How to Make And Use Design Documents

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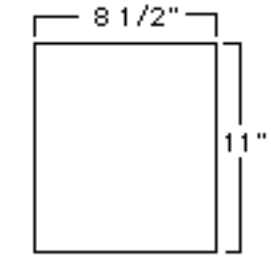
Introduction: Every programmer has seen a design document at one time or another but there may be some mystery surrounding how to actually make one. This paper describes a simple way to make and use design documents.

Why Design? Design documents are the missing link between specification and coding that make your projects simpler, and easier to understand. Design documents provide a goal statement, a statement of what the code should do which is quite different from comments within the code which describe what code does do. Design documents enhance team communication by allowing members to share ideas rather than guess intentions from the code. The bottom line is better a product with less work.

Making a Design Document, Step-by-Step:

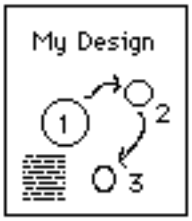
1.Get an 8 1/2" x 11" sheet of paper.



Design Document Size

2.Write the title of the document across the top.

3.Draw pictures and write words describing your idea anywhere on the page.



- Use Diagrams And Labels
- Include Your Assumptions
- Include "See also" references to other sources

Done.

You can track your design document using a scheme like the one described in [1].

Tips For Communicating Effectively: The purpose of a design document is to communicate the design idea that is in your mind to the mind of someone else, or maybe yourself at a later date, so you should make it as easy to understand as possible. Here are some points to remember:

1. Complexity Rules: The central problem is the complexity of the product being designed relative to the limited capacity of the human mind to grasp more than one thing at a time. You can see this in how many pennies you can count at a glance if you randomly arrange them on a table. This capacity for mentally grasping things varies from person to person and ranges from 3 to 7 items. Most people can grasp 5 items in a single frame of awareness.

2. Concepts Simplify: If you can form a concept that unifies many things into one thing you can extend the mental grasp of your reader. Concept formation is an instance of unit reduction, the process of replacing many things with one thing. [2]

3. Divide and Conquer: In abstract terms your job as designer essentially reduces to the problem of how to most economically organize and break up a system into simple chunks that can be easily grasped by the reader and put together again in his or her own mind.

In outline, you abstractly dismantle the machine, communicate the description in manageable chunks into the mind of the reader where he reassembles the parts into the whole concept that you have in your mind.

But there are a two basic ways that this can be done:

a) Parts-to-Whole: Start with individual things and combine them with others, progressively reducing the number of units until you arrive at the system as a whole.

b) Whole-to-Parts: First regard the system as a whole and progressively break it into parts

until the simplest part is reached.

The choice of which method to use depends on the nature of the system being described. Some things are best described one way and other things are best described the other way.

In order to know which method to use ask this question: "Are the parts caused by the whole or is the whole causally determined by the parts?" Then follow the causal chain in the direction that it flows through the system.

For example, you need to specify the operation of a machine. Should you use Parts-to-Whole or the Whole-to-Parts method? Look to the nature of the thing. What kind of thing is a machine? Is it the kind of thing where the whole determines the parts or do the parts dictate the whole?

Let's think about it: A machine exists to perform a purpose, to solve some problem or achieve some end. A shoe making machine has the purpose of making shoes. The fitness of any particular machine to this specific purpose of making shoes can be used as the selection criteria used to sort through all possible configurations of machines. Various alternative solutions can be ranked as being better or worse at shoe making until ultimately one best machine format prevails.

The whole of the machine is thus determined by it's purpose not by the parts it happens to have. In fact the part configurations can vary widely but the whole of the machine must always be fixed to the purpose of making shoes.

Therefore the whole is primary and the parts are secondary because they can vary within limits and not matter to the end result.

Therefore the correct method to use for describing a machine is the Whole-To-Parts method.

The Whole-To-Parts method should be used generally for all man-made things and also for living beings because the purpose or goal serves to shape the means in both cases.

In the case of living things the mode of survival determines the adaptation of body form to the goal of living. Aristotle was the first to say form follows function in his biological writings and Darwin made a career out exploring this principle. [3]

The Parts-To-Whole method should be reserved for purely deterministic phenomenon like weather or the collision of gas molecules where the emergent properties of the whole are determined by the specific nature of the parts.

But where volition or choice enters into the formation of the system then the Whole-To-Parts method should always be used for explaining things because in such a system the end governs the means. [4]

The biggest benefit in correctly fitting the order of explanation to the nature of the system is that your ideas will always be presented in context which makes it easier on the reader to fit all the ideas together in his own mind as he learns them.

Otherwise, even if you break the system down into manageable chunks the reader won't know how to integrate them together once they get into his mind.

This practical tip is essential to technical writing: if you can only say one thing about a machine or part of a machine, say what it's purpose is. Purpose is the most essential attribute of a man-made object because it explains its reason for even existing, the end to which it is the means.

For example, the purpose of a car engine is to move a car. The purpose of the fuel injectors is to deliver fuel to the cylinders for combustion. The purpose of the exhaust pipe is to take away the by products of the combustion process.

Apply this decomposition-by-purpose from the whole successively down to the parts, naming explicitly the purpose of each sub-system. By the time you're done the reader will know exactly what you mean and why the machine works the way it does.

There are a few marks of good design writing: everyone should be able to read at least the first part of a good design document and get something out of it before it gets too specific for anyone but a specialist. That the paper starts with common knowledge and builds from there is a mark of good technical writing. [5]

That there are more words than numbers is another rough measure of the quality of design writing. The more words the better because words are generally more general than numbers which are specific by nature, although of course numbers are really just a special category of words.

3. Diagrams Simplify: Researchers on the Xerox Star project coined the term 'visual caching' for a technique that extends people's effective mental grasp. *"During conscious thought, the brain utilizes several levels of memory, the most important being the short-term memory. Many studies have analyzed the short-term memory and its role in thinking. Two conclusions stand out. (1) conscious thought deals with concepts in the short-term memory . . . and (2) the capacity of short-term memory is limited. . . . When everything being dealt with in a computer system is visible, the display screen relieves the load on the short-term memory by acting as a sort of 'visual cache.' Thinking becomes easier and more productive."* [6] The researchers found that by laying out many things on a page people could rapidly pick them up and drop them visually. This is the same effect that you get when you work with a paper and pencil to brainstorm about an idea. By using diagrams in your design document you can make use of this principle to communicate structures and relationships easily.

4. Avoid Overloading Your Diagrams: Keep your design diagrams simple with the focus on

carrying the idea rather than as being a work of art. If you find that the number of entities in your diagrams is large, consider breaking the diagram into several separate diagrams or treating the concept at a higher level of abstraction.

5. Your Document Stands On Its Own: Your design document must be able to stand alone because it must get your idea across without you being there to explain it. If you have to be present to explain the document then it's meaningless without the additional information you provide.

6. Avoid Dangling References: If you refer to an entity not defined within your design document, briefly tell the reader where he can go to find out what it means.

References:

[1] '*How To Organize Documents*' by Tim Lee, describes a simple, non-computerized system for tracking project documents.

[2] '*Introduction to Objectivist Epistemology*' by Ayn Rand, explains concept formation.

[3] '*Aristotle*' by John Herman Randall, Jr., a great introduction to the works of Aristotle.

[4] '*Biological Basis of Teleological Concepts*' by Harry Binswanger, a PhD thesis in philosophy which explores the concept of goal-directed action in detail, picking up where Aristotle left off.

[5] '*On Philosophical Style*' by Brand Blanchard, a concise essay on how to communicate abstract ideas clearly.

[6] '*Tools For Thought: The People and Ideas of the Next Computer Revolution*' by Howard Rheingold', available at http://www.well.com/user/hlr/texts/tft10.html.