

EE/CprE/SE 491 – Senior Design I and Professionalism

Design Document

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Always design a thing by considering it in its next larger context – a chair in a room, a room in a house, a house in an environment, an environment in a city. – Eero Saarinen

Design Document

- The design document is just what its name implies; it contains the design for the project end product
- A design, if properly done, should produce an end product that:
 1. Satisfies the functional requirements
 2. Satisfies the design constraints
 3. Performs the intended use(s) for the intended user(s)

Intended Audience(s)

- Think of the design document as equivalent to providing the blueprints for a new building construction
- Audience is varied:
 - Client: to insure that the necessary functionality is present
 - Course coordinator (me): verifying the academic quality of the report
 - Project team members: to aid in the end-product implementation
 - Anyone who will do follow-up maintenance and enhancement: as a reference and potential road-map

Project Plan vs. Design Document

- The project plan should contain all of the “big picture” information about your project:
 - Includes a concise overview of the project, its functional and nonfunctional requirements, your team’s budget (if any), a timeline of work that will be done, and any constraints or issues your team will face in their work
 - Providing this information allows your team, your advisor, and your client to track the project’s progress, as well as ensure that your completed project measures up to the specifications set by the client
- The project plan should not be overly technical:
 - Best to think of it as a document you would give to a high-level supervisor or a potential client
 - These personnel often care little about the technical details behind your team’s project
 - Rather, they’re concerned with how long it will take to complete the project, how much the project will cost them, and any issues that might cause either factor to change
- In the project plan, it is important to thoroughly specify this information and avoid cluttering it with extensive technical specifics

Project Plan vs. Design Document (cont.)

- The design document should contain the detailed technical specifications behind your project:
 - Includes descriptions of the project's major functions and systems, how the different subsystems will work together, how the user will interact with/operate the project, the revisions your project has undergone over time, and your team's methods of testing and verification
 - This information should be supplemented with block diagrams, schematics, CAD designs, and other graphics relevant to your project
- Often delivered to the client after the project is completed, along with a prototype or finished product
- Should allow the client to maintain, modify, and recreate your team's project long after your team has finished working on it
- When working on the design document, it's wise to think of it as a reference manual:
 - Engineers outside your team (or a new member joining your team) should be able to reconstruct your team's work from the information contained in it, so don't skimp on the details
 - You should also be sure to include your methods of testing, so that other engineers reviewing your design document know that your team has verified that your designs work

Project Plan vs. Design Document (cont.)

- **Expect some overlap:**
 - General layout and formatting will make the documents look fairly similar
 - The project description / overview section will be nearly identical
 - Functional and non-functional requirements should be identical
- **Why is it important to include these in both?**
 - They help define the project and help the reader understand what your project is and does
 - Be careful to avoid going overboard with copy/paste or by including too many details in the wrong document

Design Document: Main Sections

1. Frontal materials (same as in project plan)
 2. Introductory materials
 3. Specifications and Analysis
 4. Testing and Implementation
 5. Closure materials
- As before, these are all required – senior design project documentation is not a great time to showcase your individuality and creativity

Section 2: Introductory Material

- This section of the plan sets the stage for the work that is being planned:
 1. Acknowledgement
 2. Problem / project statement
 3. Operating environment
 4. Intended user(s) and intended use(s)
 5. Assumptions and limitations
 6. Expected end product and other deliverables
- These can generally be copy-pasted from your project plan

Section 3: Specifications and Analysis

- Include any/all possible methods of approach to solving the problem:
 - Discuss what you have done so far – what have you tried/implemented/tested, etc?
 - We want to know what you have done
- Approach methods should be inclusive of functional and non-functional requirements of the project, which can be repeated or just referred to in this section
- The analysis should highlight both strengths, weaknesses, and any other observations of the proposed solution
- If your project is relevant to any standards (e.g. IEEE standards, NIST standards) discuss the applicability of those standards here

Section 3: Specifications and Analysis (cont.)

- **Proposed design:**
 - Discuss what your team has decided to implement / design / do
 - Should use present versus future tense
- **Design analysis:**
 - Discuss what you did so far
 - Did it work? Why or why not?
 - What are your observations, thoughts, and ideas to modify or continue?
 - If you have key results they may be included here or in the separate “Results” section

Section 4: Testing and Implementation

- **Interface specifications:**
 - Discuss any hardware/software interfacing that you are working on for testing your project
- **Hardware / software:**
 - Indicate any hardware and/or software used in the testing phase
 - Provide brief, simple introductions for each to explain the usefulness of each
- **Process:**
 - Explain how each method indicated in Section 3 was tested
 - Flow diagram of the process if applicable (should be for most projects)

A Note on Testing

- Testing is an **extremely** important component of most projects, whether it involves a circuit, a process, or a software library
- Although the tooling is usually significantly different, the testing process is typically quite similar regardless of CprE, EE, or SE themed project:
 1. Define the needed types of tests
 2. Define the individual items to be tested
 3. Define, design, and develop the actual test cases
 4. Determine the anticipated test results for each test case
 5. Perform the actual tests
 6. Evaluate the actual test results
 7. Make the necessary changes to the product being tested
 8. Perform any necessary retesting
 9. Document the entire testing process and its results

Section 4: Testing and Implementation (cont.)

- **Results:**
 - List and explain any and all results obtained so far during the testing phase
 - Include failures and successes
 - Explain what you learned and how you are planning to change it as you progress with your project
 - If you are including figures, please include captions and cite it in the text
- This part will likely need to be refined in your 492 semester where the majority of the implementation and testing work will take place

Section 5: Closing Materials

- Similar to project plan, your conclusions should:
 - Summarize the work you have done so far
 - Briefly re-iterate your goals
 - Re-iterate the best plan of action (or solution) to achieving your goals and indicate why this surpasses all other possible solutions tested
- References will likely be different than in project plan, since these will be technical references versus related work / market survey references
- Any additional information that would be helpful to the evaluation of your design document should be placed in the appendices

Getting Started (Same Advice as Previous)

1. Don't stress out! You have time to revise / iterate / improve
2. Work as a TEAM, and coordinate as needed
3. Work with your advisor and client (although they may not know the requirements of the design document, they should understand the requirements of the project)
4. Look at previous projects, as well as the grading rubric

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