FALL 2013

SENIOR ENGINEERING PROJECT HANDBOOK

Easy reference for course questions

Senior Engineering Project

GE 494/495

Senior Engineering Project

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Introduction

The Senior Project Experience

You have an opportunity to be part of one of the most challenging educational experiences at the University of Illinois.

The purpose of this handbook is to provide a consolidated source of information to help you successfully complete your GE 494/495 Senior Engineering Project. This is not a textbook — each project is different, depending on the real problem your Industry Partner wants you to solve—but it does provide guidelines and requirements that are common to all projects.

Topics of this handbook are generally organized chronologically to follow the schedule of a typical project. Early topics include procedures for travel arrangements, communications, purchasing and reimbursements. These will be necessary for arranging the initial visit to the Industry Partner and beginning work on your project. This is followed by guidelines for your first Oral Presentation or Subgroup Meeting during week 5, which is your first major deadline. This ordering of topics continues through meetings and presentations, preparation of reports, and finally, grading and exit procedures.

See the Course Calendar (Ch. 1) for a complete list of course events and deadlines for this semester. This is followed by a detailed Course Schedule which gives more information about the items found on the calendar. Good luck- and if you have any questions that are not answered in this handbook- please email us or come to the Senior Engineering Project course office in 117 Transportation Building.

Harry S. Wildblood,
Senior Engineering Project Course Coordinator

Students with Disabilities

Accessibility Statement

To insure that disability-related concerns are properly addressed from the beginning, students with disabilities who require reasonable accommodations to participate in this class are asked to see the Senior Engineering Project Coordinator as soon as possible.

Chapter

1

Senior Engineering Project Course Calendar and Schedule

The next page shows the one-page Calendar for Fall 2013 GE 494. This is followed by the detailed Schedule.

The Calendar shows the scheduled events for the entire semester in a continuous calendar format, showing the entire 17 weeks of the course. Note that required meetings, subgroup meetings, course deliverables, due dates, feedback dates for the project grading committees, etc. are listed in the Calendar.

The detailed Schedule, which follows the Calendar, gives additional detailed information about the events in the course, including guidelines and requirements.

Review the Calendar and Schedule carefully **each week** to know your responsibilities and to make sure to meet the required deadlines. If a deadline cannot be met for any reason, you must notify the staff in 117 TB and get approval from your Project Grading Committee (PGC).

Senior Design Course Calendar – Fall 2013

Sun	Mon	Tue	Wed	Thur	Fri	Sat
Aug 25 -1-	Aug 26 **Instruction Begins for UIUC**	Aug 27 **Instruction Begins Senior Design** ***9:00 am** **(101TB)**	Aug 28	Aug 29 9:00 – 10:30am Project Assign. ***** 5:00 pm Lect. #1 (101 TB)	Aug 30 Turn in Combined Schedules to 117 TB	Aug 31
Sept 1 -2-	Sept 2 **(All Campus Holiday-Labor Day)**	*Sept 3* **---------- Groups & Advisors travel to Companies ----------**	*Sept 4*	*Sept 5*	*Sept 6*	*Sept 7*
Sept 8 -3-	*Sept 9*	*Sept 10* *10:00 am Lect. #2 (101TB)	*Sept 11* Company Contact Info Due to 117 TB	*Sept 12* Advisor/team meeting or Company visit	*Sept 13* **Company Feedback**	*Sept 14*
Sept 15 -4-	*Sept 16*	*Sept 17* ***10:00 am Lect. #3 (101 TB)	*Sept 18*	Sept 19 Advisor/team Meeting	*Sept 20*	*Sept 21*
Sept 22 -5-	*Sept 23*	*Sept 24* ***10:00 am Lect. #4 (101 TB)	*Sept 25*	*Sept 26* **9:00 am Subgroup Mtg #1**	*Sept 27* **Pre-Report & P.S. to 117 TB**	*Sept 28*
Sept 29 -6-	*Sept 30*	*Oct 1* PGC Pre-Report Feedback	*Oct 2*	*Oct 3* Advisor/team meeting	Oct 4 **Company Feedback**	*Oct 5*
Oct 6 -7-	Oct 7	Oct 8 ***10:00 am Lect. #5 (101TB)	Oct 9	Oct 10 **Midterm Draft to Advisor**	Oct 11	Oct 12
Oct 13 -8-	Oct 14	Oct 15 Midterm Advisor Feedback	Oct 16	Oct 17 **3 Copies of Midterm Report to 117 TB**	Oct 18	Oct 19
Oct 20 -9-	Oct 21	Oct 22 PGC Feedback	Oct 23	Oct 24 **2 Copies, Revised Midterm - 117 TB**	Oct 25 **Company Feedback**	Oct 26
Oct 27 -10-	Oct 28	Oct 29 ***10:00 am Lect. #6 (101 TB)	Oct 30	Oct. 31 **Subgroup Mtg #2**	Nov 1	Nov 2
Nov 3 -11-	Nov 4 **---------- All groups give presentations at Industry Partner Company during this week--------**	Nov 5	Nov 6	Nov 7	Nov 8	Nov 9
Nov 10 -12-	Nov 11	Nov 12 ***10:00 am Lect. #7 (101 TB)	Nov 13	Nov 14 **Draft of Final Report to Advisor**	Nov 15	Nov 16
Nov 17 -13-	Nov 18	Nov 19 Advisor Draft Feedback	Nov 20	Nov 21 **3 Copies Final Draft Report to 117 TB**	Nov 22 **Company Feedback**	Nov 23
Nov 24 -14-	Nov 25 **Thanksgiving break**	Nov 26 **Thanksgiving break**	Nov 27 **Thanksgiving break**	Nov 28 (All Campus Holiday)	Nov 29 All Campus Holiday)	Nov 30
Dec 1 -15-	Dec 2 **Instruction resumes for UIUC**	Dec 3 PGC Draft Feedback	Dec 4	Dec 5 Invite Industry Partner to Final Presentation	Dec 6	*Dec 7*
Dec 8 -16-	Dec 9	Dec 10 Advisor/team meeting	Dec 11 **3 copies final report due 117 TB (Instruction Ends)**	Dec 12 **Reading Day**	Dec 13 **PGC Feedback Meeting w/students Final Exams →**	*Dec 14*
Dec 15 -17-	Dec 16 **Final Exams →**	Dec 17 **FINAL ORAL PRESENTATIONS & LUNCHEON W/INDUSTRY PARTNERS (tentative)**	Dec 18	Dec 19 **Colleague EVAL. Form & notebook to Advisor**	Dec 20 **Final Due date to 117; reports, CDs, Lincoln Arc (Refer to Final Report Checklist for Instructions)**	Dec 21

*indicates mandatory meeting.

GE 494 Course Schedule – Fall 2013

Date	Day	Week	Location	Time	Activity
8/27	Tu	1	TB 103	9:00 – 11:00 am	**Mandatory MTG:** Course orientation and project descriptions. **Return preference forms and individual data cards to 117 TB by 12:00 pm.** Individual pictures will be taken. Read the course manual.
8/29	Th	1	TB 103	9:00 – 10:30 am	**Mandatory MTG:** Project assignments. Discussion of Company visit, student/faculty relationship, and getting off to a good start.
			Advisor's Office	10:30 am approx.	Meet your team and faculty Advisor immediately following lecture. **Call Company to arrange visit.** Make travel arrangements in 117 TB.
Evening	Th	1	TB 103	5:00 pm	"Teamwork, Group Dynamics and Project Management," Lecture #1 with Ray Price. (**Mandatory Lecture**) Food served.
8/30	Fri	1	TB117	4:00 pm	Turn in Combined Schedules to 117 TB
9/3	Tu	2	Advisor's Office	Arr.	Advisor/team meeting or Company visit.
9/5	Th	2	Advisor's Office	Arr.	Advisor/team meeting or Company visit.
9/10	Tu	3	TB 103	10:00 am	**Mandatory** Lecture #2 with Harry Wildblood.
	Tu	3	Advisor's Office	Arr.	Advisor/team meeting or Company visit.
9/11	Wed	3	117 TB	12:00 pm	**Company contact information** due to 117 TB.
9/12	Th	3	Advisor's Office	Arr.	Advisor/team meeting or Company visit.
9/17	Tu	4	TB 103	10:00 am	**Mandatory** Lecture #3 with Harry Wildblood.
	Tu	4	Advisor's Office	Arr.	Advisor/team meeting.
9/19	Th	4	Advisor's Office	Arr.	Advisor/team meeting.
9/24	Tu	5	TB 103	10:00 am	**Mandatory** Lecture #4 with Harry Wildblood.
	Tu	5	Advisor's Office	Arr.	Advisor/team meeting.
9/26	Th	5	To Be Assigned	9:00 am-11:50 am	**SUBGROUP MEETING #1** Written meeting brief and project schedule to attendees, PGC, 117 TB. **Send meeting brief and project schedule to Company.**
9/27	Fri	5		12:00 pm	**Submit 3 Copies of Pre-Report and outline to 117 TB** for distribution to PGC. (Abstract, Introduction, Problem Statement, & Objectives). **One copy of Company-signed problem statement is also due to 117 TB (see Section 8.6).**
10/1	Tu	6	Advisor's Office	Arr.	Advisor/team meeting. **PGC Pre-Report Feedback with students.**
10/3	Th	6	Advisor's Office	Arr.	Advisor/team meeting.

Date	Day	Week	Location	Time	Activity
10/8	Tu	7	TB 103	10:00 am	**Mandatory** Lecture #5 with Harry Wildblood.
	Tu	7	Advisor's Office	Arr.	Advisor/team meeting.
10/10	Th	7	Advisor's Office	Arr.	Advisor/team meeting. **Outline and Draft of Midterm written report to Advisor.**
10/15	Tu	8	Advisor's Office	Arr.	Advisor/team meeting. **Midterm Advisor Feedback to students.**
10/17	Th	8	Advisor's Office	Arr	Advisor/team meeting.
				4:00 pm	**Submit 3 copies of midterm report to 117 TB. YOU MUST ALSO SUBMIT THE GRADED PRE-REPORTS AND GRADING SHEETS FROM BOTH OF YOUR GRADING COMMITTEE MEMBERS.** *(Be sure to include grading form from pre-report.)* Submit Midterm Colleague Evaluation Forms (MCEF) to Advisor. *Forms in mailbox*
10/22	Tu	9	Advisor's Office	Arr.	Advisor/team meeting.
	Tu-Wed		PGC's Offices	Arrange	**Midterm PGC Feedback meeting with students. Make required changes in cooperation with PGC.** (Students make apt. w/PGC).
10/24	Th	9	Advisor's Office	Arr.	Advisor/team meeting
			117 TB	4:00 pm	**Turn in two (2) copies of revised midterm report to 117 TB. One copy will be sent to Company.**
10/29	Tu	10	TB 103	10:00 am	**Mandatory** Lecture #6 with Harry Wildblood
10/31	Th	10	To Be Assigned	9:00 am - 11:50 am	**SUBGROUP MEETING #2** Written brief to attendees, PGC and 117 TB. **Send meeting brief to Company**.
11/5	Tu	11	Advisor's Office	Arr.	Advisor/team meeting, if not traveling to Company.
----------All groups give presentations at Industry Partner's during this week.----------					
11/7	Th	11	Advisor's Office	Arr.	Advisor/team meeting, if not traveling to Company.
11/12	Tu	12	TB 103	10:00 am	**Mandatory** Lecture #7 with Harry Wildblood.
	Tu	12	Advisor's Office	Arr.	Advisor/team Meeting.
11/14	Th	12	Advisor's Office	Arr.	Advisor/team meeting. **Outline and Draft of Final Report to Advisor.**
11/19	Tu	13	Advisor's Office	Arr.	**Advisor Feedback on Draft to Students.** Advisor/team meeting
11/21	Th	13	Advisor's Office	Arr.	Advisor/team meeting

Date	Day	Week	Location	Time	Activity
11/23-12/1 ----------THANKSGIVING BREAK----------					
12/3	Tu	14	Advisor's Office	Arr.	**Advisor Feedback on Draft to Students.** Advisor /team meeting
12/5	Th	14	Advisor's Office	Arr.	Advisor/team meeting
			117 TB	4:00pm	**Final Report Draft Due** Submit 3 copies (stapled) to 117 TB. **YOU MUST ALSO SUBMIT THE MIDTERM REPORTS AND GRADING SHEETS FROM BOTH OF YOUR GRADING COMMITTEE MEMBERS.**
12/10	Tu	15	Advisor's Office	Arr.	Advisor/team meeting **Draft (with comments) returned by PGC.**
	Tu-Th	15	Head Grader's Office	*Arrange*	**PGC Feedback Meeting with students.** SAVE draft with PGC comments.
12/11	Wed	15	117 TB	12:00pm	**Final report due for PGC evaluation.** Submit 3 stapled color originals to 117 TB. **YOU MUST ALSO SUBMIT THE FINAL DRAFT REPORTS AND GRADING SHEETS FROM BOTH OF YOUR GRADING COMMITTEE MEMBERS.** Exit questionnaire and Form FRC will be in mailboxes.
			117 TB	12:00pm	Assign team member responsible for final delivery. Obtain his/her signature on Form FRC.
12/12	Th	16			Reading Day
					Prepare for Oral Presentation. Begin to accumulate signatures on Final Report Checklist. **When** signatures are complete, bring signed form, printing disk, and one unbound color copy to 117 TB.
12/13	Fri	16	To be assigned	8:30 am-2:00 pm	**PGC Feedback Meeting with students.**
DO NOT PRINT FINAL COPIES OF YOUR REPORT. Final copies will be electronically submitted.					
12/17	Tu	17	TBA	TBA	**FINAL Oral Presentations and Luncheon for Companies, students, and Advisors.**
12/19	Thu	17	117 TB		**TURN IN** Title Page and Abstract, an intact copy of whole report, and final presentation on CD (in Word format for PC to 117 TB. E-mail copy of abstract and keywords to (bohln@illinois.edu). Make changes to report for Lincoln Arc Welding submission at this time. **Turn in exit questionnaires to 117 TB**.
12/20/	Fri	17	117 TB	**Advisor's Only**	PGC chairman bring GE 494 (team) grades to 117 TB with Form FWR from both graders. Project Advisors bring GE 494 (individual) grades to 117 TB.

Chapter

2

Getting Started in Senior Project – Insights for Success

Beginning GE 494 will be a new experience for virtually all students enrolled in the course. It may be the first time that you are tasked to do a professional-caliber job at solving an engineering problem for a third party, your Industry Partner. Your responsibility to do a good job extends beyond yourself to your project team, your Advisor, the ISE Department, the University, and your Company, who is well aware of the history of GE 494, and the hundreds of outstanding projects and teams that have given ISE a national reputation of excellence. The real goal of Senior Engineering Project is to transform you into an engineer who can do an excellent job, meet deadlines, overcome obstacles, communicate effectively, and produce a high quality project result and report. All you need to do is put in the required effort and follow the guidance given to you by those who are interested in your success. This course will prepare you for the rigors of the real world better than any other course. The following is designed to help you get started on your path to success in GE 494.

Team Calendars

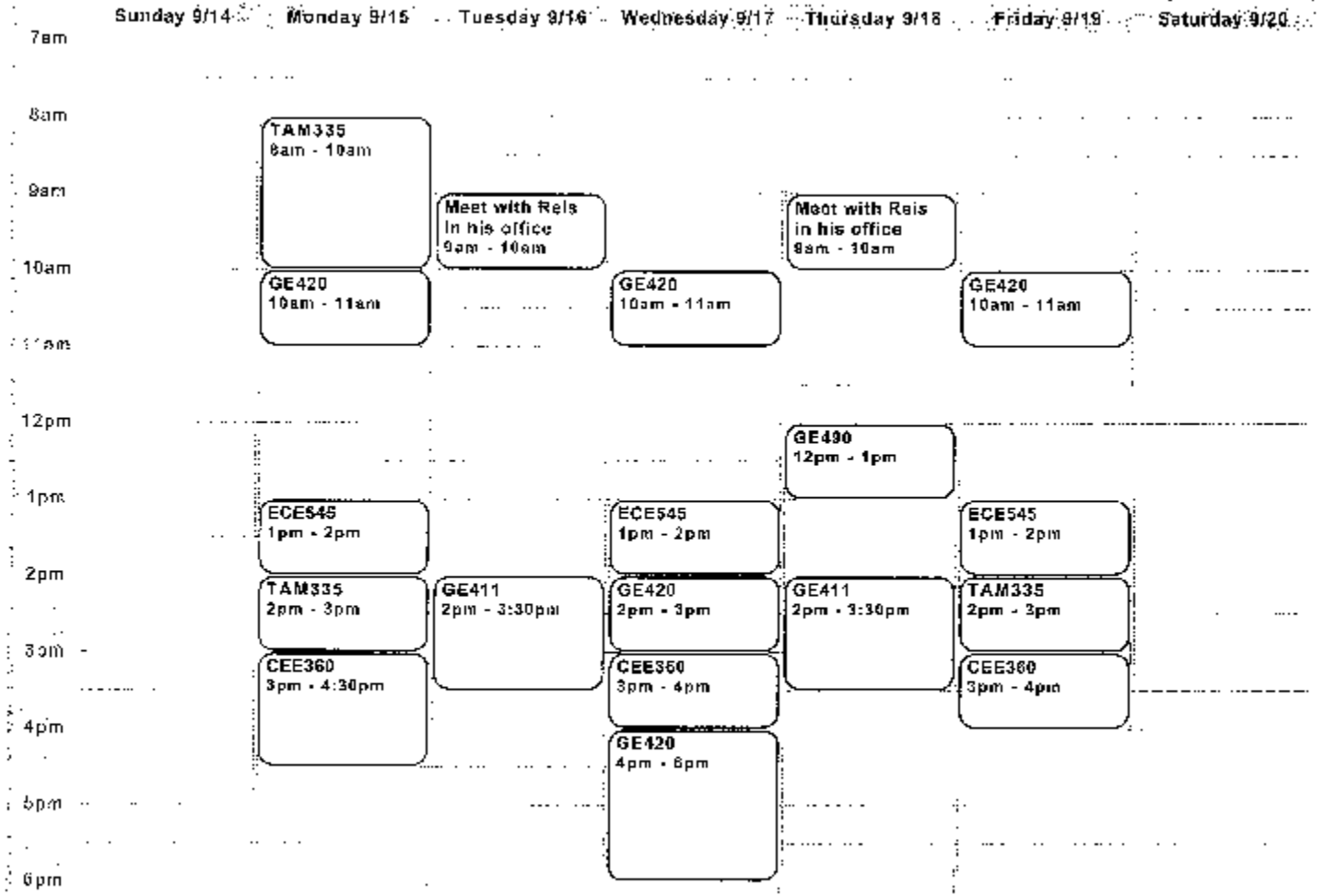
It is required that each team fill out a calendar indicating the union of all class schedules for the student team members. This will aid in determining the twice-weekly Advisor meeting times, and in making appointments for project team purposes. Web tools such as Google, etc. may be used. This combined availability calendar must be made and a copy given to staff in 117 TB.

An example of a team calendar, which was constructed using Google Calendar, is shown on the following page.

Group 1 – American Extrusion International

group1.seniordesign@gmail.com

Sun Sep 14 – Sat Sep 20, 2008 (Central Time)



Jordan VanLoon, Megan McGovern, Jeremy Mink

Meeting with your Advisor

Your Advisor has the responsibility to meet with you to give you guidance, direction, and insight throughout your project. Keep in mind that **you** are responsible for the project and its successful completion. Your Advisor will help you get going in the right direction, and help to re-direct you when necessary. Note carefully that these projects may result in one or more dead ends along the way to success. To get to that final success, just pick yourself up and keep going.

After a meeting or two with your Advisor, **you should prepare an agenda for all of your Advisor meetings** - see sample agenda below. Discuss the work you have done, research, etc., and make decisions as to their value and relevance with respect to your project. Your Advisor will give insights to help you make these decisions. In time, you should be able to make these decisions on your own. In all of your meetings, you should have an action plan for what is to be done for the next meeting and thereafter. NEVER, NEVER, NEVER leave an Advisor meeting without knowing what to do next. **Your path should be clear**. It may include more research, talking with your Company Contact, vendor research, analysis, another plant visit, experimentation, etc.

SAMPLE: Advisor Meeting Agenda – 2/2/06
GE 494, Spring 2006
Project 7 – Elkay Manufacturing - Short Run Draw Tooling
Student Team: Matt Ludmer, Dominic Shafer, Jeremy Volk, Eric Wilson
Meeting Leader: Matt Ludmer

1. Cover New information [15 min]
    a. First plant trip notes
    b. Weekly phone call (Pat: Thursday, 10:30 am)
        i. What do we need to establish/ask?

2. Go over plant pictures [10 min]
    a. Explain the process
    b. Label the die
    c. Demonstrate knowledge of die set on board
    d. Find relevant/useful pictures

3. Progress on Inventor files (Swoop sink) [10 min]
    a. 3D Printing (Room 303A)
    b. Grad. student help hours
    c. Finish date?

4. Material Specification - www.matweb.com [5 min]
    a. Aluminum-Bronze
        i. Ampco 25 (similar)
    b. D2 Tool Steel
    c. Others?

5. Microsoft Project [5 min]
    a. Progressive
    b. Rough Draft
    c. Groups

6. Future [10 min]
    a. Next plant trip
    b. Experts on campus
        i. Materials
        ii. Machining
    c. Prototyping
        i. Small scale
        ii. UIUC

7. Brainstorming/Discussion (20 min)
    a. 4" and 4"
        i. More expensive/single ring material
    b. ???

Members of the student team will lead the meetings with your Advisor. Rotate the responsibility of leading your Advisor meetings amongst all student team members such that each successive meeting is led by a different student team member. Remember, this is your meeting, your agenda, and your responsibility.

Your Advisor has the responsibility to read all of your reports and give you meaningful feedback in a timely manner before submission of your reports to your Project Grading Committee (PGC). However, you must get your reports to your Advisor in time to get that feedback. Dates for submission of all reports to your Advisor and PGC are given in the calendar. Dates are also given as to when you should receive feedback from your Advisor and PGC.

In all of your meetings, be on time, be professional, and be prepared. Have all pertinent project files, papers, drawings, notes, your project notebooks, calculators, etc. at your meetings. Carry a portable file case to your meetings if necessary, and keep your files and materials organized for quick retrieval. Use your time wisely. Make sure that you have taken proper steps and have proper organizational tools to handle the large amounts of documents, files and information that will accumulate during your project.

Trips to your Industry Partner

You will be making several trips to your Company throughout the semester. A plant trip requires valuable time and resources for all involved. Get the most out of your trips in terms of information, understanding, documentation, etc. The first meeting is different from the rest and some guidelines are given on the following page.

The initial contact with your Company will be via phone to schedule the first visit to the Company. Have two or more days selected for the first trip so you can match the schedule of your Company Contacts. It is vital that you make phone contact to schedule this first trip.

1. Call the Admin. Contact at the number listed on your project sheet.
2. If no one answers and you are sent to voicemail, dial zero (0) to talk with the attendant or operator to have this person paged.
3. Call the Tech. Contact at the number listed on your project sheet.
4. If no one answers and you are sent to voicemail, dial zero (0) to talk with the attendant or operator to have this person paged.
5. If no operator is available, call the Company using their main number (you may have to do a web search to find this) and have the Contacts paged.
6. If the Contacts are unavailable, ask for their cell numbers to make contact.
7. If still no success, see if the operator was given the preferred days for the first trip to the Company.
8. Keep trying until you are successful!

For routine phone calls: Find out the time of day your Contact is most likely available. Know your Contact's assistant or co-workers who may know his/her schedule.

IMPORTANT: If you use phone calls to establish or change your project scope of work or any other expectations or deliverables, make sure you summarize the conversation in an email to your Company Industry Partner to get their agreement and confirmation to the changes summarized in your email. (Your problem statement, including scope and deliverables must be finalized, written up by you and signed by the Company Industry Partners, student team members and Advisor and submitted with the pre-report.)

Do not be satisfied to leave your Contact several unacknowledged emails and voice mails and let several days or weeks pass. Contact other Industry Partner personnel and find out about your designated Contact. He/she may be out of town, ill, or otherwise unavailable. It may also be necessary to make a trip to the Industry Partner to get the answers or information you need from your Contact, who may be otherwise occupied with more urgent Company priorities. Note that when you are on-site at the Company Industry Partner, your level of urgency increases dramatically and it is likely that your needs will be met.

Make sure that your communications are brief, direct, and unambiguous. Requests are easier to fill if they are well defined.

The First Plant Trip

1. The attire for the initial trip is business casual. Make sure your shoes are substantial and have flat soles. NO HIGH HEELS! You will most likely be walking though a manufacturing facility which may have irregular flooring.
2. Be prepared by having done research on the Industry Partner, as well as the technologies that will likely be the focus of your project.
3. Have a set of question topics prepared for the first meeting.
4. Have a complete set of maps prepared for getting to your Industry Partner location. It is your responsibility, NOT your Advisor's, to have all directions, details, maps, arrangements, etc.
5. Leave early in the morning for the first meeting to make a full day of it. Plan to arrive at the Industry Partner by 9:00-10:00am. BE ON TIME. Punctuality is an expected courtesy in any business environment. You will likely be ready to leave the Company between 2:00-3:00pm.
6. Let your Company know that lunch should be brought in to the meeting so the meeting can continue to be productive with your limited time.
7. When you tour the plant, stay very close to the person giving the tour.
8. Make sure you can hear and understand what is being spoken. Ask questions to reinforce clarity.
9. Take lots of photos, video, etc. Think of your needs for your presentations and reports. These items will aid explanations to others about your project. Ask your Company about permission to take photos, etc. when you plan your trip. KNOW HOW TO USE THE CAMERA BEFORE YOUR GET TO THE COMPANY. If you lose a camera you will pay replacement cost of approximately $200.00 or more for video cameras.
10. Find out exactly how your project affects the profitability of the Company. Make contacts for cost accounting or other such data that will support your economic analysis.

11. Identify your project Tech. Contact person who must be routinely available at the Industry Partner and who has the authority and means to get you the help you need. This may include data, drawings, production schedules, vendor contacts, setting up meetings, etc.
12. Establish how you will communicate with your Contact and he/she with you. Make sure your emails, phone calls, etc. are acknowledged and that you do the same. Make sure there is no "disconnect" in your line of communication.
13. Determine a time slot of about 30 to 45 minutes for a **weekly conference call** with the student team. This is an excellent method to facilitate and ensure that communication is good and project goals are being properly addressed and completed.
14. Write everything down. This lets your Industry Partner know that you take the project seriously. Do not rely on your "excellent" memory; you will find out about six weeks later that you don't have one.
15. Be courteous and respectful to all you meet, from the CEO to the factory line workers. They are all vital to the Company's operation. They may all have good ideas that could be the very insights you need to solve your problem.
16. After returning from the plant trip to the University, compile a listing of all pertinent information documented by the student team and send this listing to your Company's Tech. Contact. This is done for accuracy and completeness. If there were any errors or wrong impressions during the plant trip, this is the time and the method for correcting them. Simply compile your exhaustive list and email it to your Company. This list should be about two pages long or longer; otherwise it would appear you didn't take enough notes.

After First Plant Trip

Some groups return from the first big plant trip and relax. They take it easy for a week or two and then try to figure out what to do next. This is a big mistake! Immediately after your first plant trip, your head will be swimming with facts, impressions, data, what someone said, etc. This is the time to fall into action and to establish what to do next – BEFORE you have a chance to forget anything. The next two weeks should be spent really getting to know everything about the problem and the technologies involved, and establishing the next logical steps. Here are some things to do:

1. Rewrite the problem statement and the deliverables. Make sure that you completely understand what the Company wants.
2. Make sure you understand how the project is economically motivated and how your solution will affect the bottom line.
3. Perform the initial economic analysis to establish possible savings from your project solution.
4. From your initial economic analysis, determine the maximum budget for your project solution.

5. Do library research into the technology and practices which the Company is using.
6. Review trade journals and engineering handbooks in the reference section of the library.
7. Look through the Encyclopedia of Associations, the Encyclopedia of Periodicals, etc. for pertinent technologies.
8. Establish your list of team objectives for working toward the project goals.
9. Plan your next steps and next trip to the Company.

Later Plant Trips

1. Dress appropriately for the work you will be doing.
2. Be fully prepared for everything you will/may do while at the plant.
3. Know the purpose of the trip and what you are after.
4. Notify your contact about your trip and your needs while you are there. Be specific. Plan your work and work your plan.
5. If you are doing an experiment, plan it out completely ahead of time. Know how you are going to analyze the data. Have data sheets ready for use.
6. Continue to get photos/videos and other documentation for your presentations and reports.

Effective Communications

Effective communication with your Industry Partner is a vital component of project success. Your designated Industry Partner Contacts have keen interest in the success of the project, but they are also very busy. Establish effective means of communications such as email or phone calls on a regular basis. For emails, make sure that your contact replies to your email to acknowledge receipt, whether or not he/she can satisfy your request at that time. Give your Contact the same courtesy of immediate email acknowledgement.

Each project is typically assigned two Company Contacts with whom you will work during the semester. The Administrative Contact is typically in upper management and has the authority to approve the project and cut the red tape for the project to progress. However, the Admin. Contact is usually occupied with management issues, travel, etc. and cannot dedicate time to the project on a routine basis.

Typically, each project also has a Technical Contact who will work with the student team on a routine basis, including the weekly conference call, arranging trips, experiments, etc.

Project Team Meetings

Initially, plan to meet your team members every evening at a scheduled time and place in the Senior Engineering Project rooms **(305-308 TB**). This should be the rule rather than the exception. You will get a good start on your project, and develop the habits you need to get the work done.

Share your research and work with each other. Do not let any one person do all the work or none of the work… this is to be a team effort. Eventually you must divide the work amongst your team members, and develop trust that the work will get done. If problems arise, work them out in a constructive manner. Remember that the team consists of its members. Each team member has different strengths or weaknesses.

Initial Analysis

One of your first project goals will be to do an Initial Analysis of the product, process, system, etc. You will typically review lots of information and go over many details with Company personnel. You must do some research (often lots of research) to decide how the Initial Analysis must be done. This typically involves establishing a set of metrics that measure critical parameters about the process, product, or operation in its current form. These metrics help to guide the analysis and establish the baseline performance of the process, product, operation, etc. In other words, these metrics tell you the current status of the thing you are asked to improve or redesign. Knowing the proper metrics will enable you to quantify your later success by measuring the amount of improvement with respect to that metric.

Appropriate metrics for your project may come in many different forms and may or may not be the typical metrics of choice for your Company. Some examples include:

- Cycle time (seconds per cycle in a thermoforming process)
- Feet of forklift travel (for analyzing the efficiency of a plant layout)
- Air flow (for vacuum side of thermoforming die)
- Percent Scrap (for a typical manufacturing process)
- Average total distribution cost per order (for a distribution system)
- Minutes per average changeover (for a changeover reduction project)
- Cost per minute of changeover (for a changeover reduction project)
- Oscillation dampening time
- Machine utilization (percentage of total production time)

A key metric in all projects is cost. In other words, "FOLLOW THE MONEY." Knowing the cost of the problem at the outset will give you direction in finding a solution, and how elaborate and expensive that solution can be and still satisfy the economic requirements of the Company. As an example, if the current problem is costing the Industry Partner $100,000/year and they require a two-year payback for all their investments, then you can successfully propose a $100,000 solution to reduce the problem by 50%. If, on the other hand, you propose a $100,000 solution that reduces the problem by only 10%, it will not be adopted by the Company. It will also show that you don't understand fundamental business and engineering principles.

The Initial Analysis is used to find out the general targets for the new process, product design, plant layout, etc. It will give direction in your brain storming sessions and become a roadmap to guide the rest of your project.

Your Initial Analysis must include:

1. **The basis of the analysis**. In other words, tell the reader how the process or design is being analyzed in a valid and appropriate way to determine the current status and establish the guidelines for the project.

2. **The metrics used**.

3. **The status of the current** design, process, product, market, etc.

4. **Conclusions of the Initial Analysis**. Tell the reader what your findings are. For a process that is to be improved, tell the reader how the improvement will be measured. For a design project, tell the reader the critical design targets, constraints, costs, and functional requirements that are the key to a successful design.

5. **Initial Economic Analysis and Project Budget**. This Initial Analysis is to determine the potential savings or profit increase that is possible as a result of the project. Establish a budget that would be a reasonable maximum cost or upper bound of the final recommendations to the Company.

   Example: If a scrap problem is costing a Company $100,000/year and the Company requires a two-year payback on all investments, then the maximum budget for expenditures to eliminate this problem would be $200,000. This tells the reader, and the project team, that seeking a solution that costs more than $200,000 will not be acceptable to the Company without special approval. This budget information helps to guide the solution options sought by the project team.

6. **Roadmap for future work**. State the next steps as a result of the Initial Analysis. This should essentially map out your direction and work for the rest of the project.

Computer Files

Computer files are the responsibility of the team. Your files are important and valuable to the project and your Industry Partner; therefore, treat them accordingly. **Typically, every semester, at least one team finds out they have lost their files along with a month's worth of work or more because they have managed their computer files in an irresponsible manner**. Develop a system of file backups and a naming convention that is workable. At a minimum, backup your files daily, to a CD-R, a CD-RW, or your flash drive. CDs are provided, at no charge, in 117 TB. We do not provide flash drives. Keep in mind these media have no "recycle bin" to rescue you if you are careless. Following are some workable guidelines:

1. Folder names should incorporate the date when the latest files were copied into the folders, such as: **Project-9-2005-02-04.** *(Substitute your project number)*.
2. Working files that will have many changes made to them during the course of the project should have the last editing date appended to their file names, such as: **Plant_Layout_Loading Dock_2005-02-04.dwg**
3. At the beginning of the next day's work, copy all your files to a new folder, with a folder name such as: **Project-9-2005-02-05**
4. Periodically, copy all files to a CD-R, which cannot be erased or changed later. They cost less than a can of soda and can save weeks of work. These are available, at no charge, in 117 TB.
5. Use descriptive file naming conventions that are understood by your team and can be understood by those who will ultimately receive copies of all your files in your exit procedure.

Reports and Outlines

Several reports are due during the semester. The four major reports, which will be submitted to the Grading Committee, are arranged in a sequence from the Pre-Report to the Final Report, upon which your GE 494 grade will be based. All reports follow the same format, with minor exceptions. This allows the later reports to be built upon the work from the earlier reports with minimal revision. You will be incorporating lots of information throughout the semester into your reports, and the amount of information and data can become overwhelming.

You are required to prepare a detailed outline for all reports and review them with your Advisor (see Course Schedule). This outline will include all parts of your paper. The outline can be reviewed quickly by the team and Advisor to make sure the ideas flow well and concepts are introduced properly before any detailed discussion. The outline is most useful in that it can be edited easily to reorder and restructure the report without getting bogged down in writing style. Your outline should incorporate lots of detail, which can be finalized and used as a guide for the final paper. Use this simple rule: the detail must appear in the outline if it is going to appear in the paper.

Create a storyboard from the outline that indicates where figures, graphs, etc. will be inserted to support the text. The final step is to flesh-out the outline into paragraphs to become the full report.

Keep in mind that GE 494 reports are technical reports. **You are required to incorporate figures, graphs, equations, drawings, etc. to support your discussion**. **If your reports do not include these items, your report is not acceptable.** Many samples of reports are available in 117 TB for your review, and on the Senior Engineering Project web page http://courses.engr.illinois.edu/GE494/. Also, keep in mind that you must include enough explanatory material to bring the reader up to speed with the detail of your discussion. Note, that you will eventually become relative experts in your specific project. To be well understood, you must make an effort to bring the reader into the discussion. Your report is also intended to motivate the Industry Partner to act on your recommendations, which will typically require the Industry Partner to spend money. If the Industry Partner cannot understand your report, then the Industry Partner will take no actions, make no investments, and the project will be of no value to them.

Keep the End in View

Find out very soon what is expected of you in your reports, presentations, and the specific goals of your project. Take the necessary steps to meet and exceed these expectations. From the onset, you are given a problem statement with specific criteria to meet. These will be rewritten by you during the course of the semester and put into your final report. You will also have your Industry Partner's signature to indicate their acceptance of the revised, complete problem statement and list of deliverables (**due Sept. 27th**). One of the main grading criteria for your project is whether or not you have satisfied the problem statement. Make sure you write it properly and unambiguously and fulfill it completely, in a manner that is well understood by the faculty graders and Industry Partner.

Positive Control

Many things can go awry during the course of the semester. Take positive control of your project to make sure there are minimal surprises and setbacks. Two quotes come to mind, "If it can go wrong, it will go wrong." and, "Manage what you expect, and expect what you manage." Don't hope for luck, because it doesn't exist. Plan your work, evaluate the possible downside and take appropriate steps to prevent it. Have a backup plan. Some helpful tips:

1. Acknowledge all communication and ask others to do the same.

2. Make no assumptions; make sure of everything.

3. Get definitions, second explanations, eliminate all ambiguities.

4. Verify any instructions you give to your Industry Partner; make sure they are understood and clear.

5. Verify schedules, experiments, data gathering, 2nd and 3rd shift personnel and their understanding and compliance with your needs.

6. Be on-site at the Industry Partner when you need to make sure of anything.

Resources and Research

Many great resources are available for your use, including the Web, libraries, texts, handbooks, associations, trade and technical journals, experts, vendors, past GE 494 reports, etc. Make good use of these. For several projects, world-class experts can be found here on campus. Ask your Industry Partner for sources they have used in the past. One invaluable resource for manufacturing processes is: Tool and Manufacturing Engineer's Handbook compiled and published by the Society of Manufacturing Engineers (SME). This is a multi-volume handbook that covers virtually all standard manufacturing processes, materials and methods. The articles are extensive, include glossaries of industry jargon for each technology discussed, and give additional references. This can be a good starting point for manufacturing-based projects. An Adobe Acrobat version of the TMEH is installed on all computers in the GE 494 computer lab 305-306 TB.

Contacting Vendors

For most projects, students must contact vendors at some point to get information about equipment, software, systems, etc. This may include price quotes, proposals, drawings, and other information. Feel free to contact vendors for these purposes.

University employees may search websites, get prices, specs, etc. with no logging required. It is only when actual communication-conversation and/or email-is done with a vendor representative, that the information must be logged into the website.

If you have any questions regarding purchasing procedures, please see Barb Bohlen in room 117 before contacting ANY vendor. **See last page in the handbook** for a sample procurement reporting worksheet; this will help you keep track of the information you must gather to enter later.

If you are NOT a university employee, none of this is necessary! So, the simple way to avoid this procedure is to have the non-university employees in your group do the discussions and/or emails with vendors.

Prototypes

Prototypes are routinely required for some projects. Simple prototyping may be done with ISE Department resources, such as the 3D printers in TB 307, or through the services of UIUC machine shops (see Chapter 12. GE 494 Resources & Safety).

The Industry Partners have been made aware that large prototyping efforts must be done through their own machine shops, tool rooms, or vendors, and at the Industry Partner's expense.

The project team is responsible to arrange and plan for such prototyping, and to coordinate their prototyping efforts with the Company's personnel and resources. If such prototyping is a reasonable requirement of your project, make arrangements with your Company as early as possible in the semester to interface with the Company's resources and establish communication links for plans, drawings, specifications, drawing file compatibility, etc.

Technical Team Development

Several times in your professional career, you will be faced with new major challenges such as job positions, projects, etc. To successfully meet such challenges, you will have to go through a significant learning curve to become proficient and productive in your position. You will typically have a manager, Advisor, or mentor who will have the responsibility to get you up and running and productive as soon as possible. The following diagram illustrates stages you will go through as you learn, get experience, and eventually become productive. This paradigm shows the needs you will have and the proper management response to those needs in order to get you up to speed as quickly as possible. Be advised that not all managers will be aware or respond to your needs as effectively as others. Those who do will be most effective in managing their people and have the most effective teams.

The following discussion of this paradigm follows a new employee named Neil who is reporting to a new job where his supervisor is named Sam. The diagram illustrates these stages progressively as 1 through 4.

H = high, L= low, F=Feedback, T=task.

LT - HF	**3**	**2**	HT - HF
LT - LF	**4**	**1**	HT - LF

Stage 1: High Task, Low Feedback. Neil reports the first day on a new job. No feedback from Sam is needed at this point because Neil has not yet done anything that warrants feedback. Sam has the responsibility to assign Neil with lots of tasks designed to orient Neil to the job. This may include information on the computer system, personnel procedures, specific job responsibilities, Company standards, plant layout, project managers, coworkers, etc.

Stage 2: High Task, High Feedback. Neil has been getting accustomed to job responsibilities and details, and is now working on an initial project. Sam must still assign tasks and give specific direction about how things are to be done. Sam must be available to give feedback and answer questions as they arise, otherwise Neil will be dead in the water; he'll have little confidence in what he is doing and will feel lost and unproductive.

Stage 3: Low Task, High Feedback. Neil has been doing the job long enough to be competent and knowledgeable in the work performed. Sam should no longer assign routine tasks, as this would be understood as a lack of confidence in Neil. Sam should still be highly available for giving significant feedback to support the work being done.

Stage 4: Low Task, Low Feedback. Neil has been performing the job function long enough to become the "Guru" – nobody else knows more about the job details or can provide meaningful technical feedback. Neil is happy to be essentially left alone to do the job. Minimal supervision, if any, is needed.

In a professional career, most people cycle from stage 1 to stage 3, and begin at stage 1 again as they are promoted, transferred, or change jobs.

GE 494 students begin at stage 1 and must absorb tremendous amounts of information to get up to speed ASAP. Your Advisor has the responsibility to guide you in this process, but you must do the work. Ask your Advisor for guidance in getting the information you need to get up to speed quickly.

The Senior Engineering Project Coordinator is also familiar with all the projects and is willing to help you with this process. The goal is to get to stage 2 ASAP, where you will start to become productive. It is your Advisor's responsibility to evaluate your work, decisions, direction, etc., and give you feedback that will keep you on track. Eventually, you should become more competent and confident in your project. Continue to seek your Advisor's feedback about all aspects of the project, but the project is your project. One of the objectives of GE 494 is to get you to Stage 3, where you will develop competence and confidence in your work, your analysis, your solutions, etc. This should be evident in your report and final presentation.

Meeting with Course Coordinator

Each team **MUST** meet with the Course Coordinator, Harry Wildblood, in room 104B, during the first 5 weeks of the course. This meeting should take about 30 to 45 minutes. **Schedule this meeting AFTER your first plant trip and BEFORE your Pre-Report is due (Sept. 27). Barb Bohlen will have access to Prof. Wildblood's calendar in 117 TB.**

This meeting will be to review your approach to the problem, discuss applicable engineering principles, and to do some brainstorming about possible solutions, approaches, and ideas.

Keep in mind that the Course Coordinator is very familiar with every project, has traveled to each Company, and has seen and examined every design, process, etc., which is the focus of each project. The Course Coordinator also wrote each problem statement, including the scope of work and all deliverables.

BE prepared for this meeting with all project files, drawings, notebooks, etc.

Chapter

3

Travel Arrangements

Travel is an integral part of your GE 494 project. Many arrangements have been made to make the travel process and paperwork as straightforward as possible. Note the following guidelines. **Because of a change in University policy, any student driving a UNIVERSITY CAR must be a University employee.**

At your first group meeting, determine who will be the **"designated driver"** for the group. Select the person with minimum scheduling conflicts which will enable him/her to be available for the majority of trips. **BEFORE GETTING BEHIND THE WHEEL OF A UNIVERSITY VEHICLE,** the **designated driver** for each group must immediately see Barb Bohlen in 117 TB to get on payroll. Bring a copy of a Valid Passport and a Valid Driver's license **OR** a Social Security Card and a Valid Driver's License. Then, go see Lori Frerichs in 203 Engineering Hall. Student drivers are paid $8.25 per hour of actual driving time.

For UNIVERSITY CAR usage:

1. Contact your Company for possible meeting date(s) before coming to the office to make travel reservations. Have departure and return times ready.

2. All car reservations must be made in 117 TB, where you will get your Car Release Form required by the Car Pool.

3. All trip arrangements, reservations, etc. should be made **as far in advance as possible.** There may be a backlog due to several teams who want to arrange a trip on the same day. Try to arrange trips on Tuesdays and Thursdays to minimize the number of other classes missed.

4. The **designated driver** must go to the Car Pool at 1701 South Oak Street to pick up the car. Make sure to bring your Car Release Form with you. The designated driver must show proof of driver's license. If two people are driving (for long trips) both drivers must go to the car pool and show proof of driver's license.

5. A credit card is provided with each rental vehicle for fuel purchases. The card is located in the key case. You do not need to return the car with a full tank.

6. Check the car you are assigned to make sure everything is in working order. **Report any vehicle problems BEFORE leaving the car pool.**

7. As soon as you return, submit travel vouchers to 117 TB. Each person should pay for all his/her own expenses for the trip. See the next page for information on travel expenses. For brief trips you may not have reimbursable expenses, according to UIUC policies.

8. Make sure you have all necessary directions and maps for your trip. Prepare for possible detours, road construction, and alternate routes. Remember, you are taking your Advisor, and not vice versa.

9. All car pool vehicles now have I-pass. Information about the I-Pass can be found at the I-Pass website: http://www.illinoistollway.com. You can also find information on the University's Facilities & Services website: http://www.fs.uiuc.edu/campusservices/gcp/carpool/carpool.cfm# or by calling their office at 217-333-3910.

10. Be prepared for your trip. Have money, change for tolls, credit cards, identification, cell phone, etc. Know where you are at all times during your trip. Be prepared for possible emergencies--accidents do happen.

11. Do not leave anything in the car when you return it to the car pool. Check the car carefully, (including the trunk), for personal property, ISE Dept. property, or Industry Partner property. *Cameras have been left in vehicles and you-- will have to pay to replace them.*

12. **"Under the law", all persons in vehicle must wear seat belts!**

13. Check the car you are assigned to make sure everything is in working order.

    You must pick up car release form from 117 TB before going to car pool.

14. **REPORT ANY VEHICLE PROBLEMS BEFORE LEAVING THE CAR POOL**

For PERSONAL CAR usage:

1. Use of personal cars for project trips is discouraged. If you must use your personal vehicle for an unforeseen reason, seek approval in 117 TB. These exceptions will be reviewed on a case by case basis. Do not go through the I-Pass lanes without an I-Pass (which come furnished on all car pool vehicles). You will be billed for the fine.

   If you accidentally go through an I-Pass lane without an I-Pass:
   (1) go to the I-Pass website: http://www.illinoistollway.com and click "Pay a Toll Violation"
   (2) enter the license plate of the vehicle
   (3) pay the toll
   (4) print the receipt from your online toll payment
   (5) bring receipt to 117 TB for reimbursement.

If WE get the fine for YOUR negligent use of the I-Pass lane, a fine of over $100 will be passed on to YOU.

Accident Report Procedures
In the event of an accident, drivers of any University vehicle, including departmental and car pool vehicles, must notify the University Car Pool Office by calling them at (217) 333-3910 immediately and must file a written report with that office within 48 hours after the accident.

Liability protection for University vehicles is provided through a self-insurance plan administered by the State Department of Finance. Failure to provide the notification and accident reports can result in the loss of protection and may result in personal liability for the driver. Failure to report may result in the refusal of the State to either defend the driver in any lawsuit or to pay any judgment on behalf of the driver that may be obtained in a lawsuit.

In addition to the possible personal liability incurred by the driver, the University may revoke the use of all University vehicles to the driver, or the department-in the case of repeated violations-as a result of the failure to follow the reporting procedure.

The State of Illinois' self-insured program provides up to one million dollars for the payment of claims arising out of the operation and use of University licensed vehicles provided the vehicle is operated by an authorized driver and within the scope of permission and the reporting procedure is followed. Liability protection is not provided if the vehicle is used for private purposes or outside the scope of permission.

Travel Expenses

To receive travel reimbursement for any item, you will need to provide the following:

1. Your name, local address and your I-Card ID number (number in blue).
2. The purpose of the trip or expense, title and number of project and name of Project Company.
3. Destination, exact times of departure and arrival, method of transportation (e.g., personal or University car, University or commercial aircraft, etc.).
4. Motel receipts if the trip includes staying overnight. Each person pays for their own hotel room (unless rooms are shared).
5. **No meal reimbursements will be paid if travel is not overnight.**

   Overnight Travel: Maximum reimbursable meals are calculated by ¼ day increments (12m-6am; 6am-12n; 12n-6pm; 6pm-12m) up to a total of $28.00/day.

If on overnight travel, save your meal receipts if you plan to request reimbursement after your trip. Each student should pay for his/her own meals separately and turn in **separate** receipts.

REIMBURSEMENTS: ALL reimbursements for travel expenses will be made to your student account. Note that if your student account is not negative, the reimbursement may merely reduce your balance. You may not withdraw monies from your student account until the balance is positive. DO NOT CLOSE your student account until you have received all the reimbursements you expect from project expenses.

Air Travel

Airplane use is not authorized unless the driving time would be excessive. You must get special permission for air travel in advance, through 117 TB.

Chapter

4

Communications

Mailing Address

Your mailing address is:

Senior Design Project Group # xx
University of Illinois
Department of Industrial and Enterprise Systems Engineering
117 Transportation Building
104 South Mathews Avenue
Urbana, IL 61801-2996

Make sure your address includes your group number.

Shipping Address

For shipping and/or receiving large items, you must get special instructions from Barb Bohlen in 117 TB, (217) 333-2731, for shipping address and other information.

Personal Cell Phone Use

You may use your personal phone and cell phones for project purposes. Make sure that you have appropriate message prompts for all incoming callers who may leave messages on your phone systems. Remember that those calling you are professionals, and expect to deal with you in a professional manner. No reimbursements will be made for personal cell phone use.

University Telephone Use

Use of telephone and long distance telephone calls: You should use the phones in Rooms 305-308 TB or your project Advisor's office when you need to make calls regarding your project. You may also schedule a conference room in the Transportation Building when necessary. These rooms may not always be available but there are four (4) phone lines in the Senior Engineering lab.

Weekly Conference Call with Industry Partner

A weekly conference call between your entire team and the Company is a course requirement, and is something that all Industry Partners have been told to expect.

Determine a time slot of about 30 to 45 minutes for a weekly conference call with the student team. This is an excellent method to facilitate and ensure that communication is good and project goals are being properly addressed and completed. Email your Industry Partner an agenda for the conference call, along with any drawings, files, photos, or other details that will be discussed.

Two Polycom phones are available for project teams to converse as a group with their Industry Partner. There are two conference rooms in the new Senior Engineering Lab. There are additional phone lines in the other rooms in the lab as well. Please check the phone to determine the numbers.

Paper Trails

It is important and professional to establish a paper trail of documentation of items discussed, decisions made, and action items for the various parties in the conference call. Do not rely on your memory, or the memories of others in the conference call to recollect who was going to do what, or what decisions were made. Make sure this is documented and sent to all parties via email after the call. This documentation and follow-up is critical to make sure all parties are, and continue to be, in agreement.

Occasionally, decisions and compromises are discussed and agreed upon for the overall health and success of the project. But, if this is not documented, different parties may remember the decisions in different ways. Thorough documentation and follow-up emails are the best way to make sure ambiguities or differences in opinion do not come back to haunt you and prevent you from completing your project. This will become extremely important in your professional careers.

Confirming Company Contact Information

By **September 11th**, you are required to verify the Company Contact information for your project. The contact information given on the project information sheet when the project was assigned may have changed. For instance, a different person may be assigned as your Tech. Contact, or the title of the contact may have changed, etc.

You must submit, in writing, a confirmation of the project contact information to Barb Bohlen, which will be in one of two forms *(don't forget to include Project number and name)*:

1. No changes to Contact information.
2. If changes to the Contact information are necessary you must include:

   Type of Contact (Administrative or Technical)
   Name
   Title
   Address
   Office Phone
   Fax number
   Cell phone
   E-mail

Mailboxes and Email

Each project team has an individual mailbox in the south stairwell of the Transportation Building. **CHECK YOUR EMAIL DAILY AS A MINIMUM**. You are responsible to maintain your email mailbox properly. Purge old emails so that there is always room to receive incoming messages. Verify receipt of all emails from your Industry Partner and ask your Industry Partner to do the same.

When using email, always include a signature block with all of your contact information including your full name, email address, phone number and fax number. Respond to all emails immediately to acknowledge receipt of the email, even if the answer to the email will take some time. This is a courtesy to the sender to acknowledge that the request has been received. When emailing staff in 117 TB, please be sure to include your group number.

When you plan meetings or events via email, be sure that you include the date and time of the meeting or event. Do not refer to the appointment time with relative terms such as "today" or "tomorrow". These are ambiguous and irresponsibly put the duty of interpretation on the email recipient.

Fax Use

There is a fax machine in 117 TB. The number is (217) 244-5705.

The following guidelines for the use of the 117 TB fax machine are as follows:

1. Always use a FAX coversheet with recipient and sender information. Forms are available in 117 TB.

2. To receive an incoming fax, it must have your ***group number and Industry Partner name on the first sheet***.

Chapter

5

Purchasing and Reimbursement

General Instructions

Purchases are routinely required for materials, equipment, software, etc., during the course of a Senior Engineering Project. If purchases must be made for a GE 494 project, DO NOT HESITATE to request authorization. Funding is available specifically for this purpose, as a result of the donations made by the Industry Partners of the Senior Engineering Project course. Reimbursement for expenses is contingent upon careful adherence to rules set by the University.

GE 494 has already purchased many types of equipment, both generic and highly specialized. **CHECK IN 117 TB FOR YOUR EQUIPMENT NEEDS BEFORE MAKING ANY PURCHASES.** The equipment you need may already be here and waiting for you. An illustrated equipment catalog showing and describing all available equipment can be found in 117 TB in a hardcopy catalog, complete with equipment photos – OR – you may look up your equipment in a database on the computer in 117 TB.

Any equipment, books, manuals, hardware, etc. which may be purchased for a Senior Project become the property of GE 494 and must be checked-in to the Senior Project system at the time of purchase or when the items arrive. All items purchased must be returned to 117 TB at the end of the project. All manuals, software discs, boxes, packaging, etc. must be returned with the purchased equipment for use in future projects. The only exceptions to this are items that will be consumed during work on the project.

Contact 117 TB for guidelines if the team intends to deliver purchased items to the Industry Partner at the end of the project.

Go to 117 TB for purchase authorization, forms, help, procedures, etc.

The staff in 117 TB will help you make your order and provide payment information. You are responsible to make the order, get the full information, talk to the vendor, fill out the on-line form via the web, etc. The staff (Barb Bohlen and Leslie Davison-Pirie) will then provide the payment information.

YOU ARE NOT AUTHORIZED TO PLACE YOUR OWN ORDERS WITHOUT APPROVAL.

Orders over $200 must be approved by Harry Wildblood. Approval typically takes less than 5 minutes with proper explanation and justification for the purchase.

General Purchasing Procedures

YOU MUST FOLLOW THE GUIDELINES BELOW FOR ALL PURCHASES OR YOU MAY NOT BE REIMBURSED!

I. Identify the vendor

A. University of Illinois

1. Central Stores (1609 South Oak, Champaign: 333-4330) (custodial supplies, paint, grounds, electrical and metal, hardware, plumbing and industrial supplies)— (lumber, sheet metal, and glass are at 1501 South Oak, Champaign: 333-4330. There are receiving docks at both locations. The contact number for receiving is 333-1653.
2. ECE Storeroom - electrical supplies (60 Everitt Lab: 333-1916)
3. Chem Stores - chemical supplies (94 RAL: 333-3564)
4. Illini Union Bookstore - (809 S. Wright: 3-2050)

B. P-card purchases (University Purchasing Card)

1. Can be made on-line. You MUST use the computer in 117 TB. Credit card information will be put in by Barb Bohlen.
2. **For purchases exceeding $25.00** at a local vendor, you will have to use your credit card and be reimbursed. In some cases a member of the staff might have to go to the vendor to pay for the equipment.

C. Petty Cash Reimbursement

For purchases of $25.00 or less, please bring your receipt to 117 TB to receive immediate reimbursement through petty cash. You **MUST** have a receipt to receive your money.

II. **Write a draft of your order** —as completely as possible.
Blank forms are available in 117 TB. Be sure to include the following information:

A. Vendor
If UI: (name of shop, phone, and estimated cost)
Other vendors: (name, address, phone #, fax #, and FEIN #)

B. Item(s) being purchased
(catalog number (if applicable), description, quantity, and price)

C. Your name, phone # and group #

D. Any unusual information such as:
FAX order, overnight delivery, prepayment required, etc.)

III. **Your order must be processed in 117 TB**

Non-Petty Cash Reimbursements: If you decide to purchase equipment for your project beyond the $25.00 petty cash limit, reimbursement will be made to your student account. Note that if your student account is not negative, the reimbursement may merely reduce your balance. You may not withdraw monies from your student account until the balance is positive. DO NOT CLOSE your student account until you have received all the reimbursements you expect from project expenses.

Chapter

6

Subgroup Presentations

You will prepare and give oral presentations at two subgroup meetings during the semester. A subgroup meeting will typically consist of three to six project teams and their Advisors meeting in a separate presentation room. These meetings provide opportunity to develop your oral presentation skills and build a set of visual aids that can be used at your on-site presentation to your Company during week 11 (see Ch. 10), and at your final oral presentation (see Ch. 11), to faculty, fellow students, and your Industry Partners to be given on ***December 17, 2012*** . Each team will present a synopsis of its progress, status, direction, and planned future work, all of which will be critiqued by those in attendance. The purpose is to get feedback, suggestions, and redirection, if necessary, in a timely manner for the success of the project. In addition, each team must prepare a written meeting brief to be disseminated to all in attendance, as well as to the team's project grading committee and the Industry Partner.

Subgroup meeting schedules and room assignments will be put in your mailbox and sent via email.

Subgroup Oral Presentations

Each group will be given **15 minutes to present** and an additional **10 minutes for questions and answers**. The use of MS PowerPoint is required. Exhibits and demonstrations are optional. A discussion of your project schedule is a requirement. Rehearse and know your presentation materials. **All group members** must participate by having a speaking role in the presentation. Make sure the presentation equipment that you need is available in your assigned room. For more information, see Ch. 11. "Final Oral Presentation."

Attire for Subgroup Presentation is "Business Casual" as a minimum.

You must be in attendance for **ALL** of the presentations given in your assigned room. The only exception is for other course conflicts, illness, etc.

Both of your Subgroup Presentations should include:

1. Project title
2. Team introduction
3. Overview slide
4. Project introduction – context for the problem statement – including economic impact of your project
5. Concise problem statement
6. List of determined team objectives
7. Analysis of current product/process/design/etc.
8. Solution methods, alternatives, plans
9. Proposed solutions*
10. Economic Analysis
11. Conclusions*
12. Recommendations*
13. Project Gantt Chart

* These may be omitted in the first Subgroup Presentation, if necessary.

Subgroup Meeting Guidelines

1. Presentations will begin promptly at the time scheduled to allow Advisors and graders to move between rooms.
2. Each group will be allotted 15 minutes to present and 10 minutes for questions and answers.
3. The moderator will give a two (2) minute warning at 13 minutes into the presentation.
4. Students should answer all the questions during the Q&A sessions.
5. The next scheduled group should come to the front of the room two (2) minutes before their starting time to prepare to start on time. This may be done while the previous group is completing their Q&A session.
6. Students must speak up so they can be heard by everyone in the room.
7. All presentations will be videotaped and a copy will be provided to each group the following week. Senior Design students will be taping when they are not presenting.
8. All questions from the audience will be held until the Q&A session at the end of the presentation. The only exception to this is to ask the presenter to speak up.

Some Presentation Guidelines

1. Speak clearly so that you can be heard from the back of the room.

2. Display enthusiasm in your presentation. No one in the room will have more enthusiasm than you do, so set the tone by showing excitement.

3. Introduce all team members, the project title and the Company Industry Partner.

4. After a title slide or two, show an overview slide to briefly show the structure of your presentation.

5. Make your slides clear and crisp. Make sure all slides have sufficient contrast to show the text clearly.

6. Choose or create a template background that has both the UIUC logo and the Industry Partner Logo in corners of the slide.

7. In bullet slides, make the bullets brief – typically no more than five words.

8. Each bullet slide should require YOUR explanation to be well understood by the audience. In this way, the audience will rely on YOU to bring the entire presentation together.

9. Photos should be large and clear. Use labels, arrows etc., to define and point out important features. Your photos should answer questions - not create new ones.

10. When showing a graph, briefly define the axes and then tell the purpose of the graph and what it is intended to show.

11. Use a pointer or other device to draw the audience's attention to what you are talking about at the moment. This will bring synchrony between you and the audience - they will know exactly what you are talking about and won't get confused.

12. When using a pointer, hold it firmly and be in control of it as you use it. Pass it to the next presenter effectively. Do not play with it, lose it, etc.; otherwise, the audience will be more interested in pointer antics and mishaps than your presentation.

13. Use PowerPoint animation sparingly as a tool to help sequential ideas in a slide. DO NOT use animation simply as "fluff" in transition between slides or bullets. It wastes time and becomes tiresome very quickly.

14. Be prepared and know the purpose of each slide. Explain each slide and keep in mind its purpose in the overall presentation. Do not over-explain your slides or waste valuable time babbling because you have forgotten the purpose of the slide.

15. Each slide should be used in the overall progression of ideas in your presentation. There should be a sense of forward pressure to get to the next slide as you develop your concepts and lead the audience along.

16. Establish themes that track through your presentation. In the Solo Cup Project, discussed in Chapter 8, the theme was cycle time reduction through airflow efficiency. Airflow efficiency was mentioned several times throughout the presentation as it was analyzed and improved to its final state. The audience understood it to be a measure of success and could watch it improve through the presentation to the final result.

17. Do not use small, hand-held demonstrations that cannot be seen by all in the room. Rather, display a photo of the small item so that all can see clearly and display a video of the demonstration as well. You may also then do a live demo for added effect.

18. As you present, look at the audience. Pick out three or four individuals throughout the room and look at them as you present. Their visual feedback will let you know if you are getting your message across.

19. Think about transitions between slides. Use them effectively to build anticipation for the next slide. Pose questions on one slide that are answered as you show the next slide - this will engage the audience.

20. Go from the general to specific and give context to the audience. You must begin your discussion in the context of the audiences' general experience and THEN introduce and explain new concepts, ideas, definitions, etc., or else the audience will NOT be able to follow your presentation.

21. Make sure all handouts are distributed before your presentation begins. Passing handouts during your presentation is very distracting.

22. Be clear about your conclusions and what they mean. Show how your conclusions and final recommendations satisfy the problem statement.

23. Have an appendix or "War Chest" of extra slides for the Q&A period. Anticipate questions and prepare extra slides that will help you answer them. This makes you look very professional – and allows you to "extend" your presentation through the Q&A and show some of the really impressive charts and graphs that may be too technical for the general presentation.

24. Relax and be personable but enthusiastic. If your slides are professional, your attire is appropriate, and you are well prepared, then you will present in a very natural way. The audience will relate to you and enjoy your presentation.
25. In your practice sessions, note how often you say, “um”, or “you know”, etc. and try to avoid this nervous habit. Silence is best when you have nothing to say.
26. Be sure to thank your audience and your Industry Partner when you are finished.

Practice Sessions

Practice time will be made available in your assigned presentation rooms prior to the day of the presentations. Following is a list of important items:

1. Practice time sign-up sheets will be posted on the doors of the assigned presentation rooms. The time slots are in ½ hour increments.
2. Sign up for no more than two consecutive ½ hour slots. Provide opportunity for all groups to get adequate practice.
3. Schedule your practice times such that your Advisor(s) may watch, review, and help you polish your presentation.
4. Have your presentation fully prepared and rehearsed prior to your practice session with your Advisor. The review by your Advisor is for polishing, not chiseling.
5. Provide a handout of your presentation (six (6) slides per sheet) for your Advisor to take notes during the rehearsal.

Feedback

Subgroup meetings will be evaluated using Form OP *(*see Ch. 14*)* to provide a self-improvement tool to the team.

Remember, it is the purpose of the subgroup meetings to get feedback and evoke questions from the audience. The hard questions will better prepare you for your on-site and final presentations.

Your subgroup presentations will also be video recorded to give you eye-opening feedback to aid your improvement.

Written Meeting Brief

A single-page meeting brief must be prepared by each team, with enough copies available for all session attendees, your Advisor, and your grading committee members (who may not be present at your presentation). This brief provides a hard copy for progress evaluation at the meeting. A typical brief is shown at the end of this section. Note that the status of the communication with the Industry Partner must be detailed. You must mail your meeting brief to your Company. The presentation and meeting brief should include the following items:

- progress since last subgroup meeting, as measured against previous progress and projected progress shown on prior meeting brief.
- projection of progress to be accomplished before next subgroup meeting.
- currently perceived overall semester goal of the project (if different from previous subgroup meeting).
- report of your communications with the Industry Partner, including a phone number and the name of the Company contact person.
- brief discussion of your milestone chart, tasks and dates.

MAIL BRIEF TO INDUSTRY PARTNERS!

Give copies of your meeting brief, list of team objectives (see Ch. 8.5), and project schedule (see Ch. 7) to Advisor, graders, and Senior Project office.

Mail copies of your meeting brief, list of team objectives, and project schedule to your Company on the day indicated on the course schedule.

DO NOT use laser printers to make 30 copies of your meeting brief - use a copy machine.

Participation Responsibilities

Advisors will ensure the conscientious attendance and participation of each group. It is suggested that each project team review the subgroup session comments and feedback on group performance as soon after the session as possible, so as to obtain maximum corrective benefit from the critique.

REMEMBER: The purpose of subgroup meetings is to provide midcourse correction. There isn't any benefit to anyone if all meeting attendants assume a "sweetheart" role. **Be incisive and tough in your questions and criticisms**; they serve to produce better projects and reports for everyone concerned. Questions asked during subgroup meetings help prepare groups for the Final Oral Presentation. Receive criticism graciously; it is intended to improve and strengthen you. Do not be defensive. If you don't know an answer to a question, simply say so, and then get the answer – you will probably hear the question again.

Equipment Needs

Make sure appropriate projectors, extension cords, screens, etc. are available in your presentation room. If you need special equipment, check with the Senior Project office at least two days in advance. Wooden pointers will be provided. Laser pointers are available as well.

Subgroup Assignments

Subgroup meeting organizations and room assignments will be put in your mailbox and posted on the Senior Project office door.

Use of the ITS Equipment (Integrated Teaching System)

The presentation equipment used in rooms 101, 103, 112, and 114 is equipped with an Integrated Teaching System (ITS). These systems will be unlocked and made available for your scheduled presentations. Below are photos of the ITS station:

Figure 1. ITS Station

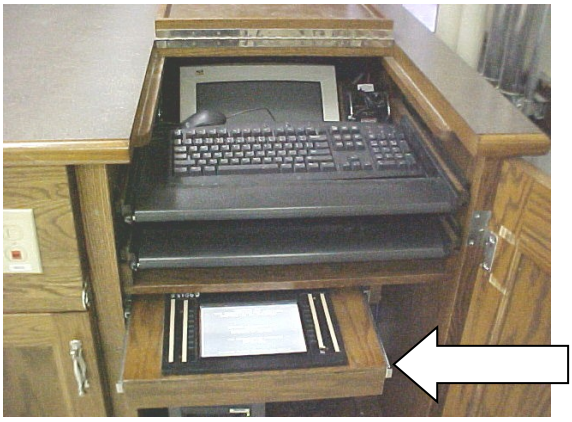


Figure 2. Control Panel Drawer

Figure 3. Welcome Screen

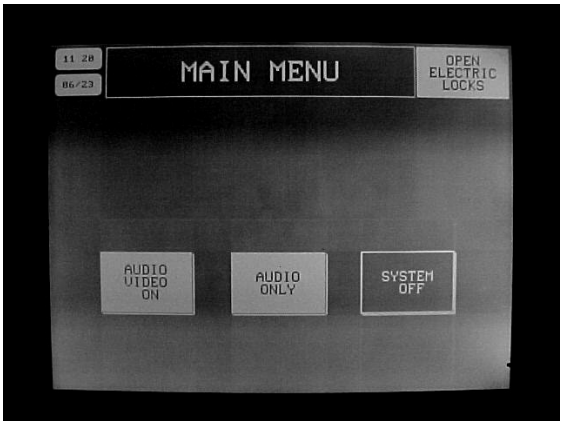


Figure 4. Select: Audio Video On

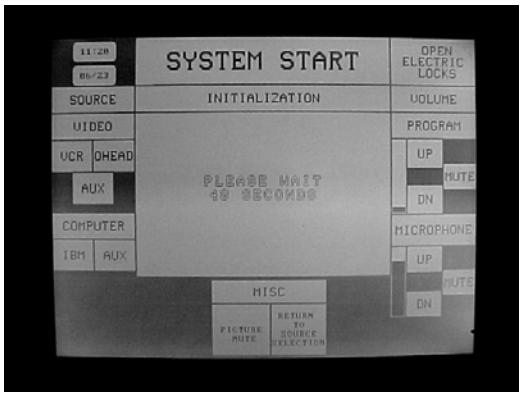


Figure 5. Wait to Select a Source

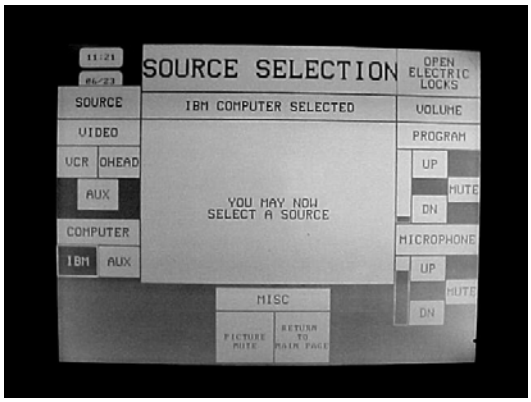


Figure 6. Select the Computer

Figure 7. CRT Initial View

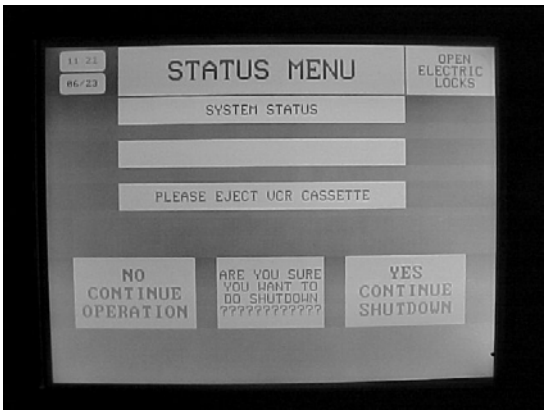


Figure 8. Shutdown Screen

The ITS station is simple to use with the control panel screens shown above. The control panel is located below the keyboard drawer (see Figure 2). The system will be set up and running prior to your use.

NOTE: The ITS system will shut down automatically if the Panel Touch has no user input for three (3) hours. If the unit appears to be off or shuts itself down while you are using it, follow the steps below:

1. Allow the projector to cool for at least one (1) minute.
2. Pull out the control panel touch screen (see Figure 2) and navigate to source selection (see Figure 6).
3. Choose COMPUTER – IBM (see Figure 6).
4. Make sure that the picture is not muted. Note the PICTURE MUTE button in the bottom center (see Figure 6). Toggle this button, if necessary, as well as the IBM button (see Figure 6).
5. If the projector is still not running, continue with step 6 below.
6. Navigate to shut the system down to allow the projector to cool for a minimum of one (1) minute.
7. Navigate to power the system up again. Touch the Welcome Screen (see Figure 3).
8. Select SYSTEM OFF (see Figure 4).
9. Select SYSTEM SHUTDOWN (see Figure 8).
10. Allow the projector to cool for at least 1 (one) minute.
11. Navigate to power the system up again. Touch the Welcome Screen (see Figure 3).
12. Select AUDIO VIDEO ON (see Figure 4).
13. Wait 40 seconds for the Select a Source screen to appear (see Figure 5).
14. Select your source (IBM). Toggle the picture mute button and the IBM button; if necessary (see Figure 6).

Sample Meeting Brief

GE 494 MEETING BRIEF

SUBGROUP MEETING NO. 1. 2/16/88 PROJECT NO. 12

PROJECT TITLE: Anomalous Fatigue Failure on Linear Recirculating Roller Bearings

PROJECT INDUSTRY PARTNER: Bendix Corporation/Scully-Jones, Chicago, Illinois

INDUSTRY PARTNER CONTACT(S): Richard Johnson, Field Engineer (708) 341-1796

STUDENT TEAM MEMBERS: Mark Rudow, Dave Bretsch, Mike Anderson

GE ADVISOR: Professor Charles Gebhardt

I. PRODUCT DESCRIPTION: The Tychoway Bearing is a recirculating precision roller bearing. It is used to minimize friction in machines which require linear motion while producing predictable, repeatable positioning of machine parts. It consists of 23 rollers, seven of which support the load at any one time.

II. CURRENT OVERALL GOAL OF PROJECT: To determine why fatigue failure consistently occurs in the same unexpected location on the race, and to eliminate the failure.

III. PROGRESS TO DATE:
- A. Methods of stress analysis were discussed
  1. Finite Element - too complicated, can't model dynamic forces.
  2. Photoelastic Analysis - also too complicated.
  3. Hertz Contact Stresses - did research on and calculated the Hertz stresses for theTychoway Bearing and found that these repeating stresses were causing the failure.
- B. Reasons for location of failure.
  1. Bearings may have only six rollers in the load zone at some times.
  2. There may be residual stresses in the failure area due to:
     a. Assembly bolts
     b. Heat Treatment Procedure
     c. Bowing of race

IV. COMMUNICATION WITH INDUSTRY PARTNER
- A. Meeting held at Bendix in Chicago on 1/19/88
- B. Items IIIA3 and IIB2 discussed with Richard Johnson on 1/30/88

V. FUTURE ANALYSIS:
- A. Calculate or assume stresses due to hole, tightening of bolt, and fluctuation of loading at failure point.
- B. Tests-Match results of tests with present theories.
  1. Move hole location and note failure location.
  2. Increase length of load zone and note failure location.
- C. Possible variations in failure area-compare failure location to entry angle variations.

VI. PROBLEMS OR POTENTIAL PROBLEMS:
- A. Residual stresses due to heat treating or bolt preloading are difficult if not impossible to calculate.
- B. Testing of bearings will take up to three weeks.

Chapter

7

Project Management Procedures

GE 494 projects routinely become quite involved and require that activities be planned and scheduled so that the goals are achieved and deadlines are met. Three standard project management techniques are required in the Senior Project course for managing time and resources:

1. Project Definition
2. Project Schedules (**Gantt** Charts (preferred) or **PERT** charts)
3. Continual communication and review

These approaches keep track of your progress with respect to your goals and the time remaining in the semester and keep your Industry Partner informed and involved in your project.

Problem Definition

The most critical component of any project management is the project definition and scope of work. This must be agreed upon by the project participants, and especially by the top management who authorizes the project. The project definition, or problem statement, and scope of work may be in flux for the first few weeks of the project as the project team and Company see more clearly how best to approach the project in a manner that is most likely to yield success. During the 5th week of the project, the project team must write up the final problem statement, including a complete scope of work and deliverables. After the problem statement has been signed by your Company, all student team members, and your Advisor, it needs to be submitted to 117 TB.

Note that the basic problem statement may be essentially unchanged from the project description given at the beginning of the semester; however, the scope may be redefined to focus on a subset of the original breadth of the project. For example, the initial project may have been to troubleshoot problems in a manufacturing line. The final scope may be narrowed to focus on two or three mutually agreed upon specific types of scrap which are typically the most troublesome for that manufacturing line.

Project Schedules

The main use of the project schedule is to aid ***you*** in managing your own project. It graphically shows serial and parallel tasks, milestones, and deadlines. It is an efficient technique to integrate the technical project phases into the GE 494 deadlines.

A copy of the current project schedule must be submitted to the Senior Project Coordinator along with a copy of your subgroup meeting brief on the days indicated on the course schedule. A copy of your current project schedule will be included in your written midterm report. Your project schedule will be discussed at each subgroup meeting. Do NOT include your project schedule with the Final Draft and Final Report.

It is typical for project goals to change as discoveries are made and information is absorbed. The key is to keep your Industry Partner informed of changes, successes and failures. Industry Partners usually dislike surprises, so involve your Industry Partner in the changes you make in your project plan.

Choose the charting format that suits your Industry Partner. The Gantt chart is used most widely as a management tool in industry and is readily constructed using Microsoft Project. PERT charts may also be used, and can be generated from a Gantt Chart in MS Project by selecting the Network Diagram view. An example Gantt chart generated by MS Project is given at the end of this chapter.

Team Development

Working on an engineering team requires communication, shared responsibility, trust, and flexibility, for the team to "be all that it can be". You must attend an initial meeting on teamwork and group dynamics (see Course Schedule). If needed, you may wish to arrange follow-up meetings as challenges arise.

If problems arise, discuss them with your Advisor. If you encounter insurmountable problems with your team dynamics, please make an appointment to discuss the situation with the Senior Project Coordinator, Harry Wildblood. Such problems must be resolved for the success of the project and your Senior Project experience.

Communication with Industry Partners

You are required to call and/or email your Company contact every week. Know when your contact is available by phone, etc. Make sure that you establish workable and efficient modes of communication. Arrange for all emails to be immediately acknowledged with a reply. Make sure that you give your contact person the time needed to comply with your needs.

To facilitate continuous communication and review, you will be mailing, faxing, or emailing to your Company the following items, consulting the course schedule for the required timing:

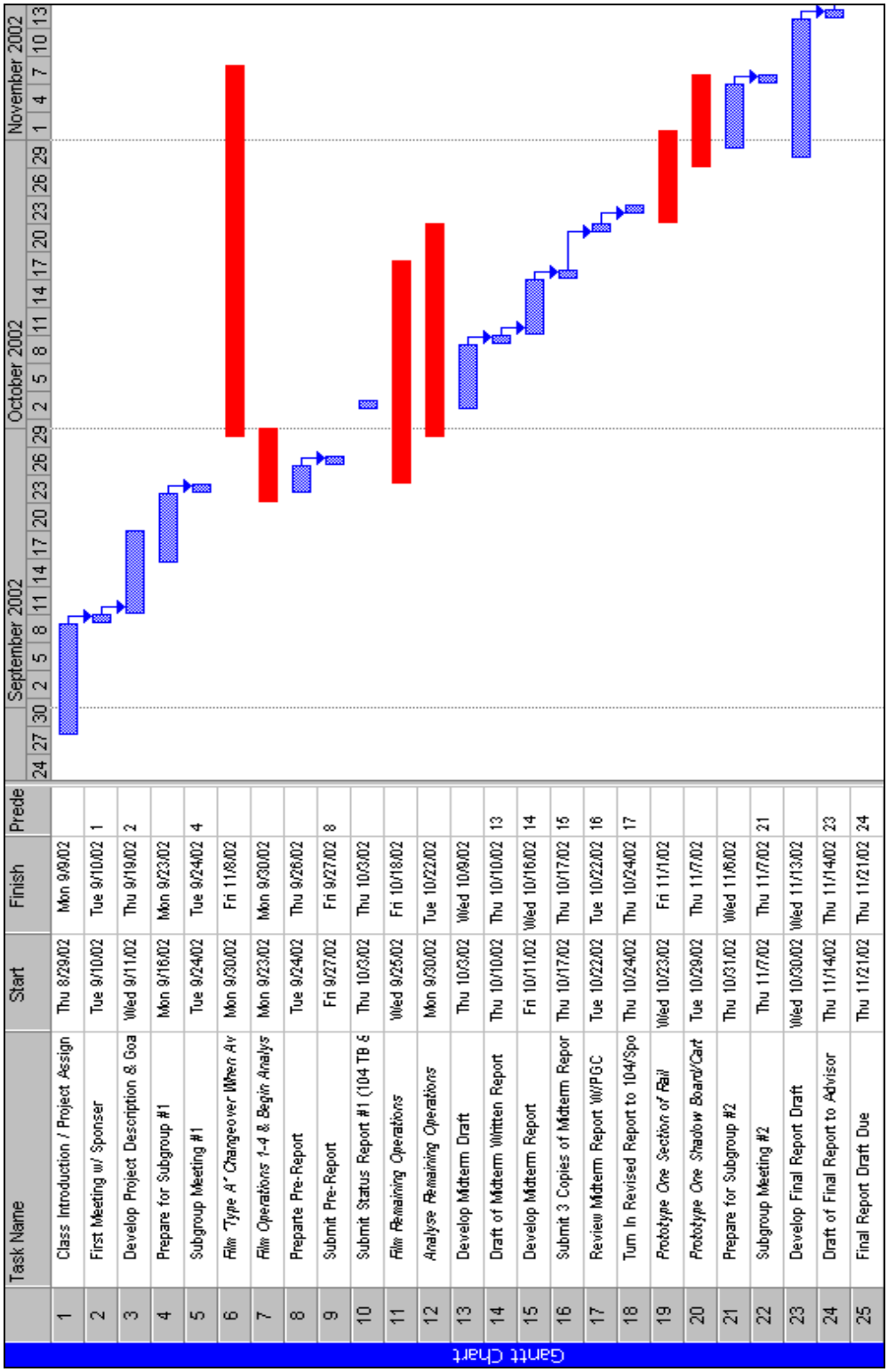
1. Your revised project description.
2. The first subgroup meeting brief and current project schedule.
3. The second subgroup meeting brief and modified project schedule.

In addition, submit a copy of each of these to 117 TB by the date indicated on the course schedule, for review by the Senior Project Course Coordinator with the Industry Partners.

Periodic Industry Partner Review

Your Company will be evaluating your work, communication, progress and effort, effective interfacing with their resources, proposed solution alternatives, etc., with the Senior Project Course Coordinator and your Advisor approximately every three weeks. This is designed to help keep the project on track and in tune with the desires of the Company. Inform your Company about your ideas and proposed solutions as they are developed. Do not keep your Company in the dark and expect to surprise them at the final presentation. Good communication is the best way to make sure you are meeting the expectations of your Industry Partner. A copy of the Company feedback form is given in Chapter 14, Form SF.

Sample Project Schedule Gantt Chart



	Task Name	Start	Finish	Predecessors
1	Class Introduction / Project Assign	Thu 8/29/02	Mon 9/9/02	
2	First Meeting w/ Sponser	Tue 9/10/02	Tue 9/10/02	1
3	Develop Project Description & Goa	Wed 9/11/02	Thu 9/19/02	2
4	Prepare for Subgroup #1	Mon 9/16/02	Mon 9/23/02	
5	Subgroup Meeting #1	Tue 9/24/02	Tue 9/24/02	4
6	*Film 'Type A' Changeover When Av*	Mon 9/30/02	Fri 11/8/02	
7	*Film Operations 1-4 & Begin Analys*	Mon 9/23/02	Mon 9/30/02	
8	Preparte Pre-Report	Tue 9/24/02	Thu 9/26/02	
9	Submit Pre-Report	Fri 9/27/02	Fri 9/27/02	8
10	Submit Status Report #1 (104 TB &	Thu 10/3/02	Thu 10/3/02	
11	*Film Remaining Operations*	Wed 9/25/02	Fri 10/18/02	
12	*Analyse Remaining Operations*	Mon 9/30/02	Tue 10/22/02	
13	Develop Midterm Draft	Thu 10/3/02	Wed 10/9/02	
14	Draft of Midterm Written Report	Thu 10/10/02	Thu 10/10/02	13
15	Develop Midterm Report	Fri 10/11/02	Wed 10/16/02	14
16	Submit 3 Copies of Midterm Repor	Thu 10/17/02	Thu 10/17/02	15
17	Review Midterm Report W/PGC	Tue 10/22/02	Tue 10/22/02	16
18	Turn In Revised Report to 104/Spo	Thu 10/24/02	Thu 10/24/02	17
19	*Prototype One Section of Rail*	Wed 10/23/02	Fri 11/1/02	
20	*Prototype One Shadow Board/Cart*	Tue 10/29/02	Thu 11/7/02	
21	Prepare for Subgroup #2	Thu 10/31/02	Wed 11/6/02	
22	Subgroup Meeting #2	Thu 11/7/02	Thu 11/7/02	21
23	Develop Final Report Draft	Wed 10/30/02	Wed 11/13/02	
24	Draft of Final Report to Advisor	Thu 11/14/02	Thu 11/14/02	23
25	Final Report Draft Due	Thu 11/21/02	Thu 11/21/02	24

Chapter

8

Written Reports

Four (4) written reports must be produced and submitted during the course of the semester. Each report is a progressive step in a logical series that eventuates in the final report, which will receive the team GE 494 grade assigned by the PGC. The formats of the three earlier reports are based on the format of the final report. Make sure you understand and adhere to the report formats given in this chapter. Your report will not be acceptable if the proper format is not used. Several examples of final reports will be made available through 117 TB and specific guidelines will be given in mandatory meetings prior to the due date for the first written report in this series. If you have questions about report formats, content, etc., ask your Advisor or the Course Coordinator in 104B TB. Samples of past reports are also available as pdf files at: http://www.iese.uiuc.edu/GE 494/sample-projects.html.

All written reports must be produced using MS Word, which is available in the Senior Engineering Lab (305-308 TB).

This chapter lists specifics for each type of report to be submitted. **Section 8.6 (Report Elements)** gives a detailed discussion of each required report element. Make sure you understand the structure of each element. Also, note that some report elements are omitted from the final report. Again, if you have questions, ask your Advisor or the Course Coordinator in 104B TB.

PRINTING COLOR PAGES: When printing your reports, print ONLY the color pages on the color printers in 305 & 306 TB – print all of the black and white pages on the default Ricoh printer/copier in the lab. This will expedite printing for the large number of reports to be printed.

8.1 Report Outline

You are required to prepare, and submit to your Advisor, a report outline which will contain the structure and content of your successive reports as indicated in this section.
This is designed to facilitate the organization of your report information into the proper format, and to readily share this organization with team members and your Advisor.
Once the outline is reviewed and agreed upon by all parties, you can write your successive reports by fleshing-out your outline into paragraphs, sentences, lists, figures, etc. The outline is intended to be highly detailed, and to include all the technical detail and content of the report. The rule is: if the detail is in the report, it must be in the outline. An example of such an outline is given on the GE 494 web page at: http://courses.engr.illinois.edu/GE 494/report-outline.html.

8.2 Pre-Report and Industry Partner-Signed Problem Statement

Each GE 494 team will prepare and submit a "Pre-Report" to the Project Grading Committee (PGC), per the course schedule. The "Pre-Report" is due the day after the first subgroup meeting, when the ideas of the project are well in mind. This report introduces the team to report mechanics and requirements and gets much of the detail work out of the way which will be the basis of the later reports. Comments from the PGC are intended to troubleshoot the problem statement, initial direction of the project, and preliminary report mechanics. The "Pre-Report" consists of the following items:

Cover Sheet
Title Page
Abstract
Table of Contents
Introduction
Problem Statement
Team Objectives

Pre-Report Outline
A detailed outline will be prepared for the Pre-Report, per section 8.1, and will be reviewed with your Advisor. Again, the outline should contain the structure and detail that will be incorporated into the Pre-Report.

Submittal of Copies
Staple the report securely-**(do not bind)**, and submit three (3) copies to 117 TB. **Please align all pages before stapling. Large heavy-duty staplers will be maintained in 117 TB-please use these staplers.** Office personnel will give the reports to your Advisor and each member of PGC. The PGC members will provide feedback as comments written on your Pre-Report, and on the evaluation form (*Form PR*) (see Chapter 14, "Grading"). Arrange a meeting with your graders if you would like feedback clarification.

Industry Partner-Signed Problem Statement
At the time the Pre-Report is due, the project team will submit a copy of the complete problem statement, scope of work and deliverables, signed by the Company Contact, student team members and Advisor, to 117 TB. **Any changes to the problem statement, scope of work, or deliverables later in the semester must be approved and signed by the Company, and a copy will be kept on file with the Senior Project Course Coordinator.**

8.3 Midterm Written Report

Each GE 494 team will submit a Midterm Written Report. First to their Advisor, and then to the Project Grading Committee (PGC) via 117 TB, per the Senior Project schedule. The Midterm Report must contain the elements given in the listing below. Note that the only acceptable generic section titles are: abstract, introduction, problem statement, Team Objectives, Initial Analysis, conclusions and recommendations. You should use descriptive, informative section and subsection titles for the body of your report. Use the appropriate tense to describe activity: "past work was done;" "future work will be done." The format for the midterm written report is as follows:

Cover Sheet
Title Page
Abstract
Table of Contents
Introduction
Problem Statement
Team Objectives
(Main Body of the Report…)
- **Initial Analysis (see pages 15-17)**
- **More Sections… (Research, Design Specification, Experiments, Design and Development, Prototyping, Testing, Solution Comparisons, Implementation Plans, etc.)**

The main body of the report is a series of major report sections (but do entitle any section of your report "Body"!) and MUST include a thorough Initial Analysis Section, typically as the first section in the body of the report (see page 15-17). This section should be at least five (5) pages in length and provide a thorough engineering and economic analysis of the problem, along with a project budget based on the desired payback period and the amount of possible saving or profit increase from the solution, including the metrics used for the analysis. The conclusions from the initial analysis provide the status of the current situation (process, product, design challenge, etc.) and provide a roadmap for later work in the project.

Because the midterm will include several body sections that include continuing work, **EACH BODY SECTION of the midterm should be divided into** "Work Completed to Date", in which you will describe tasks, analyses, results and their significance, and "Future Work"**,** in which you will describe what remains to be done, how long you expect the tasks to take, and your plan to overcome anticipated obstacles.

The Midterm must include an Economic Analysis section, even if your analysis is incomplete. You should have the current costs of the problem you are asked to solve, as well as the payback period required by the Company. From this, you should be able to present a preliminary discussion and calculation examples for ROI, NPV and payback period for your pending solution, along with a preliminary cash flow diagram (see section 8.6 and Chapter 9).

Economic Analysis*
Summary of Communications
References List
Project Schedule
Appendices

***The Economic Analysis** may not be complete at this point, but this section must be included to show the bases for the calculations that will be used for the draft and final reports. The basic equations should be listed, and the manner in which savings to the Company will be calculated. Tentative possible results should be included and clearly described as such in the text. This will allow the final figures to be inserted later into the draft and final reports with little change in the structure of this section.

It is not necessary to have a Conclusions or Recommendations section in the midterm.

Since many of the items in the midterm report are identical to the final report, get these items into their final form in the midterm and save yourself some work later when time is precious.

Midterm Outline
A detailed outline will be prepared for the Midterm, per Section 8.1, and will be reviewed with your Advisor. Again, the outline should contain the structure and detail that will be incorporated into the Midterm.

Submittal of Copies
Staple the report securely- **(do not bind)** and submit three (3) color originals to 117 TB. **(Again, print ONLY the color pages on the color printers in 306 TB – print all of the black and white pages on the black and white printers or the default printer/copier. This will expedite printing for the large number of reports to be printed.)** Two heavy-duty staplers are available in 117 TB. Office personnel will give the reports to your Advisor and each member of PGC. The PGC members will provide feedback as comments written on your midterm paper, and on the evaluation form (*Form MWR*). You are strongly encouraged to arrange a meeting with your graders for feedback clarification. After your PGC responds, you will provide two revised midterm reports to 117 TB. One copy will be reviewed by the Senior Project Course Coordinator. The second copy will be sent to the Company. These copies will be clearly marked "Midterm Report": on the front cover.

IMPORTANT: Always submit the previous PGC report comments and report with the current report due. In order for the PGC to evaluate your progress, you MUST submit your previously graded report, in its entirety, with the report which is currently due. This means:

1. Submit the "Pre-Report" comments and report with the Midterm.
2. Submit the Midterm comments and report with the Draft of the Final Report.
3. Submit the Draft comments and report with the Final Report.
4. **Make sure your graders return these reports to you each time**.

8.4 Draft of Final Written Report

Draft Outline
A detailed outline will be prepared for the Draft Final Report, per Section 8.1, and will be reviewed with your Advisor. Again, the outline should contain the structure and all of the detail of the Draft Final Report.

The Draft Final Report provides your last opportunity for evaluation and feedback by your Advisor and PGC prior to production of your graded Final Report. The Draft should therefore be as complete as possible and include all necessary drawings, photographs, etc., for review. While the Draft need not be a smooth, finished copy, **it should include all sections that will appear in the Final Report.** If a section is still in the "idea stage", write it up to the best of your ability to give an accurate representation of what the section will contain in the final report. The PGC cannot give feedback on what is omitted.

Use this last feedback opportunity wisely! Include your solutions, economic analysis, conclusions, and recommendations. You may have to include these in terms of data which is not yet available, but include a discussion of how your conclusions will be made and what metrics you are using to make your decisions. Again, your economic analysis must include a cash flow diagram, ROI, NPV and simple Payback Period. **Discuss the feedback with your PGC if you are unclear about any editing comments or requirements.**

Project Grading Committee (PGC) members will expedite examination of the document so that students are afforded the full benefit of feedback. You are strongly encouraged to arrange a meeting with your graders for feedback clarification.

The Draft Final Report must include the following items:

Cover sheet
Title page
Abstract
Key words
Acknowledgements
Table of contents
List of figures
List of tables
Introduction
Problem Statement
Team Objectives
(Main Body of the Report…see page 49)
Economic analysis
Conclusions
Recommendations
References
Appendices
Mechanical drawings

DO NOT INCLUDE in the Draft Final Report:

Summary of Communications
Project Schedule

Submittal of Copies
Staple the report securely and with all pages aligned properly, **(do not bind)** and submit 3 color originals to 117 TB. Office personnel will give them to your Advisor and each member of PGC. The PGC members will provide feedback in the form of comments written on your midterm paper, and on the evaluation form (*Form DWR*). This is the most detailed and important feedback you will receive during the semester to help you satisfy the PGC requirements. You are strongly encouraged to arrange a meeting with your graders for feedback clarification.

You must submit the Midterm Report with PGC comments with the Draft Final Report.

8.5 Final Written Report

The overall goal of the semester is to submit a complete and polished Final Report to the PGC. The prior reports and PGC feedback should have provided you full opportunity to get clear, unambiguous insights and directions for submitting an excellent report.

The Final Report must include the following items:

Cover sheet
Title page
Abstract
Key words
Acknowledgements
Table of contents
List of figures
List of tables
Introduction
Problem Statement
Team Objectives
(Main Body of the Report… see page 49)
Economic analysis
Conclusions
Recommendations
References
Appendices
Mechanical drawings

DO NOT INCLUDE in the Final Report:

Summary of Communications
Project Schedule

Submittal of Copies
Staple the report securely and align pages properly, **(do not bind)** and submit 3 color originals to 117 TB. **(Again, print ONLY the color pages on the color printers in 306 TB – print all of the black and white pages on the black and white printers or the default printer/copier. This will expedite printing for the large number of reports to be printed.)** Office personnel will give them to your Advisor and each member of PGC. The PGC members will provide feedback in the form of comments written on your Final Report, and on the evaluation form (*Form FWR*).

You must submit the Draft Final Report with PGC comments with the Final Report.

Edits to the Final Report
The feedback from the PGC will clearly indicate what edits are required to be made before the final project grade is reported. You are strongly encouraged to arrange a meeting with your PGC to get clarification for any required edits. If edits are required, you must meet with the Chairperson of the PGC to get approval of your edits.

It is **your** responsibility to arrange a time to meet with your PGC for these purposes.

8.6 Report Elements

Report Format for Word Processing

When preparing the Final Written Report, adhere to the following Word Processing format:

Margins: 1" left and 3/4" right margins. (1" LEFT MARGIN NEEDED to accommodate binding!)

Spacing: 1-1/2 line spacing for all reports, including the Final Draft and Final Report

Font: Use 12 point Times New Roman or Times font for the body of the text. Other fonts may be selected for specific purposes. For example, you may wish to use a non-proportional font such as Courier to set off examples of programming code as distinct from the rest of the body text.

Section Numbering: Sections should be numbered successively using legal outline numbering. Here is an example for your paper:

1. Introduction
   1.1. Technical Motivation for Project
   1.2. Economic Motivation for Project
2. Problem Statement
   2.1. Scope of Work
   2.2. Deliverables

3. Team Objectives
   - 3.1. Initial Analysis
   - 3.2. Research
   - 3.3. Benchmarking Similar Applications
   - 3.4. Design Development
   - 3.5. Prototype Testing
   - 3.6. Selection Criteria
   - 3.7. Finalize Design
   - 3.8. Economic Analysis
   - 3.9. Conclusions
   - 3.10. Recommendations
4. Initial Analysis of … (see Page 15-16, Initial Analysis)
   - 4.1. Basis of Initial Analysis
   - 4.2. Metrics
   - 4.3. Data Gathering
   - 4.4. Initial Economic Analysis
   - 4.5. Conclusions from Initial Analysis
5. Research of Solution Technologies and Approaches
   - 5.1. (appropriate sub sections)
   - 5.2. (appropriate sub sections)
   - 5.3. Conclusions from Research
6. Benchmarking Similar Applications
   - 6.1. (appropriate sub sections)
   - 6.2. Conclusions from Benchmarking
7. Design Development
   - 7.1. Basis of Design
   - 7.2. Design Specifications
   - 7.3. Design Alternatives
     - 7.3.1. (appropriate sub sections)
     - 7.3.2. (appropriate sub sections)
8. Selection Criteria for Successful Design
   - 8.1. Prototype Testing
   - 8.2. (appropriate sub sections)
9. Economic Analysis
   - 9.1. (appropriate sub sections)
10. Conclusions
    - 10.1. (appropriate sub sections)
11. Recommendations
    - 11.1. (appropriate sub sections)

Page Numbering: Lower right in the page footer, 12 point Times New Roman or Times font to be done as follows:

- The Title page through the List of Tables should be numbered with small Roman numerals with numbers i, ii, iii, etc.
- The first page of the Introduction is page 1, with page numbering continuing through the last page of the References section.
- Each Appendix (Appendix A, B, C, etc.) should have its own numbering scheme with the numbering beginning with A-1 through A-8, etc., B-1 through B-5, etc.

To do this in MS Word:

1. Insert Page Numbers for the entire document.
2. At the beginning of the new numbered section, (Introduction, Appendix A, etc.), insert a Section Break by clicking on **Insert, Break**… , **Section Break Type: Next Page**
3. In the section that is to be renumbered, unlink the section from the previous one by clicking **View, Header and Footer**, then click the button **Link to Previous** so that it is deselected.
4. In the new section to be renumbered, click **Insert, Page Numbers, Format, Start At**, and then enter **1**.

You can finish the Appendix page number formatting by manually inserting the "A-", "B-", etc., before the page number fields in the footers in each Appendix section.

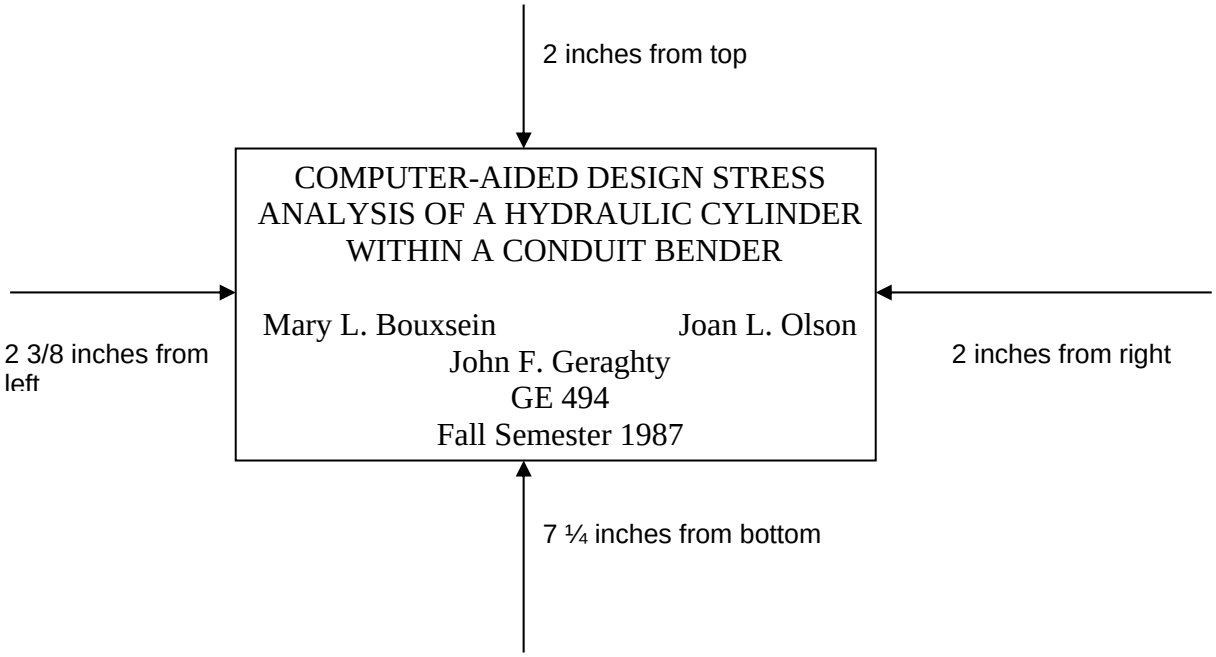
Cover sheet. (See sample on next page)

The Cover Sheet must adhere strictly with the guidelines given on the following page. The information on the Cover Sheet will be viewed through a die-cut window in the rigid binding cover of the Final Report. A sample is available in 117 TB so you can check your formatting.

Title page. (See sample following sample cover sheet)

The Title Page must contain the types of information as shown on page 59. Make sure that the information is spaced in a manner that is pleasing to the eye as shown in the example. Be sure to use middle initials in the student and Advisor names.

Sample Cover Sheet



Make sure title block fits report cover so everything can be clearly read. A sample front cover can be obtained from 117 TB.

NOTE: Title of report, names of students, course number, semester, and year must all be centered in the "window" defined by the above dimensions.

Also, do not draw a box on this page as shown here. It is only a guide.

Sample Title Page

COMPUTER-AIDED DESIGN STRESS ANALYSIS OF A HYDRAULIC CYLINDER WITHIN A CONDUIT BENDER

Project Team: Mary L. Bouxsein
Joan L. Olson
John F. Geraghty

Project Advisor: Professor Scott A. Burns

Company Industry Partner: Greenlee Tool
Rockford, Illinois 61108

Company Advisors: Mr. Gary A. Moberg
Mr. Charles Q. Fisher

GE 494
Fall Semester 1987

Department of Industrial and Enterprise Systems
University of Illinois at Urbana-Champaign

PLEASE NOTE:

You must adhere to the following:

1) Determine proportionally the exact spacing needed so the title page enhances, instead of detracts, from your report.

2) Include ALL of the information, as shown in this example. **Fill the page.**

Abstract

A good abstract is a concise summary of the entire project: introductions, problem statement, work accomplished, results, conclusions and recommendations. This requires efficiency of words and phrases. An abstract is written to stand alone, without jargon or reference to figures and tables in the report body. Note that an abstract emphasizes what was accomplished. The abstract should be about 200 words. The abstract should be on a separate page in the report (see example below).

Key words

Provide a list of words or short phrases that are descriptive of your project — words that would enable a researcher to zero-in on your work in a database search. List these below the abstract. Future Senior Design Project students will locate your paper by searching on the key words. Include approximately ten (10) words (see example below).

Sample Abstract and Keywords

ABSTRACT

Solo Cup Company manufactures a variety of thermoformed plastic cups and other food service goods. Solo Cup engineers design and maintain the tooling utilized in the thermoforming manufacturing lines. Thermoforming employs air pressure and vacuum tooling to supply suction to a plastic sheet, forcing it onto the walls of a female mold cavity in the shape of the final product. Solo Cup desires that the vacuum tooling employed within the thermoforming process be analyzed in terms of airflow efficiency, followed by measures to improve the efficiency. Analyzing and redesigning the tooling to improve vacuum airflow efficiency can lead to a reduced cycle time and thus an increased production rate. Solo Cup identified the mold cavity assembly as the area to be evaluated and improved. To arrive at a solution, the airflow through the original cavity was analyzed using fluid dynamics, and the resistance to airflow through the cavity was determined by use of a physical experiment that measured the flow rate through the cavity. Design modifications within the mold cavity were tested using Computational Fluid Dynamic (CFD) software, to yield visual representations of flow conditions. Significant changes have been incorporated into a prototype, which was manufactured by Solo Cup's machine shop.

Testing of the prototype, in the physical experiment, showed a 39% improvement at one-third the operating pressure and satisfies all the project goals, and is recommended for implementation.

KEYWORDS: thermoforming, airflow efficiency, mold cavity, computational fluid dynamics, CFD

Acknowledgements

Acknowledge the contributions of the Industry Partner, University staff, other students, faculty, and other persons who were of assistance. Be tactful in your descriptions of the contributions of those acknowledged.

Table of Contents

The table of contents should reflect the organization of the report. Sections and subsections in your report should be numbered and titled in such a way as to assist the reader in understanding the organization of the report. In MS Word, legal-formatted outline numbering works very well for a structured table of contents. The Table of Contents should follow the abstract and be on a separate page.

See the following example from a Fall 2003 project for Solo Cup Company entitled: "Thermoforming Air Pressure/Vacuum Analysis."

Note that the Table of Contents is structured to exactly follow the list of Team Objectives which will be shown later in this handbook. The Team Objectives should map out the "plan of attack" for solving the problem. The Team Objectives provide an excellent structure for the rest of the report and show the reader what to expect in the rest of the report.

This Solo Cup report is chosen as an excellent example. It was also awarded the Gold Award in the Lincoln Arc Foundation National Engineering Design Competition and the Bernt O. Larson Award in the General Engineering Department for the outstanding Senior Design Project for the Year 2003.

Sample of Table of Contents

List of Figures

This is a simple listing of all figures in the report and their location by page number. The figures should be numbered in order with the chapter number and the figure number within that chapter. Use dot leaders as shown below. These are put in by formatting the Tabs in MS Word. The List of Figures should immediately follow the Table of Contents without a page break. See the example below.

List of Figures

List of Tables

This is a simple listing of all tables in the report and their location by page number. The tables should be numbered in order with the chapter number and the figure number within that chapter. Use dot leaders as shown below. Again, these are put in by formatting the Tabs in MS Word. The List of Tables should immediately follow the List of Figures without a page break. See the example on the following page.

List of Tables

Introduction

The purpose of the Introduction is to give context to the Problem Statement. In other words, the Introduction should have enough information, both technical and economic, so that the reader understands the Problem Statement. This is accomplished by discussing the Company, the product, the market, etc., and transition into the area that will be the focus of the project. Discuss the current status of the product, process, or system that reasonably makes it something that should be analyzed for improvement or redesign. There should be a brief discussion of the current status of excessive costs, savings potential, or opportunity for increased revenues by addressing whatever is the focus of the project. In other words, the introduction should be both an engineering introduction and an economic introduction to the project. There must be both engineering and economic motivation discussed in your introduction. It should be clear that the Industry Partner will increase profits in some manner through the project that is being introduced.

Make sure that you begin your discussion in the context of the typical reader's experience – something that the typical reader can readily understand. If you don't follow this advice, you will lose the reader in the first two pages! Do not baffle the reader with unnecessary esoteric terms or undefined technical jargon. Specific technical terms can be introduced and defined later in the body of the paper. The introduction should provide the reader with a basic understanding and motivation for the project, both technical and economic, and provide a reasonable context for the problem statement.

A typical introduction will be about **1½ to 2 pages long and MUST include photos or other illustrations that give the reader a good understanding of the context of the project and its eventual focus**. As the reader comes to the end of the Introduction, the next logical idea presented to the reader should be the Problem Statement in the next section.

Do not make the mistake of putting the Problem Statement into the Introduction, or of putting the Introduction into the Problem Statement. Each of these sections serves a distinct purpose.

Also, do not confuse the introduction of the paper with the body of the paper. The Introduction should NOT include information from the results of any analyses you have done. Analytical results should be restricted to the body of the paper.

As one finishes reading the Introduction, one should understand what the Company is about, how it makes money in its business, how the focus of the project is involved in making money, and what challenge or opportunity is presented in the current status of the product, process, system, etc. One is then ready to continue to the Problem Statement which will precisely define what the Company Industry Partner wants to accomplish.

Problem Statement

The Problem Statement must be a concise and complete statement of the focus of the project, the scope of work, and deliverables that will be observed and completed. The Problem Statement should include a complete **Scope of Work** for everything that is to be done by the team and the **Deliverables** to be delivered to the Company by the end of the project. In other words, the Problem Statement is to be completely unambiguous in nature. It should precisely define what the project should include, and once those items are completed, the project is finished. It defines the goal line. The Problem Statement is written for the Industry Partner from the standpoint of asking, "What do they want?" If the Problem Statement is ambiguous, then the goal line is ambiguous and it becomes impossible to precisely determine if you have completed everything you have been asked to do – because it is subject to broad interpretation. This can result in "Scope Creep" which allows the project to be extended and expanded again and again such that you never get done. Keep in mind that if you write a precisely defined Problem Statement including the scope of work and all deliverables, you will know when you have done everything that is required, and so will your Advisor, your Graders, and your Industry Partner.

Again, the Problem statement should not include ANY introductory information. ALL introductory information belongs in the Introduction. An efficient Problem Statement can be written by completing this sentence, "Acme, Inc. desires that ... (insert goals of the project) ... subject to the following criteria:" Then give a numbered list of the constraints, criteria, and deliverables. Continue with the Problem statement immediately after the Introduction without a page break. A sample Problem Statement is given on the following page.

Problem Statement

Solo Cup desires that the airflow efficiency of the mold cavity of the P16 party cup be improved to reduce thermoforming vacuum cycle time. The following deliverables and criteria will be met:

Scope of Work:

1. The current airflow efficiency through the female mold insert must be analyzed.
2. New female mold insert designs must be developed to improve vacuum airflow.
3. General mold cavity airflow design guidelines must be established for use in other cavity design by Solo Cup personnel.
4. A prototype female mold cavity insert will be made by Solo Cup from drawings provided by the project team for testing by the project team for improved airflow efficiency.

Deliverables:

5. Drawings and all findings must be returned to Solo Cup Company with recommendations.
6. Specific recommendations will be made to Solo Cup for further testing and implementation of the new design.
7. All recommendations must meet a one-year payback.

Team Objectives

The team objectives form a "battle plan" for the project, and are essentially a breakdown of the logical steps or accomplishments that must be completed to achieve the overall project goals. The team objectives give the reader a high-level problem solving "algorithm" of all the major tasks that must reasonably be accomplished to complete the project. Write the team objectives from the standpoint of asking, "What do we do?" The team objectives form a list of high-level tasks that are necessary to complete the project. The team objectives should be established in the first two to four weeks of the project. These will be used to direct the effort for the rest of the project, and may be subject to some revision as the project progresses. The team objectives form a reasonable structure, not only for the work on the project, but also for the rest of your report. Note that the team objectives given in the example on the following page closely match the example Table of Contents given on page 62 for the Solo Cup report.

The team objectives should be a numbered list of items with one or two sentences of explanation. If the objective is almost self-explanatory, use only one sentence of explanation. If more explanation is necessary, then a second sentence may be used. The team objectives should not be written as a mini-report of the work you have already accomplished, what it means, etc. Save all of that for the Body of the report. Write the team objectives with a viewpoint from the beginning project just after the first plant trip and first few Advisor meetings when the team objectives were first established.

Note that the first objective should be "Analysis of Current (Process/Product/System, etc.). This Objective is done to establish the current status, costs, metrics, design goals, etc. for the project. See more details about this in the Initial Analysis section in Chapter 2. In some cases, it may be appropriate to begin with a "background" section to give the reader more technical information about the context of the project. This is the case in the example below.

The team objectives can be listed after a single sentence such as, "The following objectives were determined to be necessary for the successful completion of this project:"

The team objectives should follow immediately after the Problem Statement with no page break. A sample list of team objectives is given below.

Sample Team Objectives

The following objectives were determined to be necessary for the successful completion of this project:

1. **Review of Thermoforming Process.** The entire thermoforming process must be understood with the forming insert as an integral component in the overall process.
2. **Analysis of Current Mold Cavity Design.** The current female molding insert will be analyzed for airflow efficiency using design drawings and CFD (computational fluid dynamics) software.
3. **Design Alterations.** Weaknesses will be identified from the analysis of the current design allowing modifications to be made to improve airflow efficiency.
4. **Prototype Testing.** Prototypes of the new design will be produced and tested for airflow efficiency to validate CFD results.

5. **Economic Analysis.** Based on the prototype testing, the best designs will analyze in financial terms meeting the mandatory one-year payback.

6. **Conclusions.** A summary of the findings obtained from experimentation are related to project goals and objectives, including financial and technical benefits as well as further considerations.

7. **Recommendations.** Based on testing and financial viability, a course of action and design changes will be recommended. General design guidelines for female molding inserts will be established and presented.

Body (But the body is NEVER entitled "Body" in your report!)
The body of the paper is the meat of the report in which the work completed and the results are reported. Keep in mind that the report is an engineering report and therefore should be written in a technically rigorous manner. But, it is also essentially the report of a consulting team which is written for the client. It must be written for the needs of the Company Industry Partner and with regard to the motivations of the Company Industry Partner. The final purpose of the project is to make the Company more productive and profitable, and this is a theme that should be followed in some manner through the entire report. Keep in mind that economics motivate the very existence of the project, as well as the direction of the possible solutions, and the selection of the final solution to be recommended to the Company Industry Partner.

The body of the paper consists of several major sections which are logically structured and arranged. As mentioned above, the body structure can come directly from the list of team objectives. The body will be more detailed in structure, but the basic flow should be essentially the same. Again, the major section should be entitled "Analysis of Current…" (The only exception to this is a "Background" section, if deemed necessary.) This Initial Analysis forms a basis for the entire report and sets the design criteria, metrics, and costing criteria that will be used to gauge the final solutions. See the "Initial Analysis" section in Chapter 2 for more detail.

In each section, use consistent terms, definitions and jargon, and establish main points or themes that will be developed and followed through the later sections of the report. Motivate each section with a brief discussion of what the section is contributing to the report. Include the approaches used, present results, and assess the significance of each result in achieving the goals of the project, specifically with respect to the items listed in the problem statement. Include some conclusions in each section and a transition to the next section. This is especially essential in the Initial Analysis section. Include relevant data analyzed, discussion of results of calculations and experiments, and drawings of prototypes. Place figures and tables where they enhance discussion in the text.

You MUST use figures, tables, graphs, numbered lists, bulleted lists, drawings, etc., to support your discussion and make the comprehension of your paper as pleasant as possible for the reader. See the section **Figures and Tables** later in this chapter for more details.

Do not place embedded lists of significant items in the sentences of a paragraph. Place the list of items in a numbered list or table for the ease of the reader. For example, your report MUST include:

1. Figures
2. Tables
3. Graphs
4. Numbered lists
5. Bulleted lists
6. Drawings

If your discussions are not supported with figures, graphs, tables, numbered lists, drawings, etc., then your report is not acceptable.

Include raw data in the body of the paper when it is germane to the immediate discussion. Other data may be included in an appendix. When referencing an appendix, make sure you tell the reader where to look in the specific appendix page number, e.g. (see Appendix A-4). Don't create a wild goose chase for data that is misplaced or doesn't exist.

After one section of your report is completed, continue with the next section on the same page, if possible. Do not waste paper with unnecessary blank space.

Economic Analysis

Include an analysis of the economic impact of your work and its significance to the Industry Partner. Most Industry Partners will specify their investment requirements in terms of payback period which must be met by all project recommendations. Your Economic Analysis must include the following four items:

1. Net Cash Flow Diagram
2. Payback Period
3. Net Present Value
4. Return on Investment (ROI or IRR)

Typically, the economic analysis is the most crucial section in the report for the Industry Partner, as it will dictate the most logical and profitable way to implement your recommendations. Make sure your economic analysis is clear and your Industry Partner is in agreement with your calculations and predicted savings. This is NOT a place where you want last minute surprises from your Industry Partner or vice versa.

Make sure you have discussions with your Industry Partner's cost accounting, marketing, and/or other personnel who can give you accurate costing information and help you understand how your Industry Partner tracks costs, profits, overhead, burden, materials, inventory, marketing, warranties, etc. See Chapter 9 for more discussion of economic analysis.

The economic analysis section must be included in the midterm and the rough draft even if the final results of the economic analysis are not completed. You should be able to show the methods that will be used for the analysis, including the total cost of the problem and the potential savings of the proposed solution, even if rough estimates are used at this point.

In some cases, it is impossible or impractical to directly measure or calculate the savings from your recommendations. You may have to indirectly estimate savings as a function of a parameter yet to be determined from the project result. In this case, the economic analysis can be done as a function of that parameter, through a range of its possible values. An example of this is found in the Solo Cup Thermoforming Project. The technical result that improved airflow in the thermoforming die could not be directly translated into cycle time reduction in the thermoforming process. Test implementation in the actual production process was prohibitively expensive during the course of the project. The students expressed the potential savings as a function of cycle time reduction in hundredths of a second. Since the cycle time costs were well known, the potential savings could then be easily expressed. See your Advisor or the GE 494 Coordinator for clarification, if necessary.

Note that ALL calculations for costs, savings, etc. must be endorsed by your Company Industry Partner for use in your economic analysis.

Conclusions

Summarize the conclusions obtained from your work, and relate them to the project goals and team objectives. Be specific. It is often helpful to present conclusions as a numbered list with adequate discussion to fully clarify each item. Also, when possible, quantify the dollars saved and technical benefits. There should be nothing new here; all conclusions should be an echo of conclusions drawn in previous sections.

NOTE: The Conclusions section is **NOT** to be simply a summary of the entire paper and everything you did. Conclusions are just that… what you conclude from the work you have done and the results you have obtained, as well as their impact on the business model for the Company Industry Partner.

The Conclusions section is also your opportunity to clearly illustrate and *tactfully* state that all of the requirements of the problem statement have been met. You may also include additional insights which you gained during the course of the project, not specifically required by the problem statement, but still of potential value to the Industry Partner.

Tact: Avoid subjective statements that may be interpreted as negative by the Industry Partner. Keep in mind the Industry Partners take pride in their operations. Instead of saying, “The quality of the production line is poor.” rephrase to, “The production line does not currently meet quality requirements and specifications.”

Recommendations

These are a list of specific actions to be taken as a result of the conclusions of the project and economic analysis. Recommendations should include an introductory paragraph or two, followed by a numbered list of specific actions to be taken. Reference specific drawings, vendors, part numbers, costs, maintenance requirements, training, software, etc. There should be no guesswork by the Industry Partner. It may be appropriate to list recommendations in order of their importance, costs, savings, etc. You may want to group them for a stepwise implementation program into phase 1, phase 2, etc. (again, do not surprise your Industry Partner; all recommendations should have been discussed or at least alluded to earlier).

Note: If your project recommendations include significant procedural steps and capital expenditures, you may need to include a section on implementation strategies to map out an implementation plan. Typically Industry Partners will want to implement the most cost effective items first, and wait for others. If your plan involves a major disruption to production, give a stepwise implementation strategy which minimizes disruption. This may involve planning for implementation during annual plant shutdowns or other periodic opportune times.

References

Include references for all significant sources of information, such as textbooks, scientific papers, manufacturers’ publications, etc. (In some cases a list of special sources may be appropriate, such as web sites, systems used for patent searches, etc.). (See examples). Begin compiling your reference lists at the start of the project as you are doing your research.

Reference and Citation Format

You must include a list of references that you cite to support facts that are not common knowledge, or expert opinions that you include in your report. In general, it is better not to use a bibliography of sources consulted for general background knowledge, instead, make a habit of citing the sources that you actually used. The following examples demonstrate the format to use in your report and in the Reference section at the end of the report Body.

Book:

For a discussion of some of the weaknesses of Taguchi methods, see Montgomery (1991).

Or

Taguchi methods have a number of well-known shortcomings [Montgomery (1991)].

Article:
There are a variety of outlier rejection methods [Stefansky (1972)] available for experimental design.

Report with no author:
Critical values for the random variable with an F distribution are available from the Bureau of Standards (1943).
To fit a generalized linear model to the data, the GLM procedure in SAS (1988) was used.

Conversation:
A linear model was chosen since they are often appropriate for power plants [Wearle (1995)].

References:
Montgomery, D.C. (1991). *Design and Analysis of Experiments*, John Wiley and Sons, New York.

SAS/STAT *User's Guide* (1988), SAS Institute Inc., Cary, North Carolina.

Stefansky, W. (1972). "Rejecting Outliers in Factorial Design," *Technometrics,* Vol. 14, No. 2, pp. 469-479.

Statistical Tables, (1943). U. S. Bureau of Standards, Washington, D. C.

Wearle, S. R., personal communication, February 28, 1995.

Appendices
Include data tables, background calculations, specification lists for equipment used, details of experimental configuration, and other information needed for completeness, but which would bog down the discussion in the body of the report.

Your Appendices must each have footer with numbered pages for that appendix. Appendix footers may be easily inserted with use of a section break in MS Word. Use a different section for each appendix (A, B, C, etc.), and restart the appendix page numbering in each new lettered appendix section. Numbering format must be A-1, A-2, A-3, B-1, B-2, etc. See the Table of Contents section earlier in this chapter for details.

Mechanical drawings
Mechanical drawings must accompany many types of projects and are typically placed into an appendix. Drawings may range in size from A through E for typical report purposes. See Section 8.6 for specific guidelines for inclusion of drawings.

Equations

Number equations near right hand margin.

$$MS = MS(A) + MS(B) \quad (9)$$

$$F = ma \quad (10)$$

Units

By now, the eventual conversion of the United States to the SI system of units is no longer hypothetical. In the SI system, as you know, the fundamental units are:

force:	Newton	distance:	meter
mass:	kilogram	time:	second

Your Final Written Report **must contain SI units.** If you work on a project in an industry where SI units are already commonly used, then you should add the appropriate English units in parenthesis, e.g.:

... “for a distance of 1.00 m (3.28') the system ...”

If the industry typically uses English units, then put the SI equivalent in parenthesis immediately after it is needed so that both **SI and English units are present in your report.** If you are not sure of the correct SI units for a particular quantity, **find out what they are.** The above discussion of units applies to drawings as well as text.

Figures and Tables

Figures and tables are invaluable to the clarity and completeness of your report. Many times the quality of a report is judged by the quality of the figures and tables it contains because these items stand out more readily than the text. The figures and tables visually show the effort and attention to detail by the authors of the report.

Note that you MUST reference each figure and table in the text of the report, and do so at the place in the text where the figure or table is essential to the discussion. Figures and tables must be well labeled and should answer questions for the reader and create no ambiguities. Make sure your figures and tables are very clear and understandable.

Figures should be numbered and given a descriptive title or caption that is placed **under** the figure and should be explanatory of what the figure shows.

Tables should be numbered and given a descriptive title or caption that is placed **above** the table and should be explanatory of what the table shows.

Complete captions are very important! Keep in mind that many readers may simply want to skim your report. Well labeled figures and tables with complete and explanatory captions allow them to do this efficiently without significant loss of understanding.

Figures should answer questions but create no new questions or ambiguities. Makes sure your figures are clear and readily understandable. Use labels to identify pertinent features.

Pages bound "sideways" (landscape format) should have the "bottom" along the unbound, right-hand margins.

8.7 Drawings

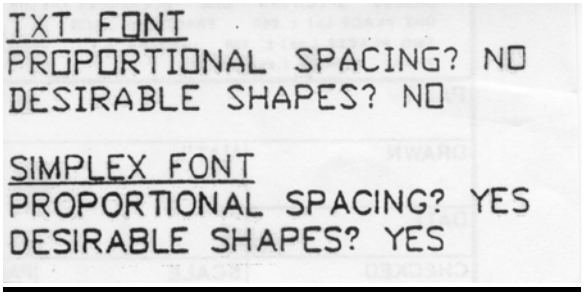
All figures, graphs and other graphical materials should be approved by your Advisor and eventually by the Project Grading Committee. **All** mechanical drawings prepared for inclusion in your report must be of high quality and meet accepted standards. Any inadequately prepared graphical material noted by your graders is sufficient cause for an "F" grade to be assigned to the project team. See the examples on the following pages for required formats.

Since the use of computer software to produce these is faster, easier and neater than hand drawing, it is highly recommended and encouraged. AutoCAD is available in the GE 494 Lab in 305/306 TB.

NOTICE TO AUTOCAD USERS

The standard AutoCAD text font "TXT" (sample on following page) may be the designated default font but is **NOT** desirable for GE 494 reports. The "SIMPLEX" font (sample on following page) is preferred, closely matching the lettering style generally accepted by the engineering profession.

> ***NOTE*:** Changing the font affects previous as well as future text (whether in DTEXT or DIMENSIONS); an automatic regeneration takes place at the end of the style command. It is better, however, to change the text font at the outset, because 'SIMPLEX' is proportionally spaced and slight misalignments may become apparent when 'TXT' is changed.



TITLE BLOCKS

Aaron Rogers (BSGE ’91) has donated a copy of a GE 494 drawing title block for use with AutoCAD drawings. The file is obtained in the GE Senior Project Computer Lab (305/306 TB). In 305/306 TB, obtain the file “title494.dwg” (omit quotes) over the network, just like 103 students would obtain an assignment.

> ***NOTE*:** The title block may need to be resized/reoriented (SCALE, ROTATE) for different drawing sizes A or B. The most efficient use, however, is to INSERT the file (use a *before the file name, i.e., *title494, to minimize storage and permit item editing).

FORMAT TO BE USED FOR ALL
MECHANICAL DRAWINGS USED
IN GE 494 FINAL REPORTS

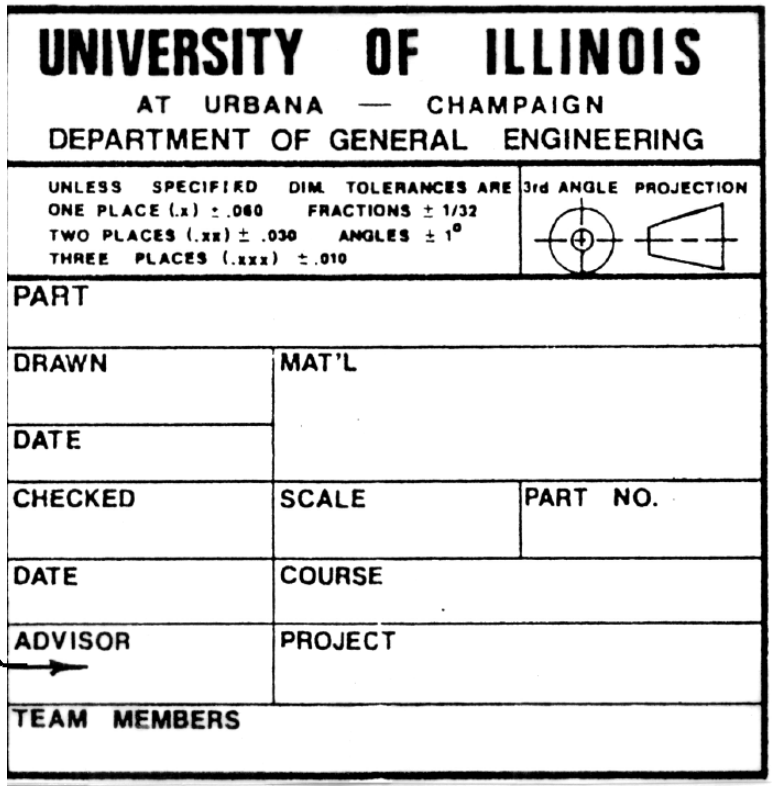
All mechanical drawings that are part of a GE 494 Final Written Report (not figures, graphs, etc., which are included in the main body of the report) **must conform to the format of this sheet and contain a title block logo as shown.** The 8 ½" x 11" format is greatly preferred. If you absolutely must use a larger format, see the next page of this handbook for instructions on how to fold, etc.

For drawings produced by computer, a facsimile of the title block logo must be included in the computer file and plotted drawing. (See previous page).

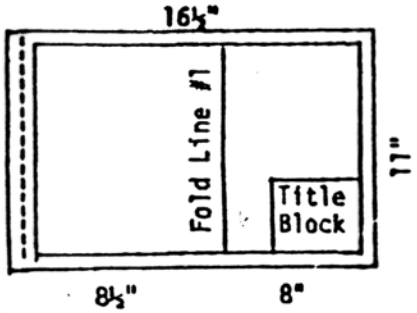
½ inch border on other three sides →

← 1" border

Your Advisor's initials *must appear here before reproduction of ten (10) copies of the drawing for your final report copies.*



B Size



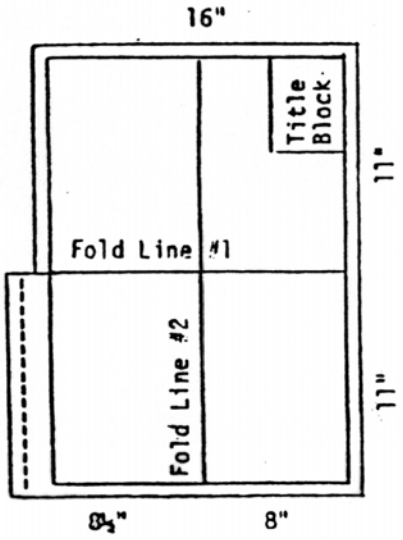
Illustrated is the standard format that will be used for all Project Design drawings. Given are B, C, and D standard sizes.

Note:

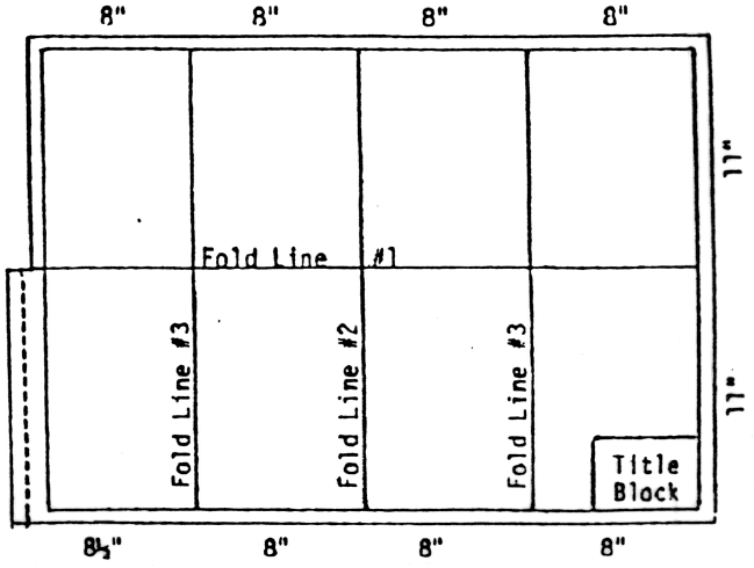
1. Fold lines are imaginary lines, but the 1 inch extension of the fold lines in the margins shall be placed where indicated.
2. All sizes fold down to an 8 ½ x 11 inch size.
3. Margins will be maintained (see section 8.6) except on C and D size where the left hand margin will be 1 inch but reduced to ½ inch above the fold line number 1.

If you have any questions, please see Jim Leake in room 309b TB.

C Size



D Size



8.8 Final Written Report Copies for Grading

On the due date specified, and for purposes of grading, **three (3) color originals (securely stapled with all pages properly aligned, but NOT BOUND)** of the report are to be submitted to 117 TB by the time specified. **(Again, print ONLY the color pages on the color printers in 305 TB – print all of the black and white pages on the black and white printers or the default printer/copier. This will expedite printing for the large number of reports to be printed.)**

Your final report and copies should be absolutely complete when submitted for grading. You will not make the ten (10) required copies (see Exit Procedure) of the report until **AFTER** it has been graded and required changes have been made.

Final Report Edits Required by PGC

Your GE 494 grade is based primarily on the PGC's evaluation of the final written report as submitted on the due date, and secondarily by the quality of the Final Oral Presentation (at the PGC's discretion). PGC members typically will require edits to the final report, due to previously undetected errors, inclusion of new material since the rough draft report, or edits which inadequately address feedback from the rough draft. All editing changes required by the PGC will be made by the project team before a grade may be assigned and the final copies sent to the Industry Partner. In the event that the PGC finds the written report deficient to the point where it cannot be rectified through editing, all the members of the project team may receive a grade of "F". Additional work may be required after the end of the semester to complete the project and resubmit a final report to the PGC for re-grading. The last alternative is to retake GE 494 the following year.

Each group is responsible for contacting its grading committee to determine if corrections are required. On the date specified on the semester schedule, your final manuscript, with PGC changes incorporated should be brought to Room 117 TB, along with your Final Report Check List (*Form FRC*). The checklist will have the signature of the PGC Chairman, indicating that the report has been graded, and that required changes have been made. It will also contain your Advisor's signature, indicating you have submitted your notebooks and colleague evaluation forms. There will also be an opportunity to check for keys, copy cards, software, equipment, etc. not previously turned in.

If there are prototypes to be mailed/shipped to the Company, package them and bring to 117 TB. Check with 117 TB concerning large items that must be sent through the Mailing Center.

Get your checklist (*See form FRC)* completed early!
This is a busy time for professors also.

8.9 Copies of Approved Final Report

When the Final Report Check List is in order, please make a CD containing only a pdf file of your completed report. When this file is copied to the CD, please print one (1) color copy from this file. Next, please check this printed copy to make sure everything is printing correctly and all parts of your report have been included. Then bring the CD and the color printed copy to 117 TB. Barb Bohlen or Leslie Davison-Pirie will then submit an electronic copy for printing.

Photocopier Use: For small copying jobs, the Department has a photocopier in Room 106 TB for use by project groups. This will be available from 8:00 a.m. to 5:00 p.m. only. See personnel in 117 TB for instructions or copier problems. You also have a printer/copier in the Senior Design Lab. Each project group is assigned a code, which is distributed with your project assignments on the first day of class. You will find this number in your notebook.

There are limitations on use. For large printing jobs - over 175 pages - (i.e., drafts and final written reports, copying from chapter(s) in book(s) and journal articles, etc.), you should see 117 TB for a copy form. There are several copying centers located across the University campus

If photographs are to be used in the report, use a digital camera or scan the photos to incorporate into the document. The department has a digital camera, a color scanner and a color printer that are available for use in GE 494. Go to 117 TB to check out digital cameras, which will make it easier to produce striking visual features for your report.

Chapter

9

Economic Analysis Basics

Motivation

The majority of GE 494 projects are specified such that the economic analysis is a crucial part, if not the most important part, of the report for determining the final recommendations to the Industry Partner and the plan for their implementation. This is because the Industry Partnering companies, in the broadest sense, are investment firms whose goal is to maximize profits for the Company owners and shareholders. The Industry Partner chooses to invest in its own processes, product development, and production capability, because it can reliably achieve a far greater return on investment than any other outside investment such as stocks, bonds, real estate, etc. Because of this, economics will determine the ultimate decisions the Industry Partner will make with respect to the project. The engineering component of the project provides the possible technical solutions to the problem. The economic analysis (generally) will be used to choose the best solution(s) and the order and timing of their implementation.

Cost Data, Savings, and Verification with Industry Partner

Your economic analysis will typically rely on costing and financial data provided by the Industry Partner for scrap rates, material costs, labor rates, overhead or burden, warranty claims, increased sales, and other types of appropriate costs and revenues. Start early in your project to make the proper contacts with your Industry Partner to get the types of information you will need for your economic analysis. Often, this data must be estimated by the Industry Partner or retrieved from sources that may take many weeks to access and compile.

As mentioned earlier in this handbook, a valid path to find the best solution in many projects is to “follow the money.” Gain a full and accurate understanding of how costs, savings and revenues are recognized by your Industry Partner. Do this as early as possible. This will give valuable insights to your economic analysis and help guide your project. Establish guidelines for the upper bound to the amount of savings and/or additional profits possible if the full goal of your project is achieved. This will give you early direction about feasibility of possible solutions. Some projects may generate savings of several hundred thousand dollars per year, which support very ambitious and costly solutions.

Other projects may result in savings of only a few tens of thousands of dollars per year. This may immediately eliminate many costly solutions from consideration by the project team and save precious time.

Typically your results will show a savings to the Industry Partner after your recommended capital expenses are made by the Industry Partner. Make sure your costing data is accurate and takes into account labor, overhead, maintenance, materials, scrap, training, testing, calibrations, and any other costs that may affect the analysis. In some cases, savings can be directly calculated by the project team for verification by the Industry Partner. In other cases, reasonable estimates for savings are made by the project team and must receive the Industry Partner's endorsement before being used in the final reports.

In ALL cases, ALL calculations for costs, savings, etc. must be endorsed by your Company for use in your economic analysis.

Projects often result in several alternative solutions, as well as many different optional solutions. In these cases, present your solutions in a table, listing capital cost along with payback period, ROI, and NPV as shown later in this chapter. It is often best to present a stepwise implementation of recommendations that begin with the lowest cost or greatest ROI investments first. The Industry Partner will use the early savings to fund the later implementations. Recommendations should also be made in a manner that is minimally disruptive to current production processes and cash flows.

See previous GE 494 reports available in 117 TB and on the Senior Project Course web site for examples of economic analyses.

For more detail, reference your materials from GE 161/261 as well as the help information provided with MS Excel.

Calculation Techniques

The mathematics of economic analysis is based on simple time value of money calculations. Although these are not complex, note that Albert Einstein called compound interest "*the greatest mathematical discovery of all time*", and "*the most powerful force in the universe.*"

Compound interest can be demonstrated by a single deposit placed into an interest bearing account. If the interest (*i*) is compounded annually, the final value of the account is determined by the number of years that the interest is compounded:

$$F = P(1+i)^n$$

F = future value
P = initial deposit
i = interest rate
n = number of compounding periods

As an example if $1000 is deposited for 6 years at 10% compounded annually, the future value is found to be $1,771.56.

Similarly, to find the present value (P) of a future payment (F) made after (n) compounding periods at interest rate (i) the equation is simply:

$$P = \frac{F}{(1+i)^n}$$

The term $(1+i)^n$ is a key term in just about all time value of money calculations. This should be a review of earlier course material you had in your undergraduate courses GE 161/261.

The present value (P) of a series of (n) future payments (A) with a prevailing interest rate (i) per compounding period is given by:

$$P = \sum_{j=1}^{n} \frac{A_j}{(1+i)^j}$$

If all payments (A) are equal, the present value (P) simplifies to:

$$P = A\sum_{j=1}^{n} \frac{1}{(1+i)^j}$$

And the term $\sum_{j=1}^{n} \frac{1}{(1+i)^j}$ can be used to find the amount of a loan payment:

$$A = \frac{P}{\sum_{j=1}^{n} \frac{1}{(1+i)^j}}$$

Where:

P = loan amount
n = months of the loan
i = interest rate per month = annual rate/12
A = loan payment

For a 30 year loan of $100,000 borrowed at an annual rate of 10%, the monthly payment would be:

$$A = \frac{100{,}000}{\sum_{j=1}^{360} \frac{1}{(1+(.10/12))^{j}}} = \$877.57$$

From the bank's perspective, which borrows money at an annual interest rate of 6%, the net present value (NPV) of a series of 360 loan payments of $877.57, which initially cost the bank $100,000, is given by:

$$NPV = -100{,}000 + \sum_{j=1}^{360} \frac{1}{(1+(.06/12))^{j}} * 877.57 = \$46{,}371.32$$

Note that **NPV** includes subtracting the initial cost of the loan, as seen from the bank's perspective.

So, the net present value to the bank for making this loan is $46,371.32.

The simple **Payback Period** for the loan is the amount of time needed to recover the initial $100,000 cost of the loan. This is simple cash recovery and does not take into account any interest rate.

Payback Period = 100,000/877.57 = 113.95 months = 9.496 years

The **Return On Investment (ROI)** is defined as the interest rate which makes NPV = 0. This is also called the Internal Rate of Return.

In the above example, ROI = 10% simple annual interest.

Note that interest rates used in the formulas are the simple interest rate per compounding period. If 10% simple annual interest is compounded annually, the effective interest rate is exactly 10%. If 10% simple annual interest is compounded monthly, the effective annual interest rate becomes:

Effective Interest Rate = $(1+(.10/12))^{12} - 1 = .1047 = 10.47\%$

Project Economic Analysis Example

Likewise, any business looks at its investments into new products, process improvements, etc., from the same standpoint.

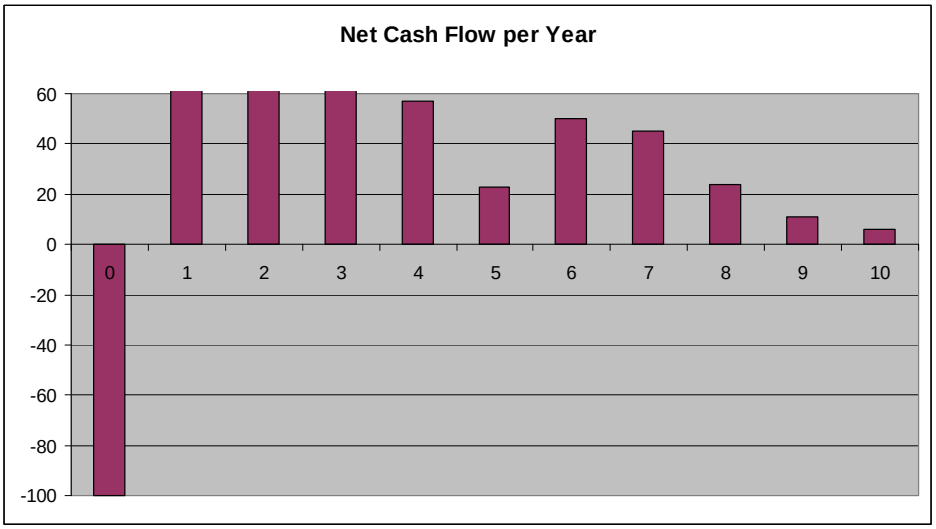
To analyze investments and their returns, construct a cash flow chart and apply time value of money calculations. The example shown below is for a manufacturing process improvement project that reduces the scrap rate of the process from 5% to 1%. The prevailing annual interest rate for the duration of this example is 10%. All numbers are in thousands of dollars.

Year	Capitalization	Production	Scrap Savings	Maintenance	Salvage	Cash Flow	NPV	ROI (IRR)
0	100	0	0	0	0	-100	-100.00	
1	0	1800	72	10	0	62	-43.64	-38.0%
2	0	1900	76	10	0	66	10.91	18.0%
3	0	1850	74	12	0	62	57.49	40.4%
4	0	1800	72	15	0	57	96.42	50.2%
5	30	1700	68	15	0	23	110.70	52.4%
6	0	1600	64	14	0	50	138.93	55.1%
7	0	1500	60	15	0	45	162.02	56.5%
8	0	1100	44	20	0	24	173.22	57.0%
9	0	900	36	25	0	11	177.88	57.1%
10	0	400	16	25	15	6	180.19	57.2%

Key points:

1. Capital cost of the scrap reduction equipment is $100K. This is purchased at the beginning of the first year or at time zero.
2. Production for the first year is $1800K and varies with product demand over the tem (10) years of the project.
3. Savings from scrap is 4% of total production.
4. Maintenance increases with the age of the equipment.
5. Partial recapitalization of $30K is done in year five (5) to reduce maintenance costs.
6. By year ten (10), the product market is dwindling, and the process is discontinued. The sale of the production equipment for $15K is listed in the salvage column.

The first step in the analysis is to construct a **Net Cash Flow Diagram** for the life of the project. Note that this is net cash flow, taking into account the savings as well as the costs. Savings are shown as positive and costs are shown as negative.



Cash Flow diagram for above example

The simple **Payback Period** for the above example is the amount of time to recover the capital cost of the initial investment. This is done using the net cash flow per year for the first few years:

payback period = (capital cost)/(cash flow/year)

payback period = 100/60 = 1.67 years

Net Present Value (NPV) is calculated by finding the value of each cash flow (A) when it is brought back to the present by use of the interest or discount rate, along with subtracting the capital cost. This calculation is accurate with the assumption that the cash flow comes at the end of the interest period.

$$NPV = \sum_{j=1}^{n} \frac{A_j}{(1+i)^j} - capital\ cost$$

A = periodic cash flows

NPV = $180,194

Note that when the NPV function in MS Excel is used for this calculation, the initial capital cost at time zero is not considered, and must be included manually.

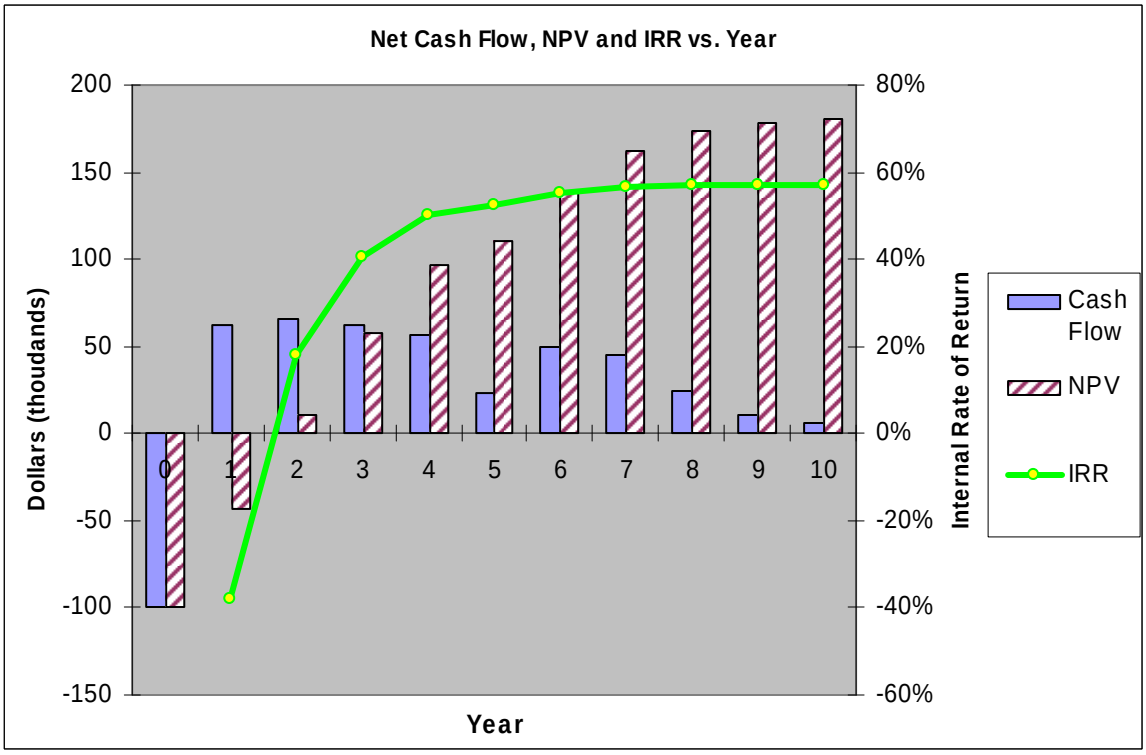
Return On Investment (ROI) is defined as the interest rate at which the NPV is zero. Note that this sets NPV to zero and solves for (i). It is clear that this calculation does not have a closed form solution. It is solved iteratively by successively testing interest rate values and checking for a NPV of zero.

$$NPV = 0 = \sum_{j=1}^{n} \frac{A_j}{(1+i)^j} - capital\ cost$$

MS Excel uses the function IRR, which takes as its arguments, all of the periodic cash flows, including the initial capital investment, and requires a guess to begin the iteration process.

For the example above ROI = 57.16% for a 10-year project life span.

The following graph shows Cash Flow, NPV and ROI or IRR together. Note that both NPV and IRR are time functions from the standpoint of how far into the future the analyst desires to consider these values for purposes of comparison of present investment decisions.

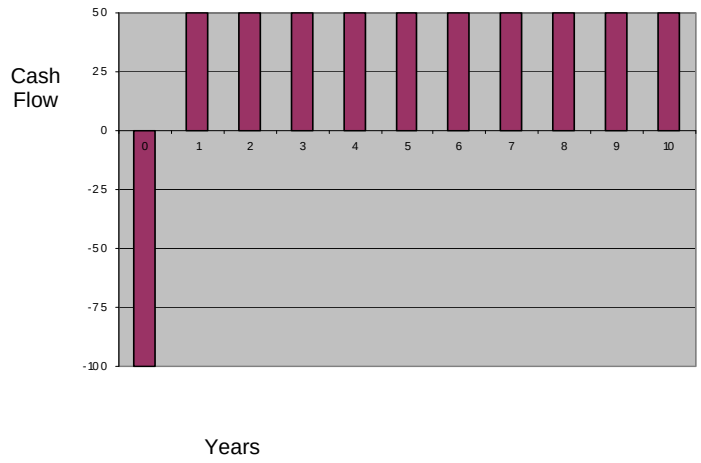


Comparison of the Three Methods

The three methods shown above are not interchangeable. Each method gives a different view of the cash flow pattern of the project being analyzed. Note this carefully. This is why all three methods (Payback Period, NPV, and ROI) must be included in your project report along with the cash flow diagram.

The payback period or simple cash recovery period ignores the interest rate and is therefore easiest to calculate. In fact, it can typically be done on the back of a napkin. But results can be very misleading. Take, for example, a Company that requires a 2-year payback for all capital projects. The implicit assumption in this payback requirement is that the net cash flow model will be similar to the "perfect 2-year payback" shown below:

Year	Cash Flow
0	-100
1	50
2	50
3	50
4	50
5	50
6	50
7	50
8	50
9	50
10	50

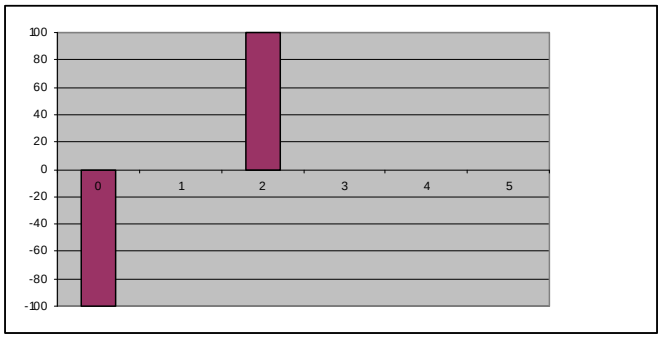


This model has the following characteristics:

Payback period	2 years
NPV	$207.23
ROI	49.08%

The following model has the same payback period but a clearly different cash flow pattern:

Year	Cash Flow
0	-100
1	0
2	100
3	0
4	0
5	0



This model has the following characteristics:

Payback period	2 years
NPV	-$17.36
ROI	0%

Although this cash flow model passes the payback period test, NPV and ROI show it to be a terrible investment. Again, this example demonstrates why all three methods should be used to get a more complete picture for decision making.

Decision Making

When choosing among mutually exclusive projects or features of the same project, NPV, ROI, and payback period should be calculated for each alternative in order to make the best economic choice.

If the mutually exclusive options have different life spans, NPV is typically the best metric for comparison because all savings are brought to the present.

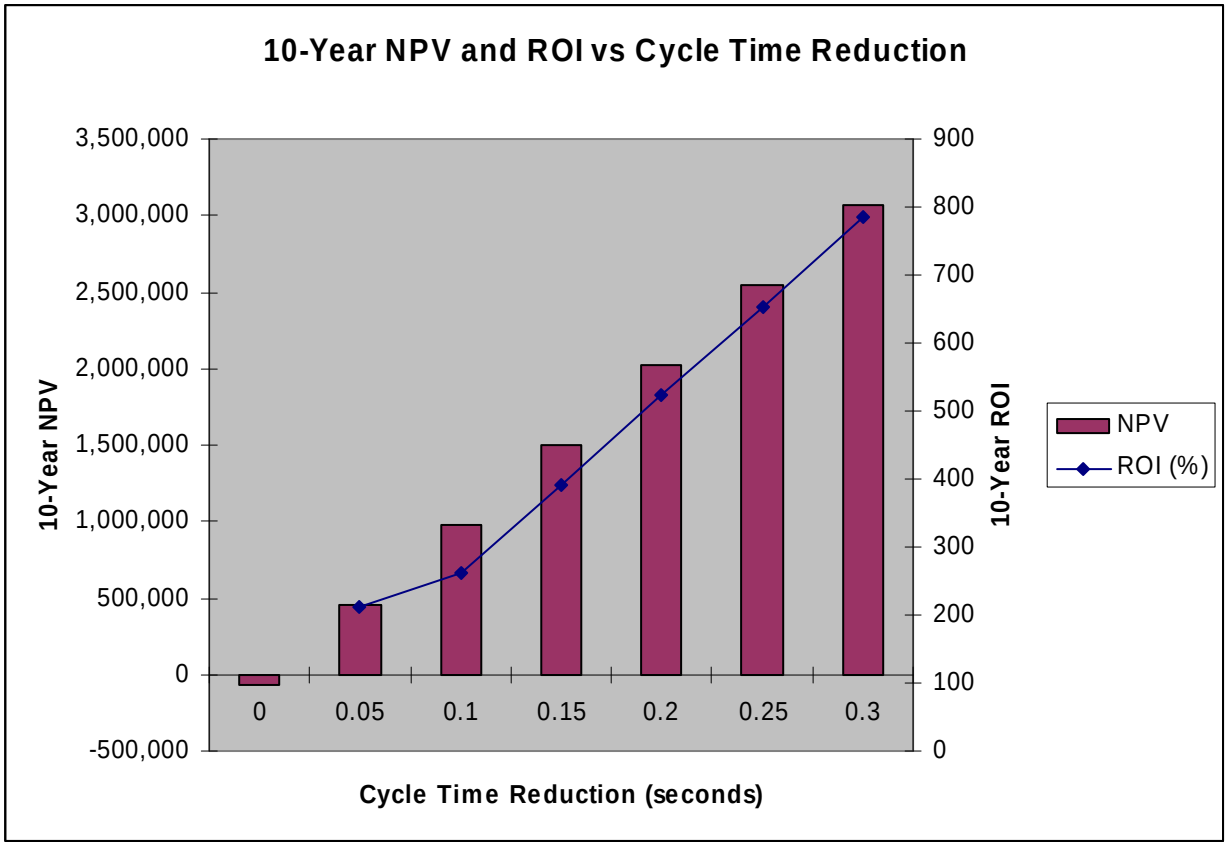
When deciding whether or not to fund non-mutually exclusive options in a project, a table can be made to show the cash flow characteristics of each option. Typically the Company will choose to fund the options with the highest profitability first, and then use the savings to fund the options with lower rates of profitability.

Options	Cost	Payback (months)	NPV	ROI (%)
Quick change fasteners	400	1.1	26,409	1,090
Tool shadow board	450	1.5	21,670	800
Cross training personnel	2,200	3	51,872	400
Adjustment jigs	4,200	14	25,908	117
Automated conveyor rails	80,000	22	188,124	54

Often the economic results of a project may not be directly measurable, but may be a function of a key parameter of the project results, whose direct measurement is beyond the scope of the project. One such project was an analysis of airflow efficiency in a thermoforming process in an effort to increase airflow rates and reduce overall cycle times for the thermoforming process. The project resulted in a 40% increase of airflow efficiency; however, direct measurement of cycle time reduction was impossible during the project due to the high cost of production prototyping. The economic analysis was presented as a function of cycle time reduction as follows. (NPV and ROI are calculated for a ten (10) year project life.)

Cycle time reduction (seconds)	Cap Cost	Annual Savings	Payback (years)	NPV	ROI (%)
0	65,000	0	n/a	-65,000	n/a
0.05	65,000	85,000	0.76	457,000	212
0.1	65,000	170,000	0.38	979,000	261
0.15	65,000	255,000	0.25	1,502,000	392
0.2	65,000	340,000	0.19	2,024,000	523
0.25	65,000	425,000	0.15	2,546,000	653
0.3	65,000	510,000	0.13	3,068,000	784

This table can be graphed with annual savings, payback period, NPV, and ROI, all as a function of the eventual cycle time reduction.



Methods for Product Development and New Technologies

Occasionally a project does not readily conform to types of analyses that are discussed above. Note that the methods above are all analyses of cash flows in one form or another. Cash flows may be in the form of a reduced cost in an existing product, a totally redesigned product, a new product in an existing market, or a new product in a totally new market. In these cases, the future cash flows, market shares, price point and profit margin for the product, etc., may be uncertain. It is important to get reasonably good estimates for these cash flows from your Company Industry Partners in order to do the required analyses. If you have questions about this, see your Advisor or the Course Coordinator.

Break Even Analysis

New product costs typically involve tooling, manufacturing, shipping, marketing, distribution, sales, warranty, etc. Estimates for these costs should be accessible by the Company Industry Partner. The Company Industry Partner should also have an idea of the price point for the new product in the market they are addressing. In order to meet a payback requirement, the analysis can be "reverse engineered". Calculations for the startup costs and the fixed and variable costs listed above can be made. With the price point of the product, the profit margin can then be determined. It is then possible to determine how many units of the new product must be sold to give the desired payback on the investment in the new product development and manufacture. Once this sales target is determined, the marketing department of the Company Industry Partner has a clear sales target to meet the Company's requirements for investments. This entire determination is iterative in nature and involves risk, but is a simple and effective way to evaluate new product economic potential.

New Product Development – Direct Value Method

The Direct Value Method is used to determine the price point for new and modified products. It is a simple method of marketing research in which the target demographic is asked to fill out a simple questionnaire to directly value the product modifications. From this analysis, the Company Industry Partner can get a very good idea of the target price point that will be successful. It will also give estimates of the profit margin for the new product. For more information, see the GE 494 Course Coordinator.

Chapter

10

On-Site Oral Presentation

During Week 11, all project teams are required to give an on-site presentation at the Industry Partner's facility. This is intended to bring all parties up to speed with the progress of the project and clarify any unanswered questions or ambiguities in the project. **Make preparations with your Company at least three (3) weeks before your presentation to allow for scheduling of necessary personnel to attend the meeting**. You should help decide who should attend the meeting. Think about all the features of your project and how far reaching your results may be. You must eliminate any technical or other unknown obstacles to acceptance of your project solution by the Company. Consider inviting personnel such as:

- CEO
- CFO
- CIO
- Engineering
- Manufacturing
- Quality Control
- Maintenance
- Information Technology
- Environmental
- Marketing
- Sales
- Warranty claims
- Field Service
- Distribution
- Shipping
- Receiving
- Line Supervisors
- Setup Personnel
- Tool Room
- Machine Operators
- Human Resources

Because this presentation will immediately follow the 2nd Subgroup presentation, you should have all of your presentation materials prepared in MS PowerPoint. **Check with your Industry Partner about the presentation equipment at their facility**. You may need to prepare transparencies for their overhead projector. Plan for the meeting to last about an hour or so (including your presentation, questions, discussion, etc.).

You may decrease the amount of introductory material in your presentation, for obvious reasons, but be clear about the problem statement, team objectives, and the remainder of the talk. Feel free to put much more technical detail into your talk than you had time for in your subgroup presentation. Your Industry Partner will be interested in every bit of detail because they will be the ones implementing your ideas. Keep in mind that the Industry Partner wants emphasis on project results, conclusions, prototypes, drawings, and recommendations. Give special emphasis to the economic analysis and clearly show how your recommendations will improve profitability.

Keep in mind that this presentation is scheduled about 4-5 weeks before the end of the semester to give you time to incorporate Company feedback into your project.

Make sure you are well rehearsed for your presentation. You should be able to present with no notes or other prompts. Make sure you have a good understanding of the jargon used in your Industry Partner's operation.

Remember **there is no 15 minute time limit on this presentation**, so don't rush through your presentation materials. The Industry Partner may ask highly detailed questions about project specifics. Allow your Industry Partner to interact with you during the presentation if they wish, and be prepared to think on your feet. Also, make sure that all of the ideas you present are clearly understood by the Company. Because the timing of this presentation is open-ended, you will have plenty of time for additional questions and answers.
Have several additional slides prepared in your "war-chest" for answering questions (see Chapter 6).

Ask for complete and candid feedback from the Company. Make sure you understand any and all concerns that the Company has for the remainder of the project to bring it to completion.

Review "Some Presentation Guidelines" in Chapter 6 and "Common Pitfalls" in Chapter 11.

When using video clips in your MS PowerPoint presentation, make sure that you have the video file on the CD, or other media that you are taking to the Industry Partner. Make sure the video is in the same folder or directory as the .ppt file. Also, make sure that this file can be played on your Company's computer (unless you are using your own laptop, etc.) Make sure you run through your presentation on all the equipment you will be using before the meeting begins – and that everything is working properly.

Be properly dressed (business casual as a minimum) and be on time and well prepared. Never make the Company personnel wait for you to set up or get your act together. This presentation is the biggest impression you will make on the Company as a whole. Seize the opportunity.

Have several additional slides after the end of your presentation already prepared for more detailed discussion of specific technical points that you may not wish to include in the main body of the presentations. You may refer to these slides when specific questions arise. This shows that you are very well prepared by anticipating these questions.

Chapter

11

Final Oral Presentation

The final oral presentation will be held on the date specified on the Course Calendar. You should plan to **devote the entire morning and early afternoon** to attending the presentations and the luncheon meeting with your Industry Partner. Make sure that you invite your Company to the presentations and find out how many Company personnel will be attending, so we can plan the luncheon accordingly. Know their arrival time so that you can greet them at the Transportation Building. **Remember that your Company is your guest for the day**; be available to have coffee with them and discuss their interests. Besides giving your own presentation, **you are expected to attend and evaluate your colleagues' presentations** as well. The only exception is when your Industry Partner needs to meet you while other presentations are ongoing.

The Final Oral Presentation should be at a level commensurate with that expected of a practicing engineer in industry. This includes high quality visual aids, exhibits, demonstrations, well-rehearsed delivery and **proper business attire**. (Dress as though you were going for an engineering job interview.)

Each team will have 20 minutes to present, followed by eight (8) minutes of audience questions. The time limit will be strictly observed since graders must move from room to room to see other presentations. The oral presentations will be evaluated by all in attendance; this will assist in the determination of your final Senior Project course grade.

Note: a Subgroup Meeting Brief is NOT required for the Final Presentation.

Any visual or demonstrative aids may be used**.** The bulk of your presentation should be prepared through MS PowerPoint. Videotapes of experiments or processes may be used as well. There is also visualization software available to enable graphical depiction from mounds of data. If your presentation has special needs that are not available in the scheduled room, advise the Senior Project Course Coordinator in writing as far in advance as possible and then follow up with him to make arrangements for the equipment you need. Check with personnel in 117 TB to obtain additional projectors, extension cords and screens.

Review “Some Presentation Guidelines” in Chapter 6. Also review the recordings of your earlier subgroup presentations.

Common Pitfalls

1. Not practicing your presentation sufficiently so that you do not use your time budget effectively.
2. Reading from a card or page instead of speaking to the audience.
3. Playing or fumbling with a pointer instead of using it effectively to direct audience attention.
4. Failing to give a thorough but brief problem introduction for those in the audience who are completely unfamiliar with your project.
5. Passing samples around the room during the presentation. This causes loss of audience attention.
6. Trying to show a small or medium-sized object to the audience by holding it up for them to see. Instead, take close-up photos and project your photos on the screen where all can see easily. Use videos if action or movement is important.
7. Showing demonstrations that fail due to inadequate preparation.
8. Using slides that are too wordy and make the presenter redundant as the audience tries to read every word on the slide.
9. Using diagrams that are too busy or fonts that are too small.
10. Introducing material to the audience with several slides without integrating that material into the logical flow of the presentation. In other words, wasting time with extraneous information that goes nowhere.
11. Showing a critical graph without explaining the axes, legend, and the overall meaning of the graph.
12. “Pulling an all-nighter” to prepare the presentation and then attempting to present material and answer questions when in an exhausted, sleep-deprived, brain-dead state. Plan ahead and use your other two subgroup presentations to build your final presentation over a period of time.
13. Not speaking loudly or clearly enough for all to hear. This demonstrates a lack of concern for the audience.
14. Lacking enthusiasm in your presentation. The audience will have no more enthusiasm about your project than you do. So, fill the room with energy and enthusiasm as you present. Keep in mind that this is your last chance to make a splash as a GE/IE undergraduate. Make your presentation memorable to your Industry Partner and show that you are excited about the work you have done and the recommendations you are making.

15. Trying to make answers to questions long and complex. If the answer is simple, state it. If you don't know the answer, just say so. Don't try to "tap dance" to hide the fact that you don't know.
16. Being defensive during the Q&A sessions. The common goal of all should be to bring out concepts that are useful in the solution to the problem. Do not be defensive if a weakness is shown in your arguments. Use this insight to make your solution better.

Chapter

12

Senior Project Resources & Safety

Many resources are available for your use in GE 494. This section lists many of the resources available in this department. Other resources are available across campus as well. Discuss your needs with your Advisor if they are not listed below. Arrangements are routinely made for use of resources in other departments. If you have special needs, contact 117 TB.

Photocopying machine	106 TB
GE 494 PC Laboratory	305 TB
GE 494 Past Project Manuscripts	117 TB
Rapid Prototyping Machines & Scanner	307 TB
GE 494 Workspace	308 TB

Safety

Many different facilities, materials, pieces of equipment, travel, etc. may be required for you to successfully meet course requirements and complete your project. Safety is the most important concern during your participation in this course.

You must get approval for use of any flammable or hazardous materials in this course. Specific facilities are available on campus for proper use and handling of hazardous materials. Even materials such as glues or solvents may become hazardous if used in poorly ventilated areas. Material Safety Data Sheets (MSDS) are required for all chemicals entering the building.

You must notify Harry Wildblood (104 TB) and receive approval before using **ANY** tools, equipment, chemicals, or other materials that may pose a personal injury risk to yourself or others in the Transportation Building.

Safety equipment such as safety glasses, gloves, ear plugs, steel toed shoes, etc., must be used in appropriate circumstances. Remember, you are the future engineers who will soon set safety guidelines for others – make sure you use common sense. Always think of what ***MIGHT*** happen, and take reasonable precautions.

For more safety guidelines, visit these campus websites:

Division of Research Safety: http://www.drs.uiuc.edu

Facilities and Services, Div. of Safety & Compliance: http://www.fs.uiuc.edu/sandc

Course Lab Facilities

The **Senior Engineering Project Laboratory** facilities for GE 494 are in **the south end of the third floor Transportation Building.** Access to the labs is on the third floor through the south-most door. **You will need your University ID card** for the security access card-swipe. The lab is equipped with computer work stations, printers, plotters, storage lockers, work benches and tables, as well as team collaboration areas and two dedicated conference rooms. This lab space has undergone a one-million-dollar renovation. Please do not leave doors open or allow others to gain access to the lab. Alarms will sound if doors are propped open. Report any destructive or inappropriate behavior to the Course Coordinator. The lab will be monitored closely, so please treat it with respect. The lab may be used 24 hours, but outside access is limited to the building hours of 7 AM to 11 PM, after which the outside doors will be locked.

Room Listing
306 – Computer room and Team Cubicles
306A&B – Conference and presentation practice rooms
307 – 3D printer and large plotter
308 – "Dirty" work area – only a figure of speech, please keep it tidy and organized
308A – Storage lockers

Security Door Alarms – The main security door to the lab must be **kept closed**. If it is propped open, a very irritating alarm will sound after 2 minutes.

Safety – Safety equipment such as gloves, eye protection, and ear plugs are available in the lab. Make sure you use appropriate safety equipment, and notify other students of any work you are about to do which required safety equipment or other precautions.

Conference Phones – There are conference phones in 306 A&B. There is a conference room on the second floor which may sometimes be available. Check in 117 TB for availability.

Presentation Practice can be done in the two dedicated conference rooms in the southwest corner of the labs. These conference rooms will have scheduled time slots about two days before subgroup meeting presentations and final presentations must be given. Additional rooms on the first floor will also be available on a limited basis. Sign-up sheets will be posted.

Storage Locker Space is available in the storage room north of the "dirty" work lab. You may check our locker combinations for your assigned lockers. These locks are your responsibility. You will be charged for their replacement if they are lost while you have them checked out. Any unauthorized locks will be removed.

Lab Computers – Active Directory Password Required – New top-of-the-line Dell computers have been purchased for your course work. Logging on to these machines will require your Active Directory Password. Make sure you have it and know it, or go to DCL to have it reassigned.

Other equipment - To use additional equipment in the lab, such as tools, etc.; check them out in room 117 TB. **Make sure you check for existing equipment in the course inventory before buying unnecessary additional equipment**. Here you can also request necessary safety equipment such as safety glasses and ear plugs.

Digital Still and Video Cameras

Digital still cameras and digital video cameras may be checked out in 117 TB, along with the disks and tapes for recording your images. Make sure you check availability of this equipment, have adequate storage media, and know how to use the equipment. It is too late to get more media or learn how to take pictures when you are in the middle of a plant tour. You may also use your personal cameras, if preferred. We are not responsible for loss or damage.

Digital video in the DV format may not be immediately usable for presentations without conversion to another Codec (Compression/Decompression Algorithm). Facilities will be made available for converting DV to MPEG or AVI files which should be compatible with presentation equipment. Test your digital video files for compatibility on the presentation systems (TB 101, 103, 114, 207, and 112) long before you try to use them in a presentation.

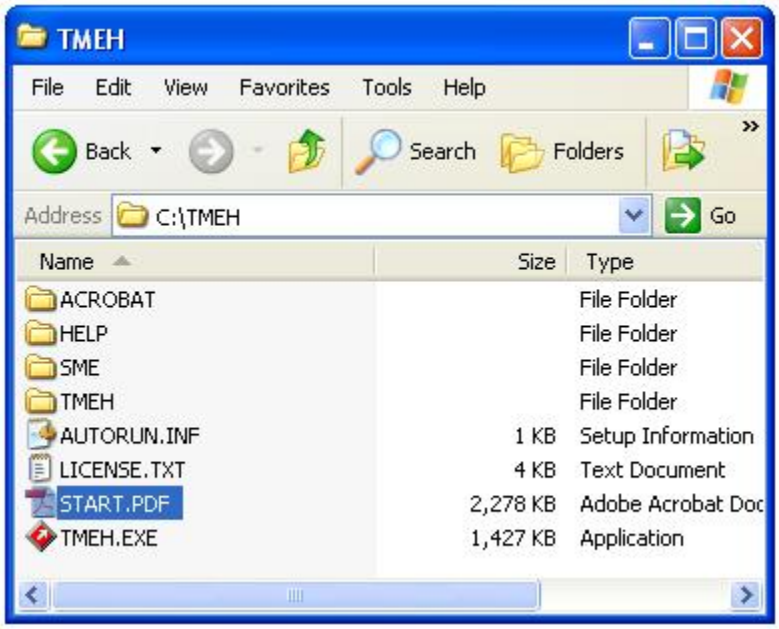
Copying and Reproductions

There is a copier in the Senior Engineering Lab. This is both a copier and the default printer. Each group has a copier number. There is also a copier in 106 TB for which you will also need to use a copy number.

Tool and Manufacturing Engineer's Handbook

As mentioned in Chapter 2, the Tool and Manufacturing Engineer's Handbook (TMEH) compiled and published by the Society of Manufacturing Engineers (SME) is installed in PDF format on all computers in the Senior Project course computer lab in 305-306 TB. This is a multi-volume handbook that covers virtually all standard manufacturing processes, materials and methods. The articles are extensive, include glossaries of industry jargon for each technology discussed, and give additional references. This can be a good starting point for manufacturing-based projects.

Access the TMEH in the Senior Project course computer lab by opening the START.PDF file shown in the folder below:



Tools and Equipment

Tool sets providing a good selection of basic tools including wrenches, sockets, pliers, crescent wrench, tape measure, etc., are available for checkout in 117 TB. These tool sets must be returned with all tools intact. Cost for replacement of the tool set is about $30.

If other tools are needed, come to 117 TB to check for their availability. Tools and equipment of various types have been purchased for previous projects and are on hand for your use. If Senior Design does not have the tool or equipment available, you can make a purchase request, which in most cases, will be approved immediately.

The GE 494 inventory system lists hundreds of items that are available for you to check out. Come to 104 TB first and ask about the items you need. Photos and descriptions are available for virtually all items to meet your needs. This also tells you exactly what you are expected to return in the same condition as when you checked it out.

Shop Services, Machine, Wood, Etc.

Machine Shop services are available on campus for most any type of machining needs. Contacts and locations:

Aeropsace Engineering Machine Shop:
Greg Milner, Supervisor
Room 4, Talbot Lab
333-3515
milner@illinois.edu

MechSE Machine Shop:
Keith Parrish, Supervisor
Room 1121, Mechanical Engineering Laboratory
333-1711
rparrish@illinois.edu
http://mechse.illinois.edu/content/services/machine_shop.php

ECE Machine Shop
Scott McDonald, Supervisor
Room 66, Everett Lab
333-1954
samcdona@illinois.edu

Life Sciences Machine Shop
Scott Baker, Supervisor
Room 59, Burrill Hall
333-0609
s-baker6@illinois.edu
http://www.life.illinois.edu/facilities/MachineShop/mshophome.html

Chemical Sciences Machine Shop
Mike "Hodge" Harland, Supervisor
B71 Roger Adams Lab
333-4278
mharland@illinois.edu
http://www.chem.uiuc.edu/shop/mindex.html

Purchasing

Senior Design Projects are funded by the Industry Partners to allow for purchasing of necessary equipment, software, travel, etc. Please discuss purchases with your Advisor. Senior Design has already purchased many types of equipment, both generic and highly specialized. Check in 117 TB for your equipment needs before making any purchases. The equipment you need may already be here and waiting for you. An equipment catalog, showing and describing all available equipment, can be found in 117 TB. If you have any questions, please see Barb Bohlen, Leslie Davison-Pirie, or Harry Wildblood.

All purchases must go through the proper procedures. Contact Barb Bohlen or Leslie Davison-Pirie in 117 TB for required procedures. See Chapter 5 “Purchasing and Reimbursement” for more details.

Software

The lab computers in 305-306 TB are managed as Engineering Work Stations and have the compliment of software similar to other EWS labs. A partial list of software is below:

@Risk for Project
7-zip
Abaqus 6.11
acrobat x pro
Adobe Flash
Adobe Reader
Alias Design 2012
alternatiff
AMPL
Ansys 13
ArcGis 9 and addons
AutoCAD 2012
Camstudio
Chemcad
Draftsight
Eclipse
eDrawings x64
EES
Firefox
GhostScript
Ghostview
IMG Burn
Internet Explorer
Inventor 2012
IrfanView
Java
Logic Works 4.1
Mathematica
Mathtype
Mathtype 6
Matlab
MedModel 2011
Microsoft Office
MikTex
Minitab
Moldflow Plastics Advisor 2012
Navisworks Manage 2012
Netbeans IDE
NI LabVIEW 2010 SP1
Notepad+
NX Client
NX Nastran
Open Office
Origin 8.5 pro
Paint.net
PDF Creator
Pidgin
Pro Engineer 5.0

Promodel 2011
Putty
Quicktime
Realterm
Revit Architecture 2012
Revit Structure 2012
Sap 2000 V14
VLC Media Player
WinSCP
WorkingModel2D
Xming
Showcase 2012
Simulation Multiphysics 2012
SketchBook Designer
Tortoise SVN
UGS NX
Vim
Visual Studio

Other software as needed – ask for what you need

- Adobe Illustrator (5 licenses)
- Cfdesign 7/8 (20 floating licenses)
- Cosmos Works
- Exceed
- Design Expert
- IIS
- Solid Works (10 floating licenses)
- Other Autodesk products

Rapid Prototyping

Two 3D printers are located in 307 TB. See Jim Leake (309 TB, 244-0401) for guidance and tutorials for the use of the 3D printers.

The MechSE department also has 3D rapid prototyping capability. You will need to provide .stl files generated from a solid modeler such as Pro/E, AutoCAD, Inventor, etc. Turnaround time varies with backlog, but in general, they try to get parts back in less than a week (often in a few days).

Contact: Ralf Moller, 333-6368, 1125 MEL, rmoller@illinois.edu. Mr. Moller will have office hours when he can meet with you, please contact him for further information

Storage Lockers

There are storage lockers located in 308A TB to secure items used in your project. These will be accessed with combination locks. If you require other facilities to secure your project materials and equipment, contact 117 TB.

YOU MAY NOT USE PERSONAL LOCKS ON COURSE LOCKERS. Any personal locks used on course lockers will be cut off for security reasons.

You must come to 117 TB to check out any locker you will be using.

Senior Project Web Page

The web page for Senior Design can be located at the following URL:

http://courses.engr.illinois.edu/GE 494/

This web page is a resource for course information and examples of project components, such as reports, technical writing guidelines, giving presentations, etc. Some features of the Web Page are listed below:

- List of available equipment
- PDF files of Course Handbook
- Course Calendar
- Course Schedule
- Search engine for past projects
- Sample Reports

Past Senior Engineering Project Reports

One of your most valuable resources is the availability of past Senior Engineering Project Reports. These reports routinely contain information that can be used in later projects. These reports are available to all GE 494 students and may be accessed through the database set up on the computer in 104 TB on the front table, by the door.

To use the database:

1. Click the Pink Panther icon labeled 494DB.
2. The database will open. (This may take several seconds).
3. Click the **Enter Password** button.
4. Enter your Logon Name as "**guest**", and your password as "**ISE**". (Entries are not case sensitive).
5. Click on the **Project Search** button, which has just appeared. The search Utility will open as shown on the following page.

Using the Utility

You may simply type **F1** for help on this utility.

Select the **Project Database** (top left). **Recent** Projects are from Fall 2003 and later (the **Archive** is for all earlier projects).

The **Project Listing** allows you to sort the listed projects by Semester, Title, Advisor, Student Name, etc.

Double-Click on a record to view the abstract.

You may open a complete Report PDF (Adobe Acrobat) file of the project by clicking the button "**Click Here to Open Report PDF**". Note that this button displays for each report selected ONLY if that report has a pdf. Reports earlier than 1993 are not yet scanned into the system.

The **Display** buttons (Center Top) allow you to display desired info about the project.

Searching

Select the desired database, Recent or Archive. They must be searched separately.

Enter the sought text into the **Search Text** field.

Click one of the buttons below for the part of the paper you wish to search. (**Project Title**, **Key Words**, **Abstract**, etc.)

Any matching records will be displayed below.

Click on the desired record, the PDF button will display if the record has an accompanying PDF file.

With the desired record selected, click on any of the Display buttons to show the desired information.

Projects without PDF Files

Projects without PDF files may be available in hardcopy. These reports may be used, but MUST be returned for future use.

If you have any questions, please ask Barb Bohlen, Leslie Davison-Pirie or Harry Wildblood.

Chapter

13

Notebook Information

As a part of your work in GE 494, you will be required to keep a notebook or diary record of your efforts and progress on your project. Doing so accomplishes at least two important things. First, a written record of all of your original effort is provided. This can serve as legal evidence to protect you in the event any conflict arises over your rights. Second, you will have an orderly history of the development of your ideas that can serve as a basis for discussion of your project with other people and as source material for reports and presentations.

Each team member will keep an individual notebook.

The required notebook will be provided to you on the second day of class. It is bound and has consecutively numbered pages. Other desirable features include a grid pattern on the pages to facilitate making sketches, and spaces provided on each page for signatures of the inventor or engineer and witnesses. Reserve the first two pages of your notebook as a contact information page for phone numbers, email addresses, etc., which you will compile during the course of your project.

Certain rules must be followed in making the entries into the notebooks.

1. Use only ink, never pencil.
2. Write the date at the top of each page you begin.
3. Make no erasures. Anything to be deleted should be done by passing a single line through it.
4. Do not leave blank spaces as you proceed. However, it is customary to make the entries only on the right hand pages, reserving the left hand pages for calculations, drawings, etc.

5. Begin each day's entries on a new page. Any space remaining on a page at the end of day's entries should have one or more diagonal lines drawn across it. On days when no time is devoted to the subject, it is not necessary to put anything into the logbook.
6. Keep the notebook up-to-date; use it to make original entries. Do not make notes on loose papers to be re-copied into the book.
7. Be sure the contents of the book are intelligible to others such as your team members, faculty members, or engineers from industry.
8. As each page is completed, sign it at the bottom. If you believe it is possible that a page contains something which could lead to a patent or other proprietary interest, have two other persons who can read and understand the contents of the page sign and date it as witnesses.

What to Include in your Notebook

1. Extensive meeting notes from your trips to your Company. Write everything down!
2. A log of how you spend your time on the project; such as meetings with teammates, or with Advisor, search of literature, making calculations, and the like. Include details from your meetings, items discussed, decisions made, and action items.
3. References that you use.
4. Calculations.
5. Any ideas that occur to you, whether eventually applicable or not, or questions that appear necessary to answer as the work proceeds, or anything else of similar nature.
6. Sketches, free-body diagrams, etc.
7. Any experiments you conduct, showing:

    purpose
    equipment used
    procedure
    results

Remember, the notebook is to be turned in to your Project Advisor and may be an important element in the determination of your grade for the course. The books may be reclaimed from your Advisor after grading is completed.

Your Project Advisor may review your notebook at any time during the semester, without advance notice. Do not wait until the semester's end to update your notebook entries. Your notebook is required to be an up-to-date working document.

Chapter

14

Grading

There will be **two grades** associated with each project.

GE 495 GRADES (2 credits) **will be determined solely by your Project Advisor.** GE 495 grades are individually assigned through your Advisor's evaluation of each team member's effort and contribution to the project. Your Advisor may use (1) your written reports, (2) oral presentations (especially the Final Oral), (3) your daily notebook, (4) peer evaluation sheets which you fill out concerning one another, and (5) his/her own judgment and experience to determine your grade for the GE 495 portion of your project. Advisors should report GE 495 grades directly to the GE 494 Coordinator 48 hours after the time of the Final Oral Presentation.

GE 494 GRADES (3 credits) **will be determined solely by the Project Grading Committee.** The PGC consists of two (2) faculty members who will hold sole responsibility for determining the GE 494 grade, which will be a team grade, shared by each member of the project team.

Both members of the PGC will independently complete Form FWR to evaluate the Final Written Report. The PGC will then meet to determine the final grade for the project report. The PGC will also consider the final oral presentation when assigning the final grade. A copy of Form FWR is sent to the Senior Engineering Project Coordinator.

The **final oral presentation** will be graded by all in attendance, using Form OP. This information will be compiled and distributed to graders and Advisors for their consideration. In addition, the Senior Engineering Project Coordinator will alert PGC members to any presentation that receives a very high or low rating. In consultation with the PGC, he will then make appropriate adjustments to the GE 494 grades.

Project Grading Committees and Advisors

The Project Grading Committee (PGC) generally consists of two (2) faculty members. The Project Grading Committee has **sole responsibility** for determining the GE 494 team grade for a project. No Advisor will serve on the Project Grading Committee for the project(s) that he or she advises. Your PGC is a potential resource for your project team; consult them often throughout the semester and develop a constructive rather than adversarial relationship. You will not offend your Project Advisor by seeking additional guidance from your graders. The roles of the Advisor and the Project Grading Committee differ. Simply put, the Advisor **directs** a project team, while the Project Grading Committee **evaluates** that team's work product. The PGC Members do so as follows:

Pre-Report Evaluation

On the dates given on the course schedule, students are to submit a copy of the written "Pre-Report" to their Advisor and then to the PGC. Each PGC member will read and evaluate the written "Pre-Report," returning it to students on the date given on the course schedule. An evaluation form (Form PR) is provided in order to help. Comments from the PGC are intended to troubleshoot the problem statement, initial direction of the project, and preliminary report mechanics. See Section 8.2 for Pre-Report requirements.

Midterm Evaluation

On the dates given on the course schedule, students are to submit a copy of their Midterm Written Report to their Advisor and then to the PGC. Each PGC member will read and evaluate the Midterm Written Report, returning it to students on the date given on the course schedule. An evaluation form (Form MWR) is provided in order to help structure the feedback to the students. The PGC will return Form MWR to 117 TB for copying and distribution to the students, their Project Advisor and to the Senior Project Course Coordinator. Project team members should pay close attention to suggestions made by PGC members and Advisors. Organization, fundamental approaches, solution techniques, etc., can all still be adjusted at this stage in the project. See Section 8.3 for Midterm Written Report requirements.

Draft of Final Report Evaluation

By the deadline given in the course schedule, students are to submit a draft of their Final Written Report to their Advisor for feedback and then scheduled resubmission for PGC evaluation and feedback. The PGC will provide very detailed feedback on Form DWR, which is intended to give specific editing directions for the Final Report. See Section 8.4 for Draft Final Report requirements.

Final Written Report Evaluation

The Final Written report will be submitted first to your Advisor for feedback and editing, and then to the PGC on the date specified in the course schedule. The Draft Report with PGC comments must be submitted along with the Final Report. See Section 8.5 for Final Written Report requirements.

Each Member of the PGC reads the Final Written Report individually. Specific comments and ratings are provided on Form FWR. PGC members typically will require edits to the final report, due to previously undetected errors, inclusion of new material since the rough draft report, or edits which inadequately address feedback from the rough draft. All editing changes required by the PGC must be made by the project team before a grade may be assigned and the final copies are sent to the Company. In the event that the PGC finds the written report deficient to the point where it cannot be rectified through editing, all the members of the project team may receive a grade of "incomplete" which will prevent their graduation until it is removed. Additional work may be required after the end of the semester to complete the project and resubmit a final report to the PGC. The last alternative is to retake GE 494 the following year. Note: GE 494 cannot be retaken in the following semester.

It is the students' responsibility to contact the Coordinator of the PGC for information about all edits required.

The final GE 494 grade will be submitted by the PCG Chairperson on Form FWR, along with the form FWR from the second grader.

Final Oral Presentation Evaluation

PGC members will receive the final presentation scores using Form OP, and when possible, one or both graders will attend the oral presentation in person. Either way, the oral presentation evaluation will be considered by the PGC before grades become final. The oral presentation may be used as a tiebreaker for the PGC.

Advisor's Role

Each GE 494 Project has an individual Advisor. It goes without saying that each Advisor will approach a given project and team of students somewhat differently from other Advisors; however, there are certain guidelines which are common to all projects. All Advisors should meet with the each project team at least twice per week for the first eight weeks of the project. This is in addition to the mandatory lectures the team members must attend on some Tuesday mornings.

Broadly speaking, the Advisor will be sure that the students remain focused on the technical issues of the project. This is done by pointing out engineering errors, suggesting possible approaches to problem definition and solution, and correlating previous coursework with project content. It is not the role of the Advisor to assist students in performing calculations (other than as a check), doing experiments, etc. An Advisor with special skills may wish to bring them to bear on the project (such as helping with model construction), but this is kept to a minimum. Within this broad framework, the Advisor will show interest in the project, attempt to stimulate some degree of team enthusiasm and, of course, attend regular course meetings of GE 494. Remember: this is ***your*** student project. You will learn the most if you make your own mistakes do your own calculations, perform your own experiments, etc.

The Advisor tries to ensure that the Final Written Report is technically correct. It is inappropriate for Advisors to write sections of the report for students; however, an Advisor may critique and edit the report. Advisors should review with the project group, the changes suggested by themselves and the PGC. The role of the Advisor is to advise, not to demand. Of course, as a practical matter, students often (sensibly) treat suggestions as demands, since the Advisor is responsible for the individual GE 495 grades for each student. In addition, the Advisor is free to communicate his/her desires/insights to the PGC.

Advisor's suggestions for improvements to written reports and presentations should be taken seriously; your Advisor is often very knowledgeable about effective presentation of technical material. Students should consider feedback from their Advisor and PGC and get clarification from all parties when necessary.

Advisors will typically use their evaluation of their project team's Final Oral Presentation as a significant part of their GE 495 grade.

Advisors should refrain from:

1. Attempting to explain a report to a PGC, or to influence the PGC's decision in any way.
2. Treating the project as anything but the work of **students.**

Advisors will report the individual 495 grades for each project team member on Form FG.

Industry Partner Feedback

Your Company will be evaluating your project work, progress, focus, attitude, enthusiasm, understanding, organization, preparation, as well as quality of drawings and other output. These evaluations will be made approximately every three weeks during the semester, as listed in the course calendar. These evaluations will be mailed to the Course Chair for review, and copied for distribution to the Project Advisors (see Form SF.)

The purpose of these evaluations is to monitor the project from the Industry Partner's viewpoint. The project team must be in tune with the needs and expectations of the Industry Partner throughout the project. The evaluations may indicate when adjustments are necessary for the success of the project.

Mail or Fax to:

Harry Wildblood
Department of ISE
117 Transportation Building
104 South Mathews Avenue
Urbana, IL 61801-2996
Fax: (217) 244-5705

Form SF

Industry Partner Feedback Form 1

Company Name_____ Project Number_____

Feedback by _____ Date_____

Rate the project team by placing a check in the appropriate box below.
If any items on the feedback form do not apply to your project, or to the current stage of the project, simply check n/a.

Item	poor	fair	good	excellent	n/a
1. Technical understanding of the project					
2. Grasp of the project's economic impact					
3. Effectiveness and productivity of onsite meetings					
4. Team preparation for on-site meetings					
5. Evidence of research and technical competence					
6. Use of appropriate terms, jargon, parameters, etc.					
7. Effectiveness of weekly communication (as a minimum)					
8. Response to Industry Partner communications					
9. Requests by team are reasonable, timely, and given with adequate time for a proper response					
10. Ability and effectiveness of interactions with Company personnel					
11. Quality of drawings and other team output					
12. Attention to technical detail and accuracy					
13. Meeting of deadlines, keeping planned meetings, etc.					
14. Number of plant trips – adequate for the needs of the project					
15. Project progress to date (reasonable to meet project goals by semester's end)					
16. Progress with prototyping efforts (if applicable)					
17. Relevance of solution alternatives posed					
18. Economic analysis is appropriate and relevant to the goals of the Company					
19. Appropriate demeanor and behavior					
20. Enthusiasm, attitude, and professionalism					
21. Overall project direction coincides with Company expectations and needs					

Give additional comments below or on the back of this form.

_____

Form PR

PRE-REPORT EVALUATION

Project Number _____ **Company Industry Partner** _____

Advisor _____ **PGC Chairman** _____ **2nd Grader** _____

Please evaluate the reports on the following aspects:
(Use this rating system: 1 = very poor, 2 = poor, 3 = fair, 4 = adequate, 5 = good, 6= very good, 7 = excellent).

1. Rate the mechanics and format of the Pre-Report, including Cover Sheet, Abstract, Table of Contents, Introduction, Problem Statement, and Team Objectives. Note any deficiencies.

Rating: 1 2 3 4 5 6 7
Comments: _____

2. Does the abstract describe the project and expected results clearly and concisely?

Rating: 1 2 3 4 5 6 7
Comments: _____

3. Is the Introduction complete, informative, and does it provide a proper context for the problem statement, as well as the economic motivation for the project?

Rating: 1 2 3 4 5 6 7
Comments: _____

4. Is the Problem Statement unambiguous and define a reasonable scope of work and include all necessary deliverables? Note any deficiencies.

Rating: 1 2 3 4 5 6 7
Comments: _____

5. Are the team objectives reasonable, workable, and do they outline a logical plan of attack for addressing all phases of the project? Note any deficiencies.

Rating: 1 2 3 4 5 6 7
Comments: _____

IMPORTANT! Please fill out and <u>submit this evaluation to Barb Bohlen in 117 TB</u> for copying and distribution.

_____ **Date** _____
Signature

_____ Students _____ Advisor _____ PGC Chairman _____ 2nd Grader _____Barb Bohlen

Form MWR

MIDTERM WRITTEN REPORT EVALUATION

Project Number _____ **Company Industry Partner** _____

Advisor _____ **PGC Chairman** _____ **2nd Grader** _____

Please evaluate the reports on the following aspects:
(Use this rating system: 1 = very poor, 2 = poor, 3 = fair, 4 = adequate, 5 = good, 6= very good, 7 = excellent).

1. Rate the mechanics and format of the Pre-Report, including Cover Sheet, Abstract, Table of Contents, Introduction, Problem Statement, and Team Objectives. Note any deficiencies.

Rating: 1 2 3 4 5 6 7

Comments _____

_____

2. Does the Abstract describe the project and expected results clearly and concisely?

Rating: 1 2 3 4 5 6 7

Comments _____

_____

3. Is the Introduction complete, informative and does it provide context for the problem statement and the economic motivation for the project?

Rating: 1 2 3 4 5 6 7

Comments _____

_____

4. Is the Problem Statement unambiguous? Does it define a complete scope of work and include all necessary deliverables? Note any deficiencies.

Rating: 1 2 3 4 5 6 7

Comments _____

_____

5. Are the team objectives reasonable, workable, and do they outline a logical plan of attack for addressing all phases of the project? Note any deficiencies.

Rating: 1 2 3 4 5 6 7

Comments _____

_____

6. Is the initial analysis thorough, relevant, and does it provide a sound technical direction for the project? Does the initial economic analysis provide economic focus and relevance to the project?

Rating: 1 2 3 4 5 6 7

Comments _____
_____

7. Is there reasonable progress toward a solution? Are the solution ideas feasible, defensible, economically justifiable, and do they address the scope of work of the project?

Rating: 1 2 3 4 5 6 7

Comments _____
_____

8. Rate the technical Content, understanding of the governing equations and principles, use of analytical tools, and overall technical rigor.

Rating: 1 2 3 4 5 6 7

Comments _____
_____

What should be the main concerns of the project team for the remainder of the semester?

_____
_____
_____
_____

IMPORTANT! Please fill out and submit this evaluation to Barb Bohlen in 117 TB for copying and distribution.

_____ **Date** _____

Signature

_____ Students _____ Advisor _____ PGC Chairman _____ 2nd Grader _____Barb Bohlen

Form MCEF

MIDTERM COLLEAGUE EVALUATION

(Confidential – submit in sealed envelope to Advisor)

Instructions: Fill out one form for each team member, including yourself. Sign and submit to your Advisor when you submit your midterm report (See Course Schedule).

Name of colleague being evaluated: _____

Advisor: _____ Group # _____

Circle your responses: 1– never 2 – rarely 3 – sometimes 4 – usually 5 – always

Has the team member attended your group meetings?	1	2	3	4	5
Does the team member notify the team when he/she cannot attend a meeting or fulfill a responsibility?	1	2	3	4	5
Has the team member made a serious effort at assigned work before the group meetings?	1	2	3	4	5
Does the team member attempt to make contributions in group meetings when he/she can?	1	2	3	4	5
Does the student cooperate with the group effort?	1	2	3	4	5

Give an overall rating on the following scale: _____
(insert one of the given words.)

> ***Excellent*** - Consistently went above and beyond—tutored teammates, carried more than his/her fair share of the load
> ***Very good*** - Consistently did what he/she was supposed to do, very well prepared and cooperative
> ***Satisfactory*** - Usually did what he/she was supposed to do, acceptably prepared and cooperative
> ***Ordinary*** - Often did what he/she was supposed to do, minimally prepared and cooperative
> ***Marginal*** - Sometimes failed to show up or complete assignments, rarely prepared
> ***Unsatisfactory*** - Consistently failed to show up or complete assignments, unprepared
> ***No show*** - Practically no participation, or no participation at all.

Comments: _____
_____

Signed_____

*Adapted from a form in *Cooperative Learning and College Teaching*, reprinted in B.J. Millis and P.G. Cottell, Jr., *Cooperative Learning for Higher Education Faculty*, Oryx Press, Phoenix, 1998.

FORM OP-1

ORAL PRESENTATION EVALUATION – Subgroup Meeting 1

Grader's Name (Optional for visitors and students) _____

Project Number_____ Project Industry Partner _____

Project Title_____

Please rate the presentation on the following features using the scale provided:

	unacceptable	poor	fair	good	excellent
1. Introduction (clear context for problem statement)	1	2	3	4	5
2. Explanation of the project's economic impact	1	2	3	4	5
3. Problem Statement (well defined scope of work)	1	2	3	4	5
4. Team Objectives (clear, reasonable project direction)	1	2	3	4	5
5. Thoroughness of preliminary research	1	2	3	4	5
6. Soundness of proposed work and methods	1	2	3	4	5
7. Discussion of economic analysis	1	2	3	4	5
8. Reasonable progress for 5 week's work	1	2	3	4	5
9. Presentation skills (note any deficiencies below)	1	2	3	4	5
10. Effectiveness of visual aids, props, videos, etc.	1	2	3	4	5
11. Handling of questions	1	2	3	4	5
12. Enthusiasm and attitude	1	2	3	4	5

Sum of all scores: _____
(for example, a presentation with "fair" in every category would score a 36.)

Please write comments in the space below or on the back of this sheet.

_____
_____
_____

FORM OP-2

ORAL PRESENTATION EVALUATION – Subgroup Meeting 2

Grader's Name (optional for visitors and students) _____

Project Number_____ Project Industry Partner _____

Project Title_____

Please rate the presentation on the following features using the scale provided:

	unacceptable	poor	fair	good	excellent
1. Introduction (clear context for problem statement)	1	2	3	4	5
2. Explanation of the project's economic impact	1	2	3	4	5
3. Problem Statement (well defined scope of work)	1	2	3	4	5
4. Team Objectives (clear, reasonable project direction)	1	2	3	4	5
5. Evidence of research and technical competence	1	2	3	4	5
6. Soundness of work, methods, probability of success	1	2	3	4	5
7. Economic analysis and costs/savings discussion	1	2	3	4	5
8. Conclusions (clear, insightful, related to scope of work)	1	2	3	4	5
9. Recommendations (specific, path for implementation)	1	2	3	4	5
10. Reasonable progress for 10 week's work	1	2	3	4	5
11. Presentation skills (note any deficiencies below)	1	2	3	4	5
12. Effectiveness of visual aids, props, videos, etc.	1	2	3	4	5
13. Handling of questions	1	2	3	4	5
14. Enthusiasm, attitude, and professionalism	1	2	3	4	5

Sum of all scores: _____
(for example, a presentation with "fair" in every category would score a 42.)

Please write comments in the space below or on the back of this sheet.

_____

FORM OP-3

ORAL PRESENTATION EVALUATION – Final Presentation

Grader's Name (Optional for visitors and students) _____

Project Number_____ Project Industry Partner _____

Project Title_____

Please rate the presentation on the following features using the scale provided:

	unacceptable	poor	fair	good	excellent
1. Introduction (clear context for problem statement)	1	2	3	4	5
2. Explanation of the project's economic impact	1	2	3	4	5
3. Problem Statement (well defined scope of work)	1	2	3	4	5
4. Team Objectives (clear, reasonable project direction)	1	2	3	4	5
5. Evidence of research and technical competence	1	2	3	4	5
6. Soundness of work, methods, and proposed solution	1	2	3	4	5
7. Economic analysis and costs/savings discussion	1	2	3	4	5
8. Conclusions (clear, insightful, related to scope of work)	1	2	3	4	5
9. Recommendations (specific, path for implementation)	1	2	3	4	5
10. Reasonable progress for one semester	1	2	3	4	5
11. Presentation skills	1	2	3	4	5
12. Effectiveness of visual aids, props, videos, etc.	1	2	3	4	5
13. Handling of questions	1	2	3	4	5
14. Enthusiasm, attitude, and professionalism	1	2	3	4	5

Sum of all scores: _____
(for example, a presentation with "fair" in every category would score a 42.)

Please write comments in the space below or on the back of this sheet.

_____

_____

FORM DWR

DRAFT WRITTEN REPORT EVALUATION

Fill out and submit this evaluation to Barb Bohlen in 117 TB for copying and distribution.

This form is intended to give the GE 494 project team's clear and well defined feedback from each grader to facilitate project completion, as well as report edits and changes necessary for submission of a final report which meets all the requirements of the grading committee.

Project Number _____ **Company Industry Partner** _____

Advisor _____ **PGC Chairman** _____ **2nd Grader** _____

Indicate the amount of editing required for the Draft Report items listed below.
Qualify the required edits with comments.

	EDITING REQUIRED (check one)				
	Section Missing	Total Rewrite	Major	Minor	None
1. General report format	☐	☐	☐	☐	☐
Comments_____					
2. Abstract and key words	☐	☐	☐	☐	☐
Comments_____					
3. Introduction (clear context for problem statement)	☐	☐	☐	☐	☐
Comments_____					
4. Introduction (discussion of project's economic impact)	☐	☐	☐	☐	☐
Comments_____					
5. Problem Statement (well defined scope of work)	☐	☐	☐	☐	☐
Comments_____					
6. Team Objectives (clear, reasonable project direction)	☐	☐	☐	☐	☐
Comments_____					

FORM DWR – continued

	EDITING REQUIRED (check one)				
	Section Missing	Total Rewrite	Major	Minor	None
7. Initial analysis of current process/design/product, etc.	☐	☐	☐	☐	☐
Comments_____					
8. Discussion of solution approach	☐	☐	☐	☐	☐
Comments_____					
9. Use of analytical tools, techniques, software, etc.	☐	☐	☐	☐	☐
Comments_____					
10. Presentation of solution alternatives	☐	☐	☐	☐	☐
Comments_____					
11. Selection process for chosen solution	☐	☐	☐	☐	☐
Comments_____					
12. Economic analysis and costs/savings discussion	☐	☐	☐	☐	☐
Comments_____					
13. Soundness of solution proposed	☐	☐	☐	☐	☐
Comments_____					
14. Conclusions (clear, insightful, related to scope of work)	☐	☐	☐	☐	☐
Comments_____					
15. Recommendations (specific, path for implementation)	☐	☐	☐	☐	☐
Comments_____					

FORM DWR – continued

	EDITING REQUIRED (check one)				
	Section Missing	Total Rewrite	Major	Minor	None
16. References Cited					
Comments_____					
_____					
17. Appendices (clear, useful, well organized)	☐	☐	☐	☐	☐
Comments_____					
_____					

General Report Feedback

	Unacceptable	Poor	Fair	Good	Excellent
Thoroughness of analysis	1	2	3	4	5
Clarity of technical presentation	1	2	3	4	5
Progress for one semester	1	2	3	4	5
Response to mid-term critique	1	2	3	4	5
Creativity	1	2	3	4	5
Organization of report	1	2	3	4	5
Clarity of writing	1	2	3	4	5
Grammar and sentence construction	1	2	3	4	5
Use of correct engineering units	1	2	3	4	5
Effectiveness of visual aids	1	2	3	4	5
Quality of preparation of visual aids	1	2	3	4	5

Comments_____
_____
_____

Signature_____ Date _____

IMPORTANT! Please fill out and <u>submit this evaluation to Barb Bohlen in 117 TB</u> for copying and distribution.

_____ **Date** _____
Signature

_____ Students _____ Advisor _____ PGC Chairman _____ 2nd Grader _____Barb Bohlen

FORM FWR

FINAL WRITTEN REPORT EVALUATION

Submit this form to PGC Chairman during grade deliberation process.
PGC Chairman will send this form to Prof. Wildblood when grades are decided.
Please wait until after final oral presentations to assign grades.

Project Number _____ **Company Industry Partner** _____

Advisor _____ **PGC Chairman** _____ **2nd Grader** _____

Please rate the written report on the following features using the scale provided. Please include any comments on the back of this form. ***Inform project team of required changes in their final report AS SOON AS POSSIBLE.***

	unacceptable	poor	fair	good	excellent
Abstract and key words (descriptive of report contents?)	1	2	3	4	5
Introduction to problem	1	2	3	4	5
Economic motivation in introduction	1	2	3	4	5
Problem statement	1	2	3	4	5
Solution description	1	2	3	4	5
Thoroughness of analysis	1	2	3	4	5
Soundness of arguments supporting solution	1	2	3	4	5
Clarity of technical presentation	1	2	3	4	5
Summary and conclusions (follow from body of report?)	1	2	3	4	5
Economic analysis	1	2	3	4	5
Recommendations to Industry Partner (plausible and defensible?)	1	2	3	4	5
Progress for one semester	1	2	3	4	5
Response to draft critique	1	2	3	4	5
Creativity	1	2	3	4	5
Organization of report	1	2	3	4	5
Clarity of writing	1	2	3	4	5
Grammar and sentence construction	1	2	3	4	5
Use of correct engineering units	1	2	3	4	5
Effectiveness of visual aids	1	2	3	4	5
Quality of preparation of visual aids	1	2	3	4	5

Sum of all scores: _____

GRADE RECOMMENDED_____ **based on written report ONLY**.
(for example, a report with "fair" in every category would score a 60.)

Note: Please do not disclose grade to students until all required changes have been made.

_____ Date _____
Signed

FORM FG

GE 495 Final Grades Submission Form

To: Advisor Name	
Project Number: (Supplied)	Note: Return to 117 TB.
Project Title: (Supplied)	

Name: (Supplied)	Grade_____
Name: (Supplied)	Grade_____
Name: (Supplied)	Grade_____
Name: (Supplied)	Grade_____

_____ _____

Signed Date

Chapter

15

Exit Procedure

1) Check with each member of your Project Grading Committee to see what changes must be made to your report. **Make them.**

2) Turn in to your Project Advisor:

   a) Your project notebook

   b) Your Colleague Evaluation Form (see page 117)

3) Have your Final Report Checklist (one per group in your mailbox) signed by your Project Advisor and by the Chairman of your Project Grading Committee. Turn in this checklist before proceeding. You must also have your "printing" CD and one color copy of your printed report after your Final Report Checklist has been signed.

4) Turn in to 117 TB on CD-R media, all project files including complete project report in MS Word and a PDF, complete presentation files in MS PowerPoint, and all other files germane to the project, including, CAD files, all JPG photos taken during the course of the project, spreadsheets, developed software, graphics, simulation files, your project schedule in MS Project, Lincoln Arc Welding submission (in word and PDF), etc. (Your project may be one of a series of projects for this Industry Partner. The files ensure continuity from semester to semester.)

   Use descriptive, unambiguous files names for all files submitted.

   The MS Word file for the final report must be named in the following manner. The example is for project 7:

   2009-Fall-Final Report-07.doc or .docx

   Use the same naming convention for the accompanying PDF file:

   2009-Fall-Final Report-07.pdf

   The PDF file of the final report must include all drawings, graphics, references, etc., in the PDF file of the report. To do this, you may need to incorporate drawings and other information into an alternate MS Word file of the final report. Convert drawings to graphics files and insert them into the alternate final report Word file.

The PDF file must be self-contained with all report materials in the single PDF file. This is necessary for future reference by later GE 494 students who will retrieve the PDF of your report and must have all report materials contained in the single PDF file. (To make a PDF file, print the Word document using Ctrl+P and select **Adobe PDF** as the printer. This will "print" the document to a PDF file. You can then designate the folder location where you want the PDF file to be stored).

5) Turn in to 117 TB any equipment you purchased, along with instructions, manuals, packaging, etc.

6) Turn in all keys and equipment you checked out from 117 TB, including tool sets.

7) Turn in to 117 TB (Barb Bohlen) any building keys you may have checked out.

8) Return all questionnaires evaluating the structure of GE 494 and your employment status form to 117 TB. These must be returned SEALED in the envelope provided.

9) Email a copy of your abstract and keywords to Barb Bohlen at bohln@illinois.edu.

10) Prepare and submit your Lincoln Arc Welding report. Carefully check the form provided to insure correct addresses (see Ch. 16). Turn in one color copy of this report with your signed form.

11) Package and ship back to the Industry Partner any equipment they loaned to you, prototypes, etc. You must have your Industry Partner email Barb Bohlen at bohln@illinois.edu that they have received everything they require. If we do not receive this email, and you have not followed through with this requirement, you will have to return to campus to complete this task.

12) Clean up your work areas and throw away anything that is not valuable for future projects.

NOTE: No groups will be permitted to EXIT if the GE 494 rooms (305-308 TB) are left in disarray. These will be checked by the Senior Project Course Coordinator. Be tidy in your work areas, replace tools, remove trash, etc. Help motivate your team members and all other teams to do the same. This will eliminate the need for a final GE 494/IE 497 "Clean-Up Party" after the oral presentations are completed.

13) Communication must be received from your Industry Partnering Company that indicates that all deliverables have been received by them. This may include materials, equipment and/or other property of the Industry Partner that they allowed you to use during the project. It may also include deliverables you were to complete such as prototypes, developed software, equipment installation, software installation, etc. Your Industry Partner must acknowledge receipt of or your arrangement to ship/mail/deliver all deliverables.

If you purchased some physical hardware, software, or other items for your project work, you must turn these in with any manuals, boxes, instructions, etc. **to 117 TB or the Senior Project Course Coordinator**, along with a short description, before you leave. If any items are not turned in, they must be otherwise accounted for with the Chairman.

FORM FRC

FINAL REPORT CHECKLIST

PROJECT
NUMBER _____

PROJECT TITLE _____

PROJECT INDUSTRY PARTNER _____

1) The final written report has been graded and **the required changes have been made.**

_____ Date _____
Chairman, Project Grading Committee

2) The project notebooks and colleague evaluation forms have been turned in *(to your Advisor).*

_____ Date _____
Project Advisor

3)
a) One printing CD (pdf of completed report) with one printed color copy.
b) Three (3) copies of all project files to CD-R media per Exit Procedure, Item 4.
c) Inventoried equipment has been returned.
d) Exit questionnaires and all forms have been returned.
e) All equipment has been packaged and returned to Industry Partner *(or is ready for shipment). Confirmation email has been received from the Company*
f) All keys, tools and equipment checked out through 117 TB have been returned.
g) Work areas in 305, 306, 307, and 308 have been cleaned and trash thrown away.

_____ Date_____
Signature of GE 494 Staff Member in 117 TB

4) The person below is in charge of final submission of report and copies.
(This person might be required to remain on campus to complete the submission.)

_____ Date_____
Signature

5) Eleven copies of final report received in 117 TB.

_____ Date _____
Signature of GE 494 Staff Member in 117 TB

2011-FA

Advisor:

Evaluator:

Form FCEF
FINAL COLLEAGUE EVALUATION
(Confidential – submit in sealed envelope to Advisor)

The purpose of this evaluation is to determine the extent of each participant's efforts relative to the remainder of the group. Imagine that your team is paid $10,000 for your efforts this semester. How would you divide that sum among the members of your team?
List below the members of your team including yourself and indicate their "payment" that would be appropriate for his/her effort. Tear out this form and return it to your Advisor before the last day of classes.

Team Member:	**Payment:**

Comments: _____

_____

_____

_____

_____

_____

_____

Signature: _____

The above information will be held in strictest confidence.
You will not receive a GE 494 grade until this form is returned and completed.

Chapter

16

Lincoln Arc Welding Foundation Design Competition

The Lincoln Arc Welding Foundation Engineering Design Competition is an annual evaluation of 800 to 1000 undergraduate engineering papers submitted throughout the United States. Each year approximately 20-25 national awards are given. The performance of your Industrial and Enterprise Systems predecessors in this national competition is legendary. Look at the north wall of the west entrance to the Transportation Building for some of the awards given over the years. In the past three years, GE 494 students have won 45% of all these awards given in the nation. Typically at least one out of every three GE 494 projects wins a national award. This is also something that will be on these students' resumes for the rest of their professional careers. Now that you have put so much work into your report you will also enter this competition. The rules and application form are simple.

Make one additional original of your report. This original will be unbound and must have all references to the University of Illinois, the Industry Partner, and your names removed. Do a search and replace and simply replace the Company name with "the Company," your names with "the authors," etc., to ensure readability. **Don't forget to modify your AutoCAD title boxes.**

You will be asked to review the entry form to make sure all information is correct. You can now compete against the best in the Nation!

Procurement Reporting Communications
Information Collection Worksheet

Below is a list of items employees should collect when participating in procurement-related discussions to ensure accurate and detailed reporting at: http://pcrs.illinois.gov.

Information to collect from the Vendor Representative(s):

Vendor Name:			
Vendor Location:			
Vendor contact Name:			
Job Title:			
Phone Number:			
Email Address:			

Information to collect from ALL University employees involved in conversation:

Name:			
Job Title:			
Phone Number:			
Email Address:			

Additional information you will be expected to provide in your reports:

Date of communication:
Time/Duration:
Communication Mode: (phone, email, fax, etc.)
Summary of communication