Project Final Report (PFR) Assignment

ASEN 4028, Senior Projects II: Design Practicum
Spring 2014

1.0 Document Scope

This document specifies the required elements and deliverables for the Project Final Report for ASEN 4028.

2.0 Report Objective and Scope

The Project Final Report is a comprehensive documentation of the project, with an emphasis on the design practicum portion of the Senior Projects course. It is a counterpart to the Fall Final Report, but has distinct objectives:

- Closed Design Loop: while the FFR provided a complete picture of the design at the midpoint of the project, the PFR should complete the picture of the project including manufacturing and testing, but should also make clear how these results relate back to the original objectives of the project and validate its functional requirements.

- Documentation archive: the PFR provides a central collection of all relevant documentation in the project, to be collected and organized as if further project development were to follow.

The PFR must stand alone as a complete description of the project, and should *not* assume the reader has seen the FFR. It must include a clear description of the purpose of the project, along with the customer's functional requirements and the specific project objectives (measures of success). It must present a requirements flow-down from functional requirements to detailed design requirements. It must describe the design solution from the top down to design details and key design decisions, including modeling efforts, and explain how the system works. It must explain key aspects of the manufacturing of mechanical, electrical, and software components. It must describe the verification and validation strategy, and present the test results, including an interpretation of these results relative to the design and functional requirements in the project.

3.0 Required Structure and Authorship

All members of the team should make a significant contribution to the PFR in terms of both content and actual writing. The report should follow the organizational structure defined below, with corresponding named chapters in the report. Within each chapter, you are free to organize the discussion as it best describes the particulars of your project. This typically does not lend itself to clean divisions among team members with respect to authorship, however, since many of the efforts on the project are highly collaborative. Accordingly, to provide a fair assessment of member contributions, the report will contain a contribution summary section, organized by team member, describing their specific content and written contributions to the PFR.

4.0 Final Report Data Package

4.1 PFR Data package Content

The Project Final Report consists of two volumes:

1) Written report named according to: TEAM_PFR.docx [must be a Microsoft Word document].
2) Electronic documentation archive, organized by project sub-systems, containing all relevant and up-to-date diagrams, drawings, schematics, source code, product spec sheets, images, videos, etc. needed to carry the project forward. Any of these items used in the written report must be inserted

into the report to make it self-contained and readable, but reference to specific archive items can be made for more detail. Each archive sub-section should contain a Word file with a short summary of its contents.

4.2 Required Written Report Content

The written portion of the Project Final Report is a comprehensive technical report that collects all the work conducted on the design into a readable whole. It contains information and ideas already delivered in the PDD, CDD, PDR, and CDR, FFR, MSR, TRR, and SFR, together with detailed testing results not presented in the SFR. Hence, much of the information required in the PFR has already been developed. However, the PFR must be an organized, concise description of the project from the more knowledgeable vantage point at the end of the project. Accordingly, the earlier design products must be revised, edited, and re-evaluated in many cases to contribute to a cogent project description in the PFR, rather than simply a collection of previous work that may confuse the reader or convey a poor understanding of the project. With this proviso, as much of the previous work as possible should be re-used in the PFR.

A comprehensive report covering the extensive amount of work accomplished by a team of engineers over many months is a challenge to organize, but good organization is essential to avoid losing the reader and diluting the impact of your work. Generally, provide a road map in the early parts of a section saying what will be covered and why, and link it to previous or following sections. Provide context before content, an overview before the details. Use diagrams to place a concept of the idea in the reader's mind before delving into wordy detail or analysis. As in presentations, where each slide should make a point, each paragraph in a report should make a point, often aided with diagrams, equations, plots, etc. You may find it useful to outline the report down to the level of the point each paragraph should make, before filling in the detail. This also helps with organizing who will write what sections in the report, and with integrating sections written by different team members into a cohesive whole.

Be concise in your descriptions, stating the ideas directly, with simple, clear language. Give all parts of the system unique names to promote clarity of discussion. Label diagrams with these names. Connect analytical methods and approaches with the needs of the project. Connect equations with corresponding diagrams, numerical results, and descriptions. Use unique symbols in analytical work, and the same symbols in associated diagrams and descriptions. Use technical terminology correctly and consistently. Avoid using pronouns, since these often dilute specificity and contribute to confusion.

Finally, and most importantly, the PFR should explain how the system works. Don't obscure your understanding of the engineering issues by piles of unrelated detail, bureaucratic filler, meaningless plots, unexplained diagrams, unlabeled pictures, etc. Seek to impress he reader with your depth of understanding and clarity of explanation, rather than weight of material or colorful pictures. Provide conclusions for segments of this work, explaining the meaning of the results to the needs of the project. Don't just describe "what", say "why". Address your discussion to a generally knowledgeable professional engineering audience, but don't assume the reader knows how or why your system works.

The top-level organization of the written report shall have the following structure:

Preamble

- Title Page, including project title, names of all group members, customer, advisor, and date.
- Table of Contents
- List of Figures
- List of Tables
- List of Acronyms
- Definition of symbols (nomenclature)

Section 1: Project Purpose

Describe the field of application, the problem addressed, and the benefits of a successful project. Place the problem in context with other work. Clearly identify what is novel about the project. Cite references to the engineering literature, popular press, or web sites as appropriate. Do not use or cite any proprietary documents or personal communication that is not available in the public domain.

Section 2: Project Objectives and Functional Requirements

Describe specifically what the project must have accomplished to satisfy the design problem or need, and thereby what "success" meant for your project, using levels ranging from the absolute minimum that must be accomplished for the project to be considered a success (Level 1) up to the most that the project *planned* to accomplish (Level N). Illustrate the operation of the system in this application and in the course with CONOPS diagrams. Include an explicit description of the project deliverables to the course and to the customer.

Provide a functional block diagram (FBD), along with its explanation. It should include the major elements of a functioning system, and how they interact to solve the problem. It should also show which elements or aspects were designed by the team and which elements were supplied or acquired. In many cases, the senior project will address only a portion of a larger system or problem; the FBD should distinguish the project elements from others in a larger system. Provide a numbered list of the functional requirements for the project, with an explanation of the source and rationale for each.

Section 3: Design Process and Outcome

Outline the set of conceptual design alternatives considered and the trade studies that were conducted. Discuss how the results of trade studies were evaluated, and how that led to the baseline design selection.

Describe the requirements flow-down from functional requirements to detailed design requirements. Describe the rationale for each major requirement, i.e. how it flows logically or technically from the parent requirement

Describe the resulting design, showing what the whole system looks like, its key parameters (dimensions, mass, data rates, etc.), what the major elements or subsystems are, and most importantly, how it works. Provide key engineering design details, showing drawings, schematics, layouts, flow charts, timing diagrams, etc., as needed to convey your understanding of all critical design elements and the corresponding design solutions.

Section 4: Manufacturing

Describe the scope of the manufacturing tasks in the project , including what parts were manufactured vs. purchased, what was involved in their manufacture, where and how they were manufactured. Include mechanical, electrical, and software manufacturing elements.

Describe the outcome of the manufacturing tasks, including a summary of challenges faced and how they were overcome.

Show how the components in the project were integrated into a functioning system.

Section 5: Verification and Validation

Describe how the design was verified against predictive models through characterization testing. Use diagrams to convey the test set up, the facilities and equipment needed, and how the test works. Describe the measurements made, and key measurement issues (resolution, sampling rate, etc.) Show how the selected sensors, instruments, data acquisition, test fixtures, etc., provided the required capabilities.

Describe how the design was validated against functional requirements and overall project success criteria.

Section 6: Risk Assessment and Mitigation

Discuss how risks in the project were identified, tracked, and mitigated. Describe the extent to which these risks were realized during project development, and what the impact was on the success of the project.

Section 7: Project Planning

Describe the planning that was carried out and how it was used in project development. Your discussion should include the following planning components:

- Organizational Chart (OC), showing the leadership roles of all team members.
- Work Breakdown Structure (WBS), showing all the work products for the project. Explain how the work products were determined.
- Work Plan (WP), showing the main tasks to accomplish the WBS products, along with their scheduling, in the form of a Gantt chart. Describe critical path tasks, and discuss how schedule margins were allocated.
- Cost Plan (CP), in the form of a financial budget, for all major items in the project, highlighting uncertainties and corresponding budget margins.
- Provide a Test Plan (TP) showing all major tests conducted and how they were scheduled. Note the use of specialized test equipment or facilities used, and how their use was secured.

Section 8: Lessons Learned

Identify the key lessons learned in the development of this project. This should include items that you wish you had known at the start of the project, as well as advice for new seniors to improve their experience and success in the conduct of their projects.

Section 9: Individual Report Contributions

Briefly describe the contributions of each team member to the PFR, including both design/develpoment work (content) and the writing itself. Each team member should write this for themselves, drawing upon information already provided in the final self-evaluations.

4.3 Written Report Format

The written report shall conform to the following standard format.

4.3.1 Font

The text of your report must use 11 point Times Roman font, 1.15 line spaced. Remember: Easy reading makes grading easier! Advisers are human too.

Other fonts (Helvetica or Arial) may be used for headings, figure captions, table captions, and figure labels. Figure labels should be at least 10 point font size.

4.3.2 Margins

Use 1 inch margins on all sides.

4.3.3 Figures

Figures must be included within the text, following their first reference within the text. Do not include figures that are not also referenced within the text.

4.3.4 Tables

Tables must be included within the text, following their first reference within the text. Do not include tables that are not also referenced within the text.

4.4 Delivery Instructions

The data package must be submitted in the following two forms. Hand delivery is preferred, but copies can be left in your LM Mailbox with an associated e-mail to your advisor and course coordinator about their deposition. The team is responsible for delivery to the Advisor/CC.

4.4.1 **Hardcopies:**

One hardcopy of the written report must be submitted by the deadline for team advisor grading. **Spiral binding is preferred**.

4.4.2 **DVD**:

The DVD shall contain all the files of the package described in **4.1.**
Two DVD's are required: one (1) for the Course Coordinator and one (1) for the team advisor.
It is recommended to make one for the team as well.

4.5 Due Date and Time

All materials must be provided to the course coordinator and project advisor no later than **5:00 PM, Thursday, May1, 2014**, either personally, or in the team mailbox in the LM room.

4.6 Cost

Teams should limit costs to print and bind their reports. Use color pictures only when necessary.

5.0 Grading

The PFR will be evaluated by your advisor, who will recommend a group grade to the PAB based on the section weightings given below. The team reports and grades will be discussed by the PAB to resolve any grading inconsistencies, and the PAB will issue a group grade for each team's PFR.

Individual grades on the PFR will be derived as differential adjustments from the group grade, based on advisor assessments of individual contributions, peer evaluations, and the stated individual contributions to the report (Section 9). Any individual adjustments will preserve the group grade as the average of the individual grades in a group.

Section 1: Project Purpose (5%)
Section 2: Project Objectives and Functional Requirements (5%)
Section 3: Design Process and Outcome (20%)
Section 4: Manufacturing (20%)
Section 5: Verification and Validation (25%)
Section 6: Risk Assessment and Mitigation (5%)

Section 7: Project Planning (5%)
Section 8: Lessons Learned (5%)
Section 9: Individual Report Contributions (0%)
Overall writing quality (10%)