## Short Version

Table 1 lists the scoring categories and point totals for the Progress Report. Table 2 provides guidance on choosing point totals for some of the categories.

## Purpose

Refer to `http://web.cecs.pdx.edu/~gerry/class/ME492/assignments/hw90.html` for the description of the assignment given to students.

The progress report summarizes the status of the team's design project at the end of ME 492. Because the Capstone projects have diverse goals and technical challenges, there is a diverse range of activities required for "progress" on the projects. This document attempts to provide a unified perspective on evaluating progress reports for ME 492. When grading the progress report, please consider these factors.

- The *Project Objective Statement* given at the top of the Executive Summary page;
- The current state of the project as described in the progress report; and
- The likelihood, given the current state of the project, that the team will achieve the goals in the *Project Objective Statement* by the end of Spring term 2017.

Setting aside the difficulty of *precisely* assessing whether and to what degree the team will likely reach their goals by June 2017, the content of the progress report should allow the faculty coach and instructor to make *an* assessment.

## Evaluation Procedure

Each Progress report will be assessed by three people: the team coach, a coach from another team, and the instructor. The three grades will be combined to yield a final grade for the progress report. This document (the one you are reading) provides a rubric to aid your scoring of progress reports.

## Scoring Categories

Scoring categories are summarized in Table 1 on the following page. An Excel spreadsheet will also be provided for recording your scores and any comments for the team.

### Executive Summary

The Executive Summary has a one page limit and needs to have three components

- Project Objective Statement
- Current status and major achievements

- Next milestones: What has to happen by When for the rest of the project.

The Project Objective Statement is a single sentence that encapsulates the overall goal of the project.

### Subsystem Decomposition

The purpose of subsystem decomposition is to divide the entire design into parts that can be more easily analyzed and implemented in the detailed design phase. At this stage in the design process, i.e., at the end of ME 492, teams should have a conceptual design that is likely to lead to achieving the overall design goals as specified by the Project Objective Statement. I am not specifying *how* their design is decomposed into subsystems as long as a reasonable decomposition is achieved.

During concept generation, a design can be described by a *functional decomposition*, whereby a collection of separate, interconnected actions for achieving the design goal are identified. The functions are not tied to a physical embodiment. For example, consider a machine that needs a source of rotational or translational power. A functional decomposition is completed without specifying whether the mechanical power source is an electric motor, an air motor, an internal combustion engine or a transmission driven by some power source.

By the end of ME 492, the design team should have a more detailed decomposition that a purely function decomposition, but the exact form of the decomposition will vary. Projects aimed at developing physical devices can most easily map functions to physical components. In contrast, projects aimed at designing HVAC systems, such as the SRTC-cooling redesign, might have subsystems aligned with energy savings, lighting controls, ventilation and cooling. In other words, the subsystems may be only coupled except in that those subsystems contribute to the overall energy budget.

Other projects with less-obvious subsystem decompositions are those sponsored by 3D systems to design engineering *processes* not products. Those projects involve manufacturing and testing of physical artifacts, but the important part of the work is to determine the design rules for optimal outcomes. I describe these projects not to suggest that they are somehow special and that the rules do not apply. Rather, I want to explain why I'm not imposing a uniform set of requirements for the design process for all of the projects. In particular, I encourage you to use your judgement on all projects in your evaluation of how well the subsystem decomposition will aid the final outcome of the project.

### Performance Measures

Throughout ME 491 and ME 492 I have been stressing the importance of using quantitative performance measures for design outcomes. Following the textbook by Mattson and Sorenson that we are using in the class, the relationship between design requirements and performance measures are summarized with *Requirements-Measurements* matrices[1]. In class, we refer to these as RM matrices.

[1] Christopher A. Mattson and Carl D. Sorenson, *Fundamentals of Product Development*, 4th ed., 2016, Brigham Young University

**Table 1:** Summary of scoring categories. Refer to Table 2 for suggestions on performance levels associated with numerical scores.

| Category or Subcategory | Max. points | Comments |
|---|---|---|
| Title Page | $+0/-5$ | No additive points for the title page, but it is a possible to lose up to 5 points if the title page is sloppy, missing or otherwise unprofessional. |
| Executive Summary | 10 | |
| Conceptual Design Summary | | |
| Analysis of Concept Selection | 20 | See Table 2 |
| Subsystem decomposition | 20 | See Table 2 and description in the *Subsystem Decomposition* section. |
| Updates on performance measures | | |
| System level performance | 10 | May have evolved from initial design goals |
| Subsystem performance | 10 | Used to set goals for detailed design |
| Planning Update | 10 | |
| Writing | | |
| Clarity of prose; organization of ideas | 10 | In other words, can you make sense of what is written? |
| Spelling, grammar | 10 | |
| Appendix | $+0/-5$ | Like the title page, a poorly organized or sloppy appendix may cost points. |
| Total | 100 | |

An RM matrix lists requirements along rows on the left side, and lists a set of performance measures as column headings across the top. The connection between a requirement and performance measure is indicated by a dot in the row-column intersection. I realize that I should provide a concrete example, but that will have to wait.

Each performance measure in the RM matrix ideally should have a target value and a set of upper and lower limits for acceptable performance. A design can be described by a two-level set of RM matrices. One RM matrix documents the system level design requirements and the required performance measures. Another *set* of RM matrices document the design requirements and performance measures for each subsystem.

Like a lot of design methodology, RM matrices give ordinary words (requirements, metrics, targets, etc.) specialized meaning. The nomenclature can be confusing at first. When you read the progress report, try not to get bogged down in the terminology. The narrative text in the body of the report should clearly explain the requirements and performance metrics for each level of the design. I've asked students to put their RM matrices in the Appendix to provide technical detail without bogging down the report in too much jargon.

### Rubric Scales

Table 2 gives suggestions for assigning numerical scales in the rubric. The point totals vary with the maximum points listed in Table 1.

Multiple descriptive attributes are listed for most of the point values listed Table 2. Those attributes are given as examples to guide your scoring and aim toward common standards across all reports. Within any one scoring level (say 12 points on Analysis of Concept Selection) all of the descriptions listed for that scoring level need not apply. You might also identify some other reason (other than the examples given in the rubric) why a different numerical score should be given. The scoring spreadsheet has a column for you to add comments if you wish to explain your numerical score.

**Table 2:** Suggested scales for the Progress Report Categories. Scores are based on the maximum point totals listed in Table 1.

| Analysis of Concept Selection | |
|---|---|
| 1 = | An inadequate number of design choices are presented in the report, such that the reader can easily identify potential solutions that are not considered by the team. The current design concept is not supported by analysis. In other words, choices for subsystems and/or components are *ad hoc* and presented without evidence of how the choices will achieve the design objectives. |
| 12 = | Plausible concept choices are presented although one or two practical might have not been considered; Concept selection process is incomplete and documentation meets minimum standards, but should be improved. |
| 20 = | A "good number" of plausible design concepts presented; The methodology for selection among concepts is clear, logical and consistently applied; Concepts selected appear to be the best choices. |

| Subsystem Decomposition | |
|---|---|
| 0 = | The team does not clearly define subsystems with specific performance requirements. |
| 12 = | Subsystems are identified, but the detailed design phase will need more precision in the defining the function or performance metrics; The interfaces between subsystems needs more detail. |
| 20 = | System decomposition is logical and clearly explained with text and figures; Required functions of subsystems can be achieved with practical components; Interactions or interfaces between subsystems are clearly defined and plausible; The subsystem definition has ho obvious missing parts or functions. |

| System Level Performance Measures | |
|---|---|
| 0 = | Sytem level performance metrics are lacking, or are unrealistic, or are incompatible with the Project Objective Statement. |
| 5 = | Sytem level performance metrics need to be more precise or more complete or more clearly related to the Project Objective Statement. |
| 10 = | Sytem level performance metrics are clearly and completely specified. The team has indicated how the performance will be measured. Achieving the performance targets will result in a design that meets customer or market requirements. |

| Subsystem Level Performance Measures | |
|---|---|
| 0 = | Subsystem performance metrics are lacking, or are unrealistic, or are incompatible with the requirements for the subsystems. |
| 5 = | Subsystem performance metrics are not precise or incomplete or not clearly related to the requirements for the subsystem(s). |
| 10 = | Subsystem performance metrics are clearly and completely specified. The team has a plan for measuring subsystem performance. Achieving the performance targets for subsystems will result in system-level a design that meets customer or market requirements. |