Advice on How to Write a Decent Engineering Report

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1) Place all figures within the text immediately after each one is first referenced in the text. Each figure should be numbered and referred to by that number (Figure 1, Figure 2, etc.). Each figure should have beneath it a brief caption describing what the figure depicts.

2) Cite references within the text (at the location where they are referenced). References themselves can be listed at the end of the report either in alphabetical order by the first author's last name or by the chronological order in which the references are cited. In the text the citations should be made numerically (e.g., "[1]", "[2]") or by the authors' names (e.g., "Smith and Johnson, 1996", "Smith et al., 2011"). I personally don't like the use of numeric superscripts because typing superscripts can result in very small and unreadable font sizes.

3) Generally avoid using pronouns such as "it". Very often the reader is unclear to what the word refers. For example, never use a structure like "It has been shown that…". Such pronouns are unnecessary. Similarly, do not use "this" as the sole object of a sentence. For example, the sentence "This can be seen in Figure 1" or "This can be accomplished by…" should be instead written "The detailed process diagram for the alcohol fermentation is shown in Figure 1." or "A reduction in carbon dioxide emission can be accomplished by….". Moreover, "this" is most appropriately used when referring to one specific item out of many considered, such as in the sentence "This red dress, out of the many on sale at Macy's, would go particularly well with my leather boots."

4) Engineering reports should be supported by *numeric evidence*. *This* characteristic (out of the many possible attributes of a report!) distinguishes an engineering report from a descriptive report that might be appropriate in relaying science or liberal arts subject matter. An example of an unacceptably vague sentence is "The reaction rate can be increased by increasing the temperature in the vessel." Such a sentence provides no useful (actionable) guidance to the reader as to *how much* the temperature should be increased to affect the reaction rate (by a specific amount), *how much* performing this temperature increase would cost, *how much* time would be required to affect this temperature change, and what are the numeric consequences of this action. Often one is presented with several choices, and sufficient information should be provided by an engineer for the reader to judge (or have a compelling recommendation for) which choice is the most effective and economic. Also avoid meaningless modifiers merely to imply a level of effect (e.g.,

"dramatically increased", "substantially reduced"). Consider the following three statements expressing a thought, having increasing quality, and the usefulness of each toward developing a practical design solution to the example problem of carbon sequestration:

a) "Planting more trees would dramatically increase the amount of carbon sequestered from the atmosphere."
b) "Planting 1 acre of pine trees would lead to the annual sequestration of 1 ton of carbon from the atmosphere [1]."
c) "Planting 1 acre of pine trees can accumulate 1 ton of carbon from the atmosphere each year [1] for the 30-year lifetime of the trees. Based on this sequestration potential, in order to reverse the current carbon accumulation in the atmosphere, 5.0 million square miles of new pine trees (130% of the land area of the United States) would need to be planted at an estimated cost of $20 trillion [2]. Using a typical pine plantation density of 500 trees per acre [3], humans would have to plant 1.6 trillion trees, about 230 trees for each and every man, woman and child living on our planet. Such a dramatic increase in the Earth's forest coverage would require international cooperation as well as extraordinary public support."

The first statement is not useful: "more" doesn't mean anything and "dramatically" is a matter of opinion—no numeric information is provided. The second statement provides some numeric information, but doesn't relate this single number to the larger question of carbon sequestration globally and its costs. The third statement is the best because it provides clear information on what (numerically) would be necessary to affect a specific change, as well as the estimated cost. The reader begins to have sufficient information to decide or be convincingly persuaded within the report on the practicality of a particular course of action among the various choices presented. In the event available reference information is incomplete, the author of a report can often make "worst-case-scenario" assumptions to provide some numeric boundaries to the problem. An order of magnitude estimate (or worse) is often sufficient to understand the magnitude of the problem

The bottom line is that for every occasion words like "increase" and "decrease" appear in a report, the report's author should indicate *how much*. Thus, the author of an engineering report must be able to *evaluate and criticize the text in progress*: the author of the first statement above should immediately wonder how many trees would be necessary to sequester a given amount of carbon; the author of the second statement should immediately wonder how many trees would actually be necessary to affect the global carbon balance, and how much it would cost.

5) Do not focus on "the answer". The goal of the report (at least as an academic exercise) is not to determine merely whether you can use your calculator and obtain the "correct" answer. The primary goal is instead to express and analyze a system carefully, and construct arguments based on evidence. An answer without evidence is meritless.