

SENIOR PROJECT GUIDELINES

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OBJECTIVE

The Industrial and Manufacturing Engineering curriculum requires that every student earning a degree in Industrial Engineering (IE) or Manufacturing Engineering (MfgE) successfully complete IME 481 (2 units) and IME 482 (3 units), Senior Project. As stated in the ABET requirements, "Students must be prepared for engineering practice through the curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints." (ABET 2000)

Objectives of the Senior Project can be broadly stated as follows:

- Execute a project that is an integrated application of coursework in IE or MFGE
- Plan and manage the project
- Do research in the area of interest
- Write a complete technical report
- Give a business presentation on the project

The senior project will be completed before a student leaves the university.

The senior project is an "academic report," similar to a master's thesis or doctoral dissertation. It is different than any other project you have completed in the IME department. In this context, you must perform a thorough review of literature in order to gain expert knowledge in the area. Projects that you work on in class or at work are generally for a client or for management and will be written with this audience in mind. The Senior Project report is written more closely to the form of a publishable research article.

ELIGIBILITY FOR ENROLLMENT

Industrial and Manufacturing Engineering students with senior standing may enroll in the senior project course. Students also must have the consent of the instructor (administrative advisor). Generally students who have less than 50 units or less remaining to complete the degree may enroll in IME 481.

IME 481 and IME 482 should be taken during two successive quarters. It is possible with some projects to take IME 481 in the Spring and IME 482 in the Fall. This will have to be discussed with the administrative advisor prior to beginning the project.

Students will have to register for IME 481/482 during the academic school year (not summer quarter), and the student should be on campus. Students should not register for these courses when on a co-op.

A change of the project or faculty advisor will normally require the student to start the senior project sequence over by repeating IME 481.

It is possible to do a senior project with one of more others. These team senior projects must be approved by the advisors. In addition, it is often desirable to define specific areas of responsibility so that grading can be completed individually.

ADVISORS

There are two senior project advisors: an **administrative advisor** and a **technical advisor**. The administrative advisor runs the senior project class and ensures that students adhere to deadlines. In addition, this advisor helps students find projects, and coordinates the senior project presentations. The technical advisor helps students with technical issues. This person gives direction on appropriate methodology and solution techniques. Both advisors jointly assign a grade in the courses.

COURSE DESCRIPTIONS

Below are the catalog descriptions of the senior project courses.

IME 481 Senior Project Design Laboratory I (2)

Selection and completion of a project by individuals or team which is typical of problems which IE or MfgE graduates must solve in their fields of employment, which is representative of those encountered in professional practice. Project typically involves system design, modeling, analysis and testing. Project method includes costs, planning, scheduling, and appropriate research methodology. Formulation of project outline, literature review, project activity scheduling and regular progress reviews by instructor are required. 2 laboratories. Prerequisite: Senior standing in major and consent of instructor.

IME 482 Senior Project Design Laboratory II (3)

Continuation of IME 481. Involves research methodology: problem statement, method, results, analysis, synthesis, project design, construction (when feasible), and evaluation/conclusions. Project results are presented in formal written report suitable for reference library and formal oral report. 3 laboratories. Prerequisite: IME 481.

SELECTION OF TOPIC

Selection of a suitable topic for the senior project is a critically important step for successful completion of the project. It is best to have a project decided upon before registering for IME 481.

Project Requirements

A senior project will include the following:

- The project must require 150 to 200 hours to complete

- The project must apply knowledge and skills acquired in earlier coursework in the major often from multiple areas of study.
- The project must incorporate design. The design process must be used to create a solution (product, process, or system) to a problem (satisfy a need).
- The project must define an initial state (before the recommended improvements) and a projected state (after implementation of the improvements). There must be a quantifiable comparison between the two states in order to calculate the value of the design.
- The project must include an economic justification.

Inadequate attention to the topic selection may result in a change of topic by the student which typically leads to less than desirable results, including inadequate time for completion, poor quality project, change of faculty advisor, delay in completion of the project, and a poor grade. Therefore it is important for a student to give careful considerations in selecting a senior project topic.

It is possible to do a senior project as a team. Team senior projects must be approved by the advisors. In addition, it is often desirable to define specific areas of responsibility so that grading can be completed individually.

Finding a topic

Each student is responsible for deciding on their own project. Often an area of interest can turn into a really good project topic. Provided the objectives above (i.e., design, economics, etc.) are addressed in the project, there are many options available to a student in order to find a topic for a senior project. Listed below are a few of the methods students have used in the past.

Coop Program or Summer Internship. Students working on a co-op program or a summer internship often work on a project that can be used as a senior project. These company-defined projects are often excellent in that they satisfy all the project requirements listed above and they provide the company with a good solution to a real problem. A student should remember that the deliverable for the senior project must be the “design” of something: a product, process or system. If a student works on implementing a previous designed solution or performing data collection, this may not qualify as a senior project.

If a student is working at a company and they find a project that they believe satisfies the requirements for a senior project, the student should contact a faculty member with a project description. The faculty member can help to define the project and possibly give solution technique advice. Generally a student on co-op or internship should do the following while still at the company:

- 1) Obtain Permission from the Company. The student must obtain permission from the company in order to use the project as a senior project. The senior project is published in the library and thus the company needs to know that it will be publicly available. If the company does not want the senior project published, often changing the name of the company is enough to make them feel comfortable. In rare cases, the senior project does not have to be published in the library.

- 2) Collect data. The student should collect all possible information regarding the project. All computer files, data sheets, and pictures should be gathered before leaving the work site. It is very difficult to go back and collect this information.

If a student is on co-op or internship and receives technical elective unit credit for their work experience, he/she may need to perform extra work (consistent with 150-200 hour requirement) for the senior project beyond the work credited. It is not possible to double count co-op technical elective units and senior project units.

Senior Electives. In most senior elective courses, instructors discuss possible areas for senior projects. Students must be aware that these projects will focus to a great extent on the subject matter of the course.

Course Projects. Frequently, students are required to do practical group projects or literature reviews as part of the requirements in the courses. These efforts, may lead to a senior project topic.

Industrial & Manufacturing Engineering Laboratories. The IME Department is engaged continuously in modernizing and expanding its laboratories in the following categories:

- Human Factors
- Computer Aided Design
- Computer Numerical Control
- Microcomputer Interfacing
- Programmable Controllers
- Robotic Applications
- Pneumatic Automation
- Industrial Metrology
- Computer Networking
- Manufacturing Simulation
- Electronic Manufacturing

Senior projects involving the modernization of these facilities allows the student to work closely with a faculty member and through expanded expertise enhance the student's job opportunities.

Faculty Research Projects. Department faculty may be involved in sponsored or individual research activities. Students with research aptitude may have an opportunity to work in these projects as research assistants. Part of such research can form excellent topics for a senior project.

Current Journals. Students can also develop senior project topics by regularly reading the current issues of journals related to the industrial or manufacturing engineering discipline. This approach, not only helps in the selection of a good senior project, but also makes a student aware of the wide range of developments taking place in the industrial or manufacturing engineering.

Currently relevant topics. Current meaningful “hot topic” may be suitable senior project topics. Global warming, sustainability, community and service learning project may provide opportunities for a good senior project.

Local companies. Sometimes local companies have engineering projects that can lead to a senior project. Students can contact local companies directly. They may have worked with the company in other classes and thus have established a working relationship. These companies are a good source for projects.

COURSE STRUCTURE

Students will meet with the administrative advisor in a classroom setting at least five times a quarter. During these meetings, the administrative advisor will discuss topics such as project deadlines, literature reviews and research, methodology, and technical report writing. Several class meetings will also be spent with students giving presentations on their progress.

In addition, students will be expected to meet with their technical advisor at least five times a quarter. This will vary from advisor to advisor and project to project, but in general the student must keep their technical advisor updated on technical issues and progress.

Class meetings

Even though the senior project lab classes are scheduled at various times during the week, the administrative advisor will decide on the time for the class meeting. It usually meets for several hours in the evening approximately every other week. These class meetings are coordinated by the administrative advisors each quarter. Students will receive an email regarding the planned meeting time during the first week of the quarter.

Below is an example schedule of the activities during these class meetings. This schedule may change each quarter. Please refer to your course syllabus for exact dates.

Week 1 – Define Projects

IME 482 students will give a quick project topic presentation during the class meeting

IME 481 students who have a project will give a quick project presentation during the class meeting

IME 481 students without a project will develop a plan to find a project

Week 2

IME 481 will decide on technical advisor

IME 481 will receive a lecture on literature review, and senior project expectations

IME 482 students will turn in a status report to the technical advisor and the administrative advisor, via email, see description below

Week 3

IME 481 Students will turn in a project proposal. This should be emailed to both the administrative and the technical advisor, see description below

Week 4

Class meeting with all IME 481 and IME 482 students to discuss write-up guidelines

Week 5

Each IME 482 student will present a short PowerPoint presentation on their project, see Description below

Week 6

Each IME 481 student will present a short PowerPoint presentation on their project, see Description below

Week 7

IME 482 students will present a practice IAB presentation

IME 481 students will turn in their literature review to administrative advisor and to the technical advisor, via email

Week 8

IAB Presentations of senior projects

Week 9

IME 482 students will turn in a draft of the senior project to their technical advisor

Week 10

IME 481 students turn in Introduction and Background to the technical advisor and the administrative advisor, via email

Week	Students meet in the class	481 Subject for class meeting or item due	482 Subject for class meeting or item due
1	481 & 482	Project Decision	Project update
2	481	Discuss Lit review, and requirements Technical Advisor name	Project status report due
3		Project Proposal due	
4	481 & 482	Class meeting to discuss writing guidelines	
5	482		Status Report PowerPoint Presentations due
6	481	Status Report PowerPoint Presentations due	
7	482	Lit Review due	IAB Practice Presentations
8	482		IAB Presentations
9			Draft due
10		Introduction and background due	

Project Proposal. All students registering for IME 481 must prepare a project proposal and submit it via email to both the administrative advisor and the technical advisor. The senior project proposal must include the following:

1. **Project title and technical advisor's name**
2. **Problem Statement:** A brief description of the problem to be solved or issue to be addressed.
3. **Expected Deliverables:** A brief description of the deliverables for the project.
4. **Technical Approach:** Brief description of the problem solving methodology.

5. **Industrial or Manufacturing Engineering Orientation:** Description explaining the relationship of the project to Industrial or Manufacturing Engineering, including applicable courses and topics.
6. **Project Outline and Schedule**
 1. Work breakdown structure
 2. Time estimates and milestone dates for proposed work.
 3. Gantt chart or something similar

Status Reports.

IME 481 Project Status Report

The Progress report at a minimum should include:

- Project title and technical advisors name
- Brief problem statement
- Discussion of why this is an appropriate Senior Project (see project selection guidelines)
- Expected Deliverables
- Scope (what you will do and what you won't)
- Work accomplished to date
- Project Management of Senior Project
 - Updated work breakdown structure for remainder of work
 - Updated time estimates and milestone dates for proposed work.
 - Updated Gantt chart or something similar

IME 482 Project Status Report

The progress report at a minimum should include:

- Project title and technical advisors name
- Problem statement
- Expected Deliverables
- Discussion of why this is an appropriate Senior Project (see project selection guidelines)
- Scope (what you will do and what you won't)
- Work accomplished to date
- Project Management of Senior Project
 - Updated work breakdown structure for remainder of work
 - Updated time estimates and milestone dates for proposed work.
 - Updated Gantt chart or something similar

You should have received feedback from you advisor on the literature review and introduction and background. Make sure you understand their input.

PowerPoint Presentations (both IME 481 and 482)

The presentations will be 5 minutes and will cover the following.

- Project title and technical advisors name
- Problem statement
- What you have done so far
- Technical issues addressed

- What you plan on doing to finish the report

IAB Presentations (IME 482)

The Industrial Advisor Board reviews our senior project for technical content and oral presentation ability. Listed below are the basis requirements. We will practice these presentations so they will be very professional.

- Student has identified and defined a suitable problem
- Student has solved the problem using an appropriate strategy (i.e., the engineering design process)
- Student has used appropriate techniques, skills, or tools for the project (i.e., based on knowledge and skills acquired in course work)
- Student has assessed the economics of the project
- Student shows an ability to communicate effectively.

Draft Senior Project The initial manuscript must be prepared and submitted by the beginning of the **ninth week** of IME 482. The initial manuscript represents the cumulative work of the student in the project and includes all the data, analysis and the relevant information to support the notion that the project tasks have been completed.

Generally after the submission of the senior project the technical advisor will fully edit the paper and return it to the student for revisions. This will take at least a week. During the last week of the quarter the student will make the revisions and then submit the final paper to the technical advisor. The final submission will include the following five items.

1. A bound copy of the senior project
2. An unbound copy of the senior project, single sided
3. A copy of the Abstract with project title and author
4. Cashier's receipt for submission of the senior project to the library
5. Three copies of the senior project form from the library website.
<http://www.lib.calpoly.edu/collections/seniorprojects/submissionform.pdf>

The Department shelves the bound copy of the report and the abstract. A copy of the senior project requirement form is filed in the student's file.

The Library will put the report on microfiche. One microfiche of the report will be filed in the reserve book room for public use. The other is returned to the Department with original of the project report.

Grading of Senior Project

Grades for the senior project are assigned by both the administrative and the technical advisor. The grading guidelines are listed below.

- A All the following are true:
- All deliverables on time, professional quality and complete
 - Project suitable for publication

- Topic appropriate for a senior in engineering
 - Technical advisor agrees
- A- Any of the above areas has slipped once during the quarter
Technical advisor agrees
- B Two or more areas are not up to appropriate quality
Technical advisor agrees
- C Report turned in too late to grade, but appears satisfactory
Technical advisor agrees
- D No final report but the majority of the work has been accomplished
Technical advisor agrees
- D- Significant portion of the work was accomplished, but nothing was finished
Technical advisor agrees
- F Poor attempt at senior project
- I Incomplete grades are not given

WRITING THE REPORT

Organizing the report

Most reports should be organized in the following manner. Sometime there is a valid reason to include extra chapters in within the body of the report.

1. Title page
2. Executive Summary or Abstract
3. Preface and/or Acknowledgements (optional)
4. Table of Contents
5. List of Tables (if appropriate)
6. List of Figures, or illustrations (if appropriate)
7. Notation or symbols (if appropriate)
8. Chapters
 1. Introduction
 2. Background and Literature Review
 3. Design
 4. Methodology
 5. Results
 6. Conclusion
9. References/Bibliography
10. Appendices (if appropriate)

APPLICATION OF AUTOLISP PROGRAMMING
FOR PRINTED CIRCUIT BOARDS
by
ANTHONY S. CELEBRINI

A Senior Project submitted
in partial fulfillment
of the requirements for the degree of
Bachelor of Science in Industrial Engineering

California Polytechnic State University
San Luis Obispo

Graded by: _____ Date of Submission: _____
Checked by: _____ Approved by: _____

Figure 1 - Title Page

Title Page

Title page must be of the same format as shown in the sample (Figure 1). The title must be the same in all the senior project related documents i.e. title page, abstract, senior project requirement form.

Table of Contents

The table of contents should only contain the major divisions of the project, including the list of tables and list of figures, the chapters of the text and their headings exactly as in the text, the bibliography/references cited, the appendices, and their respective page numbers. See Figure 2 for a sample Table of Contents. Consider using the automatic Table of contents function within Word. It can be found under the “Insert” menu, “Reference” option, “Index and Tables” option, “Table of Contents” tab. This is a very useful method of organizing the document and updating tables, figure and the table of contents.

Table of Contents	
Abstract.....	2
Introduction.....	4
Background	5
Literature Review.....	6
Facility Planning in the Stockroom.....	6
Kanban Systems.....	11
Project Management.....	11
Design.....	14
Define Objectives.....	14
Define Stockroom Areas.....	14
Determine New Space Constraints.....	19
Develop and Evaluate Layout.....	22
Methods.....	25
Results.....	29
Conclusion.....	30
Appendix A.....	31
Appendix B.....	32
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Figure 2 – Example Table of Contents

Executive Summary (or Abstract)

The executive summary is usually less than 500 words. It summarizes all the important points of the study: context, problem, objective, approach, conclusions, and recommendations. When writing this section, imagine that the reader is incredibly simple-minded, or has so little time to think about the report that only the most simple and direct statements are appropriate. Avoid technical vocabulary. Be sure to include the most important findings in your study, but be careful not to promise more than you actually found. Express results in quantifiable financial terms. Note an Executive Summary self-contained and is a substitute for the report itself. The executive summary will fulfill the Library’s need for an abstract. An abstract is also usually less than 500 words , is a guide to the report, but does not summarize the report content.

Introduction

This section should present the background/problem addressed by the study. The background/problem tells the reader WHY you performed the study, i.e., what problem you are attempting to solve. The progression is often from a very general background statement to a very specific and concise “problem statement.” Though much background may be needed to get the

reader ready for the report, only a summary is presented here in the introduction. The rest is placed in the next section (see below).

State the objectives or purpose of the study, i.e., what you hope to accomplish with the project or hope to convey with the report. A set of two to eight objectives is often appropriate and should be listed with bullets. These objectives should clearly define the scope of the project so that the reader is not surprised later by information or is not expecting something that isn't there. Any bulleted list of objectives (or any other list) must have 'parallel' structure; e.g., all starting with action verbs – study, design, investigate, select, etc.

Summarize the solution approach you will take to reach your objectives. If you will experiment, say so, and say why. List the key tasks you will accomplish as you solve the problem. At least some of these tasks must be related to engineering content found in your coursework or related activities and should be generally aligned with your major.

Regardless of the organization of the introduction section, it should answer the following questions:

- What is this report about?
- How did the idea for this project originate?
- What is the problem that needs to be solved?
- What needs to be accomplished to solve this problem?
- What do you intend to complete as part of this project?
- What deliverables will result from your work? Prototype, product design, process design, recommendations, etc.
- How will you meet each of your objectives?
- What will not be included in the scope of the project?
- What main tasks will you perform on the way to completing the project?

Make sure you include a few sentences telling the reader how the rest of the report is organized.

Background (includes Literature Review)

The background should provide a context for the project and should describe any important information the reader needs to know in order to understand what you've done. This may include information concerning existing products, processes, systems, or organizations. Company literature, catalogue or manual information, advertising material, or other literature may be referenced here.

The background may also include important theory that has been developed by others (literature review). This is information the reader should know (or be reminded of) before reading the rest of the report. The theory is what is known (or believed) about the important concepts under study. It may describe a link between process/system inputs and outputs or define how quality, productivity, or cost is related to design decisions. The theory can usually be found in textbooks or landmark articles about the subject. Include references to give credit to the originators of the theory.

The background should also indicate what has been completed or attempted with regards to solving this or similar problems in the past (literature review). The published literature may include those that have attempted to solve the same problem as you, similar problems related to your work, or simply problems related to some of the methods you will use. References to recent works may include journal or magazine articles, theses or previous senior projects, conference proceedings, or other sources. Explain why your project is still necessary in the face of this prior work.

Literature Review

Many students commit themselves to work on their senior project before they have done sufficient background reading on the topic, dismissing the literature search as completed after a few books and articles have been reviewed. Wide reading in the topic is strongly recommended as a means of discovering a suitable project and/or an appropriate approach to analyzing the selected problem. Often as result of such reading, an already selected senior project may be modified extensively or redefined.

A review of the related literature is an essential part of a senior project. The topic must relate to existing knowledge on the subject and must demonstrate an ability to locate, organize, and use the literature in the field. The literature search should be almost complete before proceeding with the project. This literature review will help in defining the problem, and provide insight into the methods and approaches used by others.

The review of the related literature involves locating, reading, and evaluating materials in your area of interest in the library and online. The library is, therefore, an indispensable resource for those engaged in project writing. The efficiency with which materials relevant to problem are located depends considerably on students' knowledge of the University Library and its various resources.

Generally you will need to have at least fifteen references; at least ten on them should be non-internet sources. There is much information online, but you must be diligent in evaluating the sources of the material. Cited material must be peer reviewed and published by a reputable source. Wikipedia is not an acceptable source in a literature review.

The methods of conducting the literature review differ to some extent from subject to subject. However, in most fields the first step consists of locating or identifying key words related to the

substantial change in response latency in the later portion of the test and a corresponding negative change in performance (Hadadi & Luecht, 1998). In a paper-and-pencil test, because the response times to individual items can not be recorded, only the performance can be examined. Secolsky (1989) examined scores on different sections of the Test of English as a Foreign Language (TOEFL) to see if there were sections of the test, especially at the end, that showed a pattern of random guessing.

topic under investigation. This is usually done by checking the main reference sources and textbooks on the subject.

These key words are needed to locate specific references in

the indexes and abstracts.

Figure 3 - Reference by Author and Year

During the search of indexes and abstracts a bibliography card should be prepared for each book title, report or article which might contain material pertinent to the project. The bibliography card should include all the information necessary to identify the reference, such as author, title, publisher, date, periodical title, volume number, and inclusive paging. PolyCat in the Library will provide this information. Libraries will also have facilities to search for references using key word search through database of current periodicals. Some of the needed materials may not be available in the library, but may be obtained on interlibrary loan.

The review of the literature should include those articles and other references that bear a valid relationship to the problem under study. They should provide the background information that is needed to understand the project's contribution to the field and a point of reference in discussing and interpreting the conclusions in the project.

When writing the Literature Review all sources must be cited within the report and in the reference list of the bibliography. One method of citing sources includes a reference to the source by author and year. An example is included in Figure 3. Another method is to reference the sources by number in the reference list. This is shown in figure 4. Anything reproduced from another source must be cited. Pictures taken by others or figures created by someone else must be referenced.

develop a new product in half the time. Also, it requires keeping far less than half the needed inventory on site, results in many fewer defects, and produces a greater and ever growing variety of products" [4].

Taiichi Ohno and Dr. Shigeo Shingo are credited as the founding fathers of the Toyota Production System. The Toyota Production System took over twenty years to develop, perfect, and implement. In a thorough investigation into the inner workings of the Ford production system, Ohno and Shingo were able to identify and create solutions to address the shortcomings of the mass-production assembly line while adapting techniques they found useful. Toyota Production System evolved in Japan in response to: lack of space, lack of money for inventory holding costs, and the need to build a large variety of vehicles for a small market [17]. The aspect of TPS that really makes it so successful is Dr. Shingo's SMED (Single Minute Exchange of Die) technique, which aided in reducing all changeover times to less than 10 minutes [16].

Lean manufacturing Principles evolved through a series of situational constraints Japan experienced in the 1940's and 1950's. It is very important to

Figure 4 - Reference by Number

Design (or Theory)

This is often the longest chapter and usually has subheadings that show the steps used in the design of the solution. For a product, process, or system design, describe the overall approach and the specific steps taken (calculations, reasoning, modeling, etc) to arrive at the initial design. This includes defining requirements, constraints, or user specifications and explaining the initial concept for the design solution and any alternative concepts. Justify each major decision by describing the theory or logic used. Justify any unusual or unique aspects of the design.

Present the original design in the form of drawings, process plans, or system specifications. Your initial cost, quality, or productivity estimates should be presented here. Refer to any drawings, tables, or diagrams in your text - whether these are embedded in the text or placed in an appendix.

If you have developed new theory for this project, derive it in detail in this section. You may change the title from Design to something more appropriate.

Methods (or Experimentation)

In this section you will explain how you tested your design. If a virtual or physical prototype is produced for the product, process, or system design, explain how, including all equipment and

methods. Include visual aids. If you ran experiments, indicate what you did, especially detailing your set-up. Describe all equipment and techniques used and conditions of the tests. Justify any non-standard methods. Describe any statistical tests or simulations used to evaluate the design. Include as much information as you feel is relevant. No results, however, should be included unless they are preliminary results used to justify a certain method.

Results and Discussion

In this section you will present the resulting data – whether numerical measurements or subjective observations. You should include only the important results in this section; the rest should be placed in an appendix (you should refer to them in the text). Any tables or figures should be referred to in the text.

Describe and explain the results. Answer the following questions:

- Were the results as expected? Why or why not?
- Did the theory hold?
- Is the design a good one?
- Were your cost, quality, or productivity estimates on track
- How should the design or theory be changed based on results? Your progression should be from facts to opinions.

Describe any problems or limitations with the methods or experiment. Answer the following questions:

- Were any unusual conditions present?
- Were any results difficult to interpret?
- Are there some questions that remain unanswered?

Interpret the results in terms of how successful you believe the actual implementation of the design will be. Answer the following:

- Based on the results, what do you predict for the future?
- Where might legitimate problems crop up?
- How should use of the design or theory be limited?

Conclusions (or Summary and Conclusions)

In this section you will summarize the project: problem, objectives, and solution approach.

List a set of conclusions as bullets. Summarize the results by answering the following:

- What were your most important results?
- What can you say about the theory or the topic in general based on your experimental results?
- Did you accomplish each objective listed in the introduction?

What did you learn in the project? How would you do the project differently next time or what would you try next? What do you recommend based on your findings?

Bibliography

All published literature referred to by the student to carry out any of the project tasks must be listed in the bibliography. MLA or APA should be used to format the bibliography. There are several books and online resources that can help in this formatting. The following essential information must be included in the listing: authors, literature title, journal name or publisher's name, volume, number and year of publication, and page numbers referred.

Appendices

Appendices include materials that cannot be presented in the text (due to length, form, or complexity) without interrupting its continuity, but which are helpful in clarifying the meaning of the text. Materials which are valuable in providing supporting evidence, (i.e. summary tabulations, forms, documents, letters, manuals and questionnaires) may also be provided in the appendix.

General Writing Guidelines

Use this as a guide only. Each project has unique elements and may require a different structure or different sections for the report.

- Write the Introduction first, the Executive Summary last.
- Do not use first person in the senior project write up.
- Headings and subheadings should mean something.
- Start each major section with a short explanation of what will be covered.
- Keep in mind who you're writing for and what you want to say. Most senior projects should target a general audience (not your advisor!). Imagine that the most likely people that will read it are a future boss or a future student that wants to know what you did.
- Use headings, subheadings, bulleted lists, tables and figures whenever possible. Refer to all tables and figures in the text (same for Appendices).
- Be honest, cite others, and don't conclude more than your results tell you.
- You don't have to sound like an encyclopedia, but technical writing is meant to inform, not entertain. Shorter sentences often work better.
- Spell-check. It's easy. Consult a resource on grammar and word usage if unsure. Have a friend or colleague read over your work to catch mistakes and suggest changes.