailor
ROTAMETER

Read Rotameter
Bob at this Edge

Prony Brake

\[ T = F \cdot L \]
HW #6 – due Monday Feb. 22, 2010

* each final project team turns in ONE assignment

* the assignment should be one page and contain the following:
  - brief descriptive title of project
  - names of all group members and 1 contact email
  - brief statement of hypothesis or research question(s)
  - overview of experiment design and apparatus
  - sketch of apparatus (if applicable)
  - list of required materials/sensors indicating what subset of these materials (if any) you need ME to help you obtain

* it would be good for you to have a draft of this ready for in-class discussion on Wednesday Feb 17.

Prof. Sailor