Senior Design Project

Process and Advice

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The Solution

Your work evolved along five phases:

1. **Proposal**
2. **Design**
3. **Implementation**
4. **Presentation**
5. **Report**

Each phase serves to keep your work on schedule. Within a highly creative context, you need to develop your skills in various technical areas as well as written and oral communication.

Teamwork

You will experience working with a team in the context of this engineering project. It takes will power and effort to adapt to different personalities, schedules, and work ethic.

The larger and the more complex the problem, the more stressful the experience. Reflect on how well your team worked together and on what you can change about yourself to make future team experiences more efficient and rewarding.

Communication

An engineer needs to know how to communicate ideas both orally and in writing.

Remember that this communication must be accurate, complete, clear and succinct. Strive to become a better communicator and your work as an engineer will have stronger impact.

The Engineering Design Process

As you develop more complex projects, you need a systematic method. Engineers work with a process created to tame this complexity. You will start practicing it with your team.

1. Identify the problem
2. Research and gather data
3. Establish design criteria/goals/constraints
4. Identify potential solutions
5. Analyze potential solutions
6. Develop and test models
7. Select the best alternative
8. Communicate and specify for implementation
9. Implement and/or commercialize
10. Perform post-implementation assessment

Engineering Design Process (Cont.)

If you were to simply search online for a hardware device, throw lines of code together, and bang on the program until it works that would make you a ‘hacker’, not an engineer. To work as a bona fide engineer, you need to follow the systematic approach of the Engineering Design Process outlined in the previous slide.

1. **Identify the problem**: The problem is spelled out clearly for you. It’s still up to you to understand it completely. Ask for clarifications where they are needed; brainstorm with your colleagues.
2. **Research and gather data**: You may have to work harder at digging deep into the problem. Talk to the client, analyze what knowledge is missing and go after it. Collect all information you need.
3. **Establish design goals/criteria/constraints**: Enumerate what objectives you must achieve, the constraints you must observe, an objective list of points that will indicate how well a solution meets expectations.

Engineering Design Process (Cont.)

4. **Identify possible solutions**: There are many approaches to meet your design goal. You might come up with one or more ideas to develop: save them to decide later which one to expand.
5. **Analyze potential solutions**: Look at your solutions in the light of your goals, constraints, and criteria. You'll be able to junk immediately anything that doesn't meet all goals or that violates constraints. One possibility is to assign points to how well the solution meets each specific criterion. Then, you'll be able to compute a numeric score for each solution. The solutions which have the highest scores possibly have the best potential.
6. **Develop and test models**: You should develop a top-down approach, concentrating on the key aspects first (and on structure) and leaving details to be fleshed out later. This can be used to see if your solutions are as good as your analysis indicate.
7. **Select the best alternative**: By now, you have enough material to choose the solution that seems to be the best.

Engineering Design Process (Cont.)

8. **Communicate and specify for implementation**: The real world gives you open ended problems and often only a partial lists of specifications. The engineer must enumerate the specifications which will guide the development of the design. This involves communicating with the client (advisor) so that all parties agree on what needs to be built.
9. **Implement and/or commercialize**: This is when design talent is put to the test. The problem is fully fleshed out, tested by the developers and then tested by independent parties. Bugs will be found and corrected, before it's given out for commercialization or public use.

Engineering Design Process (Cont.)

10. **Perform post-implementation assessment**: How well the process works can only be determined by the analysis of the final product. No design is so perfect that it has no room for improvement. This assessment gathers information that the engineer can use in a future version of the design. Depending on the degree of success of the solution, the engineer might iterate the whole process or only part of it. It is likely that the final users will find more bugs and suggest different or additional functionality.

Design Tradeoffs

- Most engineering problems involve design tradeoffs.
  - Cost vs. Time: More expensive equipment will sometimes get the job done faster.
  - Cost vs. Reliability: Expensive parts break less.
  - Time vs. Quality: A project that's rushed will not be as high of quality.
- Recognizing and controlling design tradeoffs is one of the most important tasks of an engineer.

Project Management Guidelines

- Organize your projects and never miss a deadline
  1. Decompose the project into small tasks and determine accurate deadlines;
  2. Use a Gantt chart to schedule all of the tasks and determine which tasks depend on the results of others;
  3. Use a team chart to assign the right people to the right tasks.
- Remember all of the "Little Things" before they become "Big Problems“
- Standardize your work to prevent errors
- Get it done right the first time
  - Here are the following things that can be communicated more clearly using visuals:
    1. Who is responsible for this?
    2. What are we doing?
    3. When is it due?
    4. Where is it?
    5. Why is this important?
    6. How are we going to do it?

Oral Presentation Advice

Oral Communication is different from written communication Listeners have one chance to hear your talk and can't "re-read" when they get confused. In many situations, they have or will hear several talks on the same day. Being clear is particularly important if the audience can't ask questions during the talk. There are two well-know ways to communicate your points effectively. The first is to K.I.S.S. (keep it simple stupid). Focus on getting one to three key points across. Think about how much you remember from a talk last week. Second, repeat key insights: tell them what you're going to tell them (Forecast), tell them, and tell them what you told them (Summary).

Oral Presentation Advice

- **Think about your audience** Most audiences should be addressed in layers: some are experts in your sub-area, some are experts in the general area, and others know little or nothing. Who is most important to you? Can you still leave others with something? For example, pitch the body to experts, but make the forecast and summary accessible to all.
- **Think about your rhetorical goals** Leave your audience with a clear picture of the gist of your contribution
- **Practice in public** It is hard distilling work down to 20 or 30 minutes.
- **Prepare**