

**Systems Problems #1 and #2**

Issued: Wednesday 3 September, 2003

Due: *See page 5*

**ENGINEERING COMMUNICATIONS**

**Objectives**

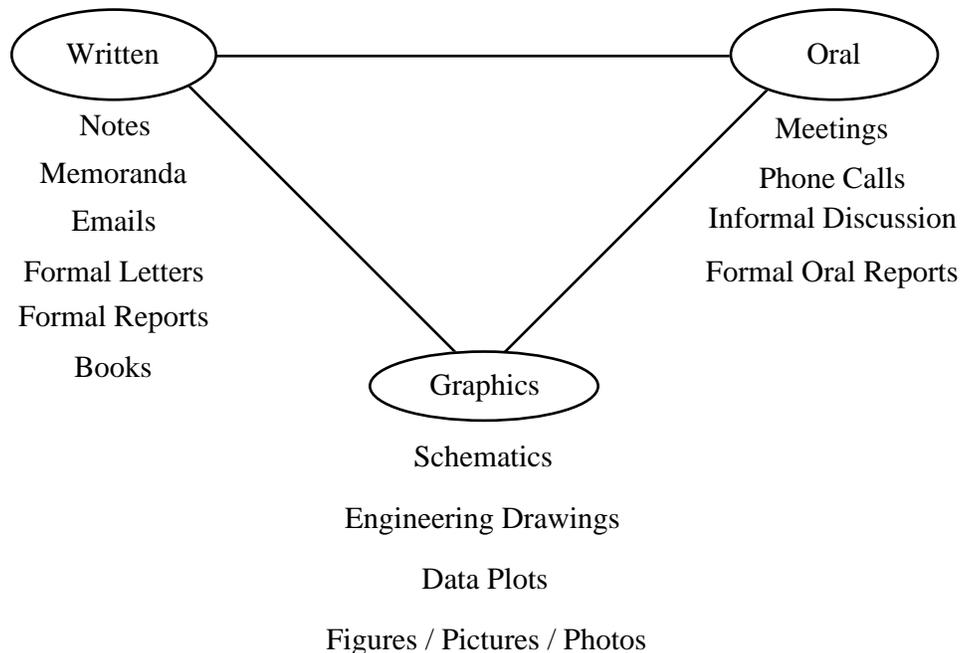
By the end of Systems Problem #2, you will be able to:

- Make and interpret engineering drawings of a simple object.
- Write a professional letter or memo to communicate technical information to a colleague.
- Discuss technical communication, its role in engineering, and potential communications pitfalls in the Conceive-Design-Implement-Operate (CDIO) process.

**Discussion**

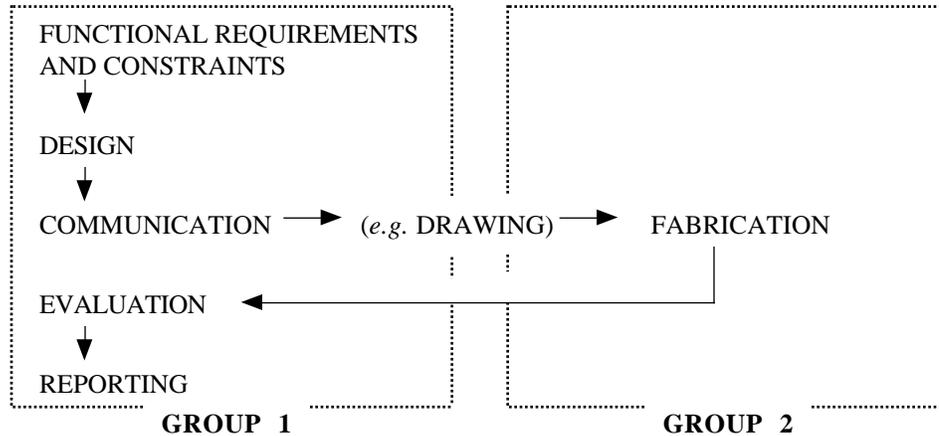
Communication is essential to engineering. Without proper communication, your ideas and expertise cannot be conveyed to others efficiently, leading to errors that may increase costs, delays, and even lead to loss of life.

**Example Forms of Communication**



In systems problems 1 and 2, we will focus on communicating a design concept for a glider (that you will design) using formal letters and engineering drawings. Rather than performing drawing as an isolated task, we will imbed it within the context of design and manufacture to more clearly highlight the importance of good communication in engineering.

Below is a simplified schematic of a design process involving two groups. One group designs and tests an object, the second group builds the object. For the engineering process to succeed, it is necessary that the two groups can communicate effectively. Group 1 obviously needs to transmit a clear, unambiguous drawing of the components of the object and the manufacturing process that should be used. Group 2 must communicate the outcome of the fabrication process (including any problems or failures along the way) so that Group 1 is able to properly report on the success of the project as well as to potentially redesign any faulty parts.



This is the basic model you will follow for this assignment. You will each get to play the role of designer *and* fabricator.

This systems problem covers the following aspects of engineering:

- *Conception/Design* -- You will design a glider, make detailed drawings, write construction plans, and write a memo. This must be completed by **1PM Thursday September 11, 2003**.
- *Implementation* -- You will exchange drawings and fabrication instructions for the airplane with one of your classmates. You *give* your drawings to the person in class just *below* your name on the alphabetical list of Unified students. You *get* a set of drawings from the person in class just *above* your name on the alphabetical list. You must build the plane and write a memo to the designer evaluating the construction plans and drawings. Fabrication and its associated memo must be completed by **1PM Thursday September 18, 2003**.
- *Operation* -- You will fly the airplane you designed in the Johnson Athletic Center. The glider with the longest flight time will earn the designer and fabricator a lovely prize. You will prepare a written evaluation that focuses on whether or not the airplane meets the manufacturing tolerances you specified in the construction plans. The flight event will be held from **1-2PM Thursday September 18, 2003** in the Johnson Athletic Center (2nd floor).

## 1. Functional Requirements and Constraints

We realize that you have not yet learned about aerodynamics, stability and control, propulsion, structures, *etc.*, (you will!). So the functional requirements are watered-down a little bit:

- Design a hand-launched glider that *looks like it will fly*. You will of course get the chance to test your design to see if it really does fly, but *your grade will not depend on how well your airplane flies*.
- The airplane must be constructed from balsa wood and glue (no more). All the stock materials will be available from the TAs so that you can see and feel the materials. Following is a list of stock materials and tools from which you may draw:

Balsa wood:

One (1) of the following:

1/16" x 3" x 36"

3/32" x 3" x 36"

1/8" x 3" x 36"

"Unlimited" quantities:

1/16" x 1/16" x 36"

3/32" x 3/32" x 36"

1/8" x 1/8" x 36"

Cyanoacrylate glue (medium viscosity)

Elmer's glue

Razor blades (for cutting balsa)

Pins (for holding parts together while the glue dries)

Rulers and straight-edges

- The complete assembled glider must fit within a box that is 16" x 16" x 6".
- **IMPORTANT:** The design must be simple enough that it can be *constructed in less than 90 minutes* by an untrained Unified student (fabrication time is expensive).

## 2. Construction Plans and Transmittal Letter

You will provide the fabricator with at least:

- a) a cover letter with appropriate salutations, your name, address, phone number, *etc.*
- b) a parts list
- c) a three-view drawing of the assembled glider
- d) fabrication instructions
- e) any additional single part drawings or details that are required

Neat hand drawings are acceptable and encouraged. The drawings must be properly dimensioned and include any important tolerances.

*Your construction plans and transmittal letter are due to your fabricator on Thursday September 11, 2003 at 1:00PM in the System Problem lecture.*

## 3. Fabrication

- Carefully read the bill of materials in the fabrication instructions. You may then obtain the required materials from the TAs.
- Build the airplane, and note the amount of time it required.

- Write an evaluation letter to the designer that includes
  - a) appropriate salutations, addresses, *etc.*
  - b) a brief discussion of the clarity of the construction plans, aspects that were easy to follow, aspects that were unclear
  - c) an estimate of the amount of time it took you to fabricate the glider
- Return the glider and the letter to the designer at 1PM Thursday September 18, 2003 at the Johnson Athletic Center – **don't be late!**.
- Please return unused construction materials to the TAs when you are finished.

#### **4. Evaluation**

There will be three phases to the evaluation.

- First, the designer will perform a small flight test. You will have ten minutes to try out your glider and you will be allowed to trim the airplane using clay and/or masking tape.
- Second, you will engage in a competition to determine the glider with the longest duration of flight. There will be no grade for this part of the effort, but we will give a lovely prize to both the designer and fabricator who produce the airplane with the longest time aloft (not counting those gliders that get stuck in the rafters). The airplanes will be hand launched. The time aloft is measured from the time the plane leaves your hand to the time the aircraft first touches the ground. You should account for the fact that the plane must fly within the confines of a gymnasium.
- Finally, the designer will measure the airplane to determine whether or not it meets the dimensional tolerances prescribed in the construction plans. This can be done after class.

#### **5. Final Report Letter**

Write a one or two page letter to Professor Coleman that includes:

- Your evaluation of the glider that was fabricated for you.
- A brief description of how you might change the plans to make them clearer if necessary.
- An evaluation of the flying qualities of your glider.
- A brief description of how you might change your design to make it fly better.
- An estimate of the amount of time you spent on each phase of SP1 and SP2.

This letter is due 5PM Friday September 19, 2003.

## Summary of Deliverables and Schedule

There are four deliverables in Systems Problems #1 and #2:

1. Construction plans (75% of the grade in SP1)
2. Formal transmittal letter to the fabricator, with instructions (25% of the grade in SP1)
3. Formal evaluation letter from the fabricator to the designer (25% of the grade in SP2)
4. The final report letter (75% of the grade in SP2)

Failure to fabricate a glider for your associated designer by 1PM September 18, 2003 will forfeit your entire SP2 grade.

- 1300 Thursday Sept. 4:            Systems Problems 1 and 2 handed out
- 1300 Thursday Sept. 11:        Construction plans and the transmittal letter are due at the end of Unified lecture. **Two copies are required** — one for the graders, and one is given directly to the fabricator. Fabricators may pick up construction materials from the TAs.
- 1300 Thursday Sept. 18:        The fabricator's evaluation letter and the completed glider are due in the Johnson Athletic Center (2nd floor). We will have the test flights and fly-off during lecture SP3. **Two copies of the letter are required** — one for the graders, and one is given directly to the designer.
- 1700 Friday Sept. 19:            The designer's final report letter is due in the TA office. **Two copies are required** — one for the graders, and one will be forwarded to the fabricator by the TAs.

Original: JKKuchar Fall 2000  
Modified: CPColeman/PWYoung Fall 2001  
CPColeman Fall 2 003

## Appendix A

### *Example Formal Letter Format*

(Note: this is only one possible format; other formats are widely acceptable, though the basic components should be generally similar to those shown here)

{ Your address – this typically  
does *not* include your name }  
<Name>  
<Address>  
<Phone No.>  
<E-Mail Address>

August 17, 2000

{Recipient's Name & Address}  
Ms. N. Gineer  
Director, Widget Systems Division  
U-Buildem Co., Inc., Ltd.  
456 Widget St.  
Podunk, NV 88888

Dear Ms. Gineer:

Thank you for mailing the grinding blueprints for the X-1000 Blue Widget, which we received yesterday morning. Our staff has begun retooling our Smootho grinding machine to provide the finish that is required, and we expect to be ready to receive your Widgets for machining by September 9, 2000.

Please, however, clarify in writing whether we will be receiving 10 Widgets for grinding (as we expected based on our telephone conference of August 10, 2000), or 10,000 Widgets as indicated on the engineering drawing.

Sincerely,

A handwritten signature in black ink, appearing to read 'J Schmo', with a stylized, cursive script.

Joseph Z. Schmo

## Appendix B

*Example Memorandum (typically used for brief communications inside an organization)*  
(Note: this is only one possible format; other formats are widely acceptable, though the basic components should be generally similar to those shown here)

<Name>  
<Address>  
<Phone No.>

### MEMORANDUM

To: A. Grinder  
From: Joseph Z. Schmo   
cc: L. Brackett  
T. Fitting  
Date: August 24, 2000  
Re: X-1000 Blue Widget Grinding Order #PF637

Please be advised that we expect to receive a total count of 10 of the X-1000 Blue Widgets on September 9 for Smootho grinding at our facility. This quantity corrects an error on the original grinding blueprint from U-Buildem Co. — please make the appropriate modification to the blueprint, and notify me and Leo Brackett should there be a slip in the schedule as a result.

{Note: the “cc:” recipient list (cc = “carbon copy”, sometimes abbreviated “xc” for Xerox copy) shows secondary recipients who may be interested in this memo, but are not the primary audience. The sender of the memo generally writes their initials next to their name near the top, rather than a full signature, and no signature is used at the end of the memo. A salutation (“Dear So-and-so”) is generally not used in memos.

You can see that email derives from memo formats, though for good form in business a salutation *should* be included at the beginning of the message (e.g., “Dear Mr. Schmo,” or even just “Mr. Schmo,” – not “Hi there”), and you should include your name (and address) at the close of the email. }

## Appendix C Rules of Thumb for Glider Design

The following are some general suggestions for the layout of your glider, based on engineering practices used in aircraft design. Do not feel compelled to follow them — unusual, nonconventional designs are welcome.

1. The tail length (distance between the center of pressure of the wing and the center of pressure of the horizontal tail) should be 60-90% of the wingspan. A tail that is too close to the wing will result in a glider that is difficult to trim for stable flight.

2. The horizontal tail volume coefficient  $\frac{(\text{tail area})(\text{tail length})}{(\text{wing area})(\text{average wing chord})}$  should be

between 0.5 to 0.9. If the horizontal tail is too small, the glider will be unstable in pitch.

3. The vertical tail area should be 15-40% of the horizontal tail area for good lateral stability.

4. The wing should have 10-15° of dihedral. Too little dihedral will result in instability in roll; too much will result in spin instability.

5. The wing and the tail should be aligned at the same angle of incidence.

6. The center of gravity of the glider should be near the mid-chord point. You can use clay on the nose to move the center of gravity as needed.

7. The fuselage must be robust enough to handle flight loads as well as occasional impacts.

