Personal Engineering Recommendation

Due: 2020-10-03 @ 2200 EDT **Weight:** 10% **Submitter:** Individual

Overview

Engineers make recommendations. Engineers use their experience, research, testing, and judgment to ensure that what they recommend is clear and defensible. This assignment provides a first opportunity to practice engineering rigour and an engineering mentality by asking you to make an engineering recommendation about your everyday activities.

This document defines the scope and structure of the Personal Engineering Recommendation (PER) assignment including the objectives for the assignment, the criteria by which it will be evaluated, and the constraints the assignment must meet. The PER requires that you frame a detail-level, selection-style[1] engineering decision that pertains to your own life experience.

Stakeholders

- You, a student engineer who needs to practice applying an engineering mentality and bringing engineering rigour to different types of design activities.
- Your engineering design teams – in Praxis I and beyond – who will benefit from having members with greater skill at making and defending engineering recommendations.
- The Praxis Teaching Team, who are responsible for providing you with support and who expect their students to demonstrate both engineering rigour and an engineering mentality.
- Your PER assessor, who has between 20 and 30 minutes to evaluate your submission.

Requirements

Objectives

The high-level objective of the PER is to have you practice an engineering design process (framing, diverging, and converging) by making a detail-level, selection-style design decision.[2] This assignment asks students to use an engineering design process

- to **frame** a personal choice as an engineering opportunity
- find a set of **diverging** alternatives,
- **evaluate** the alternatives using appropriate research and experience,
- **converge on** a recommendation and
- create a **report** that meets an **engineering reader**'s needs.

[1] These descriptions will be introduced in synchronous or asynchronous lectures prior to the assignment being due.

[2] As discussed in ESC101 20209 Lecture Video on "FDCR and Types of Design" completing an engineering design activity usually involves practicing each of the different elements of design (framing, diverging, converging) multiple times and in no specific order. The list of objectives in this assignment presents an idealized model of engineering design because of the linear limitations of textual lists. You should expect to (re)frame, (re)diverge, (re)evaluate, and (re)converge multiple times before reaching a single recommended alternative – with appropriate supporting documentation.

Metrics and Criteria

In design and in assessing student work, "criteria" are used to compare measurements, usually against a standard. In the criteria listed below[3], "more" of a measurement is considered better. The metrics associated with the criteria can be found on the Rubric available on Quercus.

1. **Quality of the opportunity**

   A good opportunity will be well connected to a student's individual interests or needs (with a clear sense of "why") and will be fully addressable by selection-style design.

2. **Correctness and appropriateness of the requirements**

   Good requirements define **objectives**, provide **metrics** (qualitative and/or quantitative) that can be used to assess different possible alternatives, and establish **constraints** and **criteria** to guide use of metrics.

3. **Credibility of candidate alternatives**

   Credibility can be demonstrated by the **number** of alternatives and the **difference** in those alternatives. When selecting from a set of alternatives, a common approach is to designate one alternative as the "reference" against which the other alternatives are compared. As such, you should expect to identify at least four (≥4) alternatives – one (1) to use as a reference and at least three (≥3) that are viable alternatives. This requirement aims to limit the time spent searching for (potentially non-existent) alternatives.

   As a note of caution: If one alternative is far superior to all the others, it suggests at least three possible problems:

   - the decision is not very interesting (there's no real contest)
   - too little effort has gone into finding credible alternatives, or
   - the objectives are not well-enough developed to be useful.

4. **Credibility of the decision-making process**

   The real challenge in decision-making is establishing appropriate "metrics" to measure the alternatives. To work through your decision as an engineering decision, you need to make use of systematic comparisons against objectives or against a "standard" and need to focus on particular measurable attributes. This will come from research and possibly testing of alternatives.

5. **The quality and credibility of your engineering arguments**

   Arguments in engineering depend on the data to inform decision making. You need to recommend one alternative, and explain why you recommend it using engineering evidence.

6. **The quality of the design of your report, including structure and introduction**

   An engineering report should allow a reader to understand without re-reading, find information quickly, and find the reasoning substantive and acceptable based on testing, experience, or research.

7. **The coherence and clarity of your English written and visual communication**

   Proficiency with engineering language is important to communicate to engineering readers, so you need to try to use the specific language of design decision-making and integrate visuals to express meaningful connections or concepts (not just decoratively).

[3] Note: The metrics for each criterion integrate some process guidelines to help you in operationalizing these criteria and metrics. In future documents, and in Engineering Requirements, such process guidelines are not usually integrated into the description of the criteria.

Constraints

Constraints are used to determine whether a particular alternative (in this case the report you have developed) meets the requirements set out for it. In this case, the constraints are largely related to administration and formatting.

Your PER must meet the following constraints[4]:

1. It **should not** exceed (≤) five (5) pages, including figures but excluding references.
2. Relevant extracts from any cited references **must** be included in an Appendix titled "Source Extracts".
3. It **should not** be more than (≤) 1200 words of text, excluding references.
4. It **should** be formatted with 11-point font, 1.25 spacing, and one-inch margins on standard letter-sized paper.
5. It **must** be submitted as a single PDF file through Quercus.
6. The submission **must** have a file name that describes the opportunity but **must not** include the final decision (such that (e.g.) a classmate could quickly scan a list of titles and identify interesting or relevant PER topics).
7. It **must** include quantitative metrics and **should** include qualitative ("rubric style") metrics.
8. The recommendation report **must not** be about one of the vetoed items listed below**:**
    a. a laptop computer
    b. a smartphone
    c. a backpack
    d. what a team should do for a break when working online
    e. an electric vehicle
    f. communication methods with your peers

Guidance and Guidelines

Possible Process

Normally, Praxis assignments do not prescribe specific structures or templates (because form follows function). However, since this is your first written University Engineering Report, we are providing a process that may suggest a possible way of structuring your work.

1. Select an opportunity with personal relevance that can be framed as a selection-style design decision. It could be something you want, want to do, or need (for personal life or school). It must also be an opportunity that can be satisfied by "choosing one" (that is, 'selecting' from existing entities rather than by having to design something new).
2. Pause and Reflect: Explain why your *opportunity* is a good reflection of you and your interests.[5]
3. Use the reasons you identified for choosing the opportunity to establish a set of requirements that will allow you to evaluate possible alternatives to fulfill the opportunity. Formulate the requirements to include appropriate objectives, metrics, criteria, and constraints. This stage will almost certainly involve some research into how your opportunity can be evaluated or compared.

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[4] Unlike in industry, violating a constraint on this assignment will **not** result in the assignment receiving 0 (i.e. not being assessed or evaluated and instead considered not to have been submitted). Instead an appropriate penalty will be applied to the final evaluation.

[5] In technical terms, we would call that explanation a "stakeholder analysis"—in this case you are the primary stakeholder (personal decision), but may not be the only one, so consider others as appropriate.

4. Pause and Reflect: what are your key guiding questions that allow you to evaluate both what the acceptable limits are (the constraints) and what defines comparative quality (criteria)?
5. Diverge in order to generate a viable set of candidate alternatives, and describe each alternative briefly. In this case, the process of diverging involves finding a range of possible alternatives that will meet the need defined by the requirements.
6. Converge to a single alternative by assessing the candidate alternatives against the requirements to determine the "best" one. Explain the assessment process. Recommend that alternative.

About Metrics

As this assignment is your first (individual) attempt to develop a set of requirements, we want to acknowledge that metrics are particularly challenging. We accept that in this assignment you are going to exercise a degree of common sense in establishing metrics, particularly because the design decision in this case is "personal".

Where possible look for metrics that allow you to measure or quantify an assessment – this could be size, time, etc. Qualitative metrics—which could include comfort, convenience, or aesthetic appeal, etc— for example in rubric form, are also appropriate where quantification is not feasible or tractable.

Above all try to develop metrics that are practically useful (e.g. that you actually use to evaluate the candidate alternatives) as opposed to metrics that are theoretically applicable (e.g. that you cannot use given the time and equipment available to you).

About Constraints

Developing constraints can be an extremely time consuming process. The PER assignment is intended to provide you with practice on all aspects of selection-style engineering design. Therefore assuming quality metrics, it is more important that your constraints be useful and within an approximate order of magnitude of the "true" value (e.g. accurate) than that they be correct down to the decimal place (e.g. precise).

As a rule-of-thumb, avoid stating requirements as constraints when you have insufficient justification for a hard limit.

Format

A formal design report should include an introduction, structured headings to indicate sections, and a brief conclusion. The introduction should provide the framing, purpose, and overview of the report. The internal structure of the report, as indicated by headings (and subheadings) should be governed by the content of the report. Any headings should be informative. The conclusion can provide a summary **or** simply present the report's conclusion (which will be a recommendation). Aside from these requirements, the format, structure and writing of the report are design decisions you need to consider, with the objective of the coherent and clear communication to your primary stakeholders, the teaching team.

Chapter 4 of *Writing in Engineering* offers a fairly comprehensive set of typical components for a design report. You will certainly **not** need all of these, but you can use the chapter as a guide to help you **select** specific elements to structure your report. However, remember that you should begin with what you want to accomplish (function of the report) and make the form serve that purpose.