

Key Document Instructions

August 22nd, 2019

Stakeholder Communication

A crucial responsibility of an engineer is effective communication to all stakeholders involved in a project. The capstone course requires you to address the information requirements of the following stakeholders:

Stakeholder	Stakeholder Question
User	Can I use the product to meet my needs?
Designer	How does the product meet the user needs?
Business Personnel	Does the product achieve our organization's objectives?
Legal Personnel	Does the product respect the laws and values of society?
Quality Controller	Can the product be realized to meet our organization's objectives?

Key documents

This course requires three key [deliverable](#) documents and a project hand-off document based on project management best practices. These documents address the needs of the various stakeholders. In addition, the client and / or capstone supervisor may define additional documentation based on the project.

Relationship to Stakeholders

The table below shows the relationship of the documents to the stakeholder domains where the darkness of the cell is proportional to the importance. The documentation format reflect the specific needs of the client and his / her organization, e.g. type of project, industry specific conventions, application domain, organization size, business context, etc.

Document	Stakeholder				
	User	Designer	Business Personnel	Legal Personnel	Quality Controler
1. Requirement					
2. Design					

3. Validation					
4. Hand-Off	Documents defined by the client and / or capstone instructor needed to close the project				
Special Details	Documents defined by the client and / or capstone supervisor which are specific to the project / client needs.				

Document Templates

Because your Capstone project is unique, there is no one-template-fits-all for these documents. You may find industry standards for these documents, offering some typical outline (e.g., IEEE software engineering standards), but using them often turns the documentation of the project into a “fill the form” exercise, where text pops up with no real reason nor purpose.

Build your outline based on your project’s specific circumstances in consultation with your client and your Capstone supervising instructor by identifying who the readers and the producers of the documents are, what they need to know and when.

Document Evolution

The final version of your key documents for milestone 4 should not have

- Tracking history - this information is only useful for feedback. The client does not need this information in the final report. However, check with your instructor to see if they want tracking information submitted separately.
- Any sections that were not completed. This may include goals that could not be met before the end of the course.

Evaluation

The capstone course evaluation emphasizes the final deliverables which are sent to your project client. The course also recognizes that there is a steep learning curve as your knowledge and expertise develops throughout the course. To reflect this, two types of evaluation are used:

- *Formative evaluations*: Confirm with the students / teams what they are doing well and what needs improvement.
- *Summative evaluation*: Assess how well students / teams have met the requirements of the course.

A comparison of formative and summative assessment can be found [here](#). A detailed description of the capstone course evaluation can be found in the syllabus.

Your final deliverables documents will be evaluated by the:

- *Supervising instructor* who will assesses the technical content, and correctness as it applies to the project. The supervising instructor will use the following technical rubrics for assessment. For milestones 1-3 the final deliverables document will make up a portion of the grade for that milestone.
- *Supervising TA* who will assess the technical content as it applies to the project and make a recommendation to the supervising instructor.
- *Communications TA* who will assesses the written communication as it applies to organization, clarity, and quality of english and make a recommendation to the instructor.

The communications TA will use the following communication rubrics for assessment.

In what follows, we provide some guidelines on how to create the final deliverable documents which will form the basis for evaluation.

1. Requirements Specification

Purpose

This document defines what your product is, what it does, and for whom. It is also the basis for evaluating success which may include an expected level of quality, performance, environmental impact, and/or cost. The requirement specification should not assume a particular form of solution - that is, it should focus on what the product should do and how well it should perform, rather than on how it is built.

Audience

The stakeholders who use the **Requirements Specification** include the:

- *User* who will determine if the scope of the product addresses his / her needs.
- *Designer* who will identify skills, knowledge and / or materials needed to create a solution.
- *Business personnel* who refer to the quality and performance requirements of the product in order to achieve the organization's objectives.
- *Legal personnel* who will identify regulatory and safety requirements among others.
- *Quality controller* who will relate the product's quality and performance requirements to how it will be realized.

The stakeholder roles will typically be represented by the client or someone from the client's organization. In some cases the supervising instructor may take on the stakeholder role.

Content

Context / Background which describes the importance of the product to the organization. For example a for-profit company may be focused on an emerging market.

Domain describes how the product can be classified. This classification can be based on technology, market, application, etc. For example an iPhone's domain may be the consumer communication technology sector.

Goal describes the specific set of objectives that differentiates the product from similar existing products. This may include improved performance, e.g. higher accuracy, reduced cost, improved reliability, etc. It may also include qualitative outcomes, e.g. environmental awareness, learning facilitation, etc. The goal is often linked to the organization's purpose or mission statement.

Functional specifications include the services, capabilities or functions delivered by the product. If there are several types of users using this product, these functions can be organized by type of users. A use case model is an example of functional specification for a software system.

Non-functional specifications include the quality attributes the product needs to exhibit; the "ilities": reliability, security, portability, interoperability, etc.

Constraints identify requirements that the product must meet in terms of how it is implemented, e.g. environmental impact, cost constraints, weight limits, compatibility with other or previous systems, certification by authorities (for safety), compliance with standards, legal constraints, etc. Constraints are not part of functional or non-functional specifications:

2. Design document

Purpose

To design is to make choices about the way the product is going to be built. The design document is a concise description of the main choices you've made. Design choices are not arbitrary -- they must be justified by linking them to the content of the requirements document; e.g., *We've chosen solution X over solution Y. This will allow us to:*

- *implement the functional requirement F_i*
- *achieve the quality attribute Q_j*
- *satisfy constraint C_k*

This linkage to the requirements, and/or selection among alternatives (if any) is called the **design rationale**, and is crucial for further evolution of the product (especially if done by other people than the original designers).

Audience

The primary audience of the design document is:

- *Designers* including other members of your team or the client's organization who need to modify, extend, improve or interface with your component now or in the future.
- *Legal Personnel* who may review the design based on intellectual property, safety or in the context of a legal dispute.
- *Quality controllers* who will base their manufacturing and quality decisions on the design.

Other stakeholders may reference the design document as well.

Content

The design document usually starts with a high-level decomposition of the product into major components. Using a diagram to convey this information is usually a good practice. This is sometimes called the high-level design, or the system architecture.

For each design component, the design document describes the organization, technological choices, reasons behind those choices, and sometimes which alternatives have been eliminated.

The design document may be supplemented by additional documents specified by the client, the Capstone project instructor or due to the nature of the project. These supplemental documents should be placed in appendices, or indicated by a reference.

The content of the design document should be like a map to guide its reader to these more detailed design artifacts. For example, the source code of a software systems is actually a very detailed design of the software-intensive product, and is therefore a natural extension or appendix to the design document. Source code should not be a substitute for the design document,; nor should the design document paraphrase the code.

3. Validation document

Purpose

The validation document may carry different names, such as: quality assurance plan, or test plan, etc. It is used for the following:

- Assessing the methods, tests, or scenarios that have been used to validate the product
- Proving product satisfies the requirements specification and identifying deficiencies: what is missing, not up to expectation, faulty.

The status of a project on a given date can be described by how much of this document “passes” and a description of the discrepancies (features not implemented yet, errors, failures, measures below acceptable threshold etc.)

Audience

The users of this documents are:

- *Designers* to assess the current degree of completion of the product or to ensure that product evolution does not bring unwanted regression (existing functionality impaired by new development).
- *Business personnel* to assess the degree of completion of the project to make decisions in the context of the client’s organization.
- *Legal Personnel* who may review the validation based on intellectual property, safety or in the context of a legal dispute.
- *Quality controllers* for assessing the validation methodology and results in order to implement the product. This may include third party certification organizations.

Content

The validation document is a list of actions performed and results collected by the designers or builders and sometimes includes another group, such as a certification organization. These actions include inspection, manual tests, review by users, automated tests, measurements, etc. These tests, checks, measurements or inspections are explicitly related to items in the Requirements specification. Ideally, the document should cover all of these items completely.

4. List of Deliverables

Purpose

The list of deliverables is agreed upon by your team and the client at the beginning of the project that specifies what must be completed in order to complete the project. **The final list of deliverables must be signed or acknowledged by your client in the final version of your key documents.** Acknowledgement must be in written form and could include an email or a letter that references the list of deliverables.

By signing-off on the list of deliverables, the client formally acknowledges that the project is closed.

Audience

The list of deliverables is referenced by:

- Designers to identify the project resources in the context of evolving the product.
- Business personnel to close the project and insure that all required documentation is available to the organization
- Legal personnel who may reference the list of deliverables based on intellectual property, safety or in the context of a legal dispute.
- Quality controllers to identify the project resources in the context of implementing the product.

Content

In addition to the requirements, design and validation documents, the list of deliverables may include the following depending on your project:

- Source code
- Blueprints
- Bill of material
- Prototype
- Capstone video you produced.

The list must include an acknowledgement from your client confirming that all deliverables have been received and that the project is closed. The form of acknowledgment of a successful handoff from your client may take different forms: checklist signed off, an email, etc. (See your capstone instructor for specific modality).

Appendix A: Style Guidelines

These documents are long-lived. They represent the best of the knowledge of the designers at some given time, for a given design cycle.

- Use present tense and active voice. Using the future or conditional will create some confusion 3 months later when the feature has been implemented.

Final Document Statement	
Unacceptable (passive, future, conditional)	Acceptable
When the surface mounted resistors are received in milestone 2 the product will meet the form factor requirement R1.	We are using surface mounted resistors to meet the form factor requirement R1.

- Use bulleted and numbered list, rather than long paragraphs.
- Avoid names of specific individuals.
- Include only information relevant for the audience of the document. It is not a narrative of what happened or will happen in the project. you are not writing a novel, e.g.

Unacceptable	Acceptable
...and by Christmas Joe decided that the Mongo DB database was a fantastic choice, so eagerly soon after New Year eve, he immersed himself in a total refactoring of the persistency layer, forgoing some fantastic skiing in Whistler that winter.	The persistency layer is implemented around Mongo DB (url), which satisfies all the storage requirements of section 4.5, and is demonstrably faster than a relational database such as MySQL (a 37% improvement).

- Keep track of major changes in the document in a table at the beginning with this information: date, author(s), change, reason for the change if useful, e.g.

Date	Author	Location	Change
2016-5-19	PBK	section 5.6 to 5.8	change to Mongo DB, performance issue

- Avoid duplication of information. Use the [single point of maintenance principle](#). Any information that is duplicated runs the risk of an incomplete update, and will rapidly lead to confusion, disconnect, errors, or at minimum a distrust of the documentation.
- Identify elements of your requirements document so that you can easily reference them in subsequent documents, i.e. use some unique ID, such as UC7 (for use case number 7), or P4 (for performance requirement 4). This will orient the reader without you having to repeat statements from the requirements document.