The Department of Mechanical Engineering at the University of Hawaiʻi at Manoa

ME481 Senior Design
Fall 2022

Instructions for the ME 481 Preliminary Design Review and Report
PDR-F22-S#-P#

Review (Presentation)
Date: Week of 31 October, during your lab time as schedule by your section instructor
Location: TBD

Report
Due (Time & Date): 12 p.m., 4th November 2022
Delivery:
   Softcopy: Email to your section instructor or via Laulima per your Section Instructor’s preference.
       If email use
       Subject: ME 481 F2022, PDR [Team Name]
   Hardcopy: None
       S1: atrimble@hawaii.edu
       S2: sorensen@hsfl.hawaii.edu
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**Purpose:** “A design review is a retrospective study of the design up to that point in time. It provides a systematic method for identifying problems with the design, aids in determining possible courses of action, and initiates action to correct the problem areas.” Design reviews are a critical part of every design process. They help avoid “group think” and identify problems in the concept or analysis. Design reviews should occur at multiple stages throughout the design process; otherwise, if left to the end of the project, changes, errors, or new brilliant ideas will be expensive and difficult to implement. Typically, design reviews occur at each major stage of the design—before the design team can move into the next phase: project specifications and metrics defined, strategy selected, concept and modules selected, detailed design/analysis finished and ready for initial fabrication, and possibly more depending on the scope of the project.

The Preliminary Design Review (PDR) presents the top-level design process and establishes a viable concept. It gives an overview of how the design concept was developed; an understanding of the requirements; what problems or concerns need to be overcome; what resources are needed; and the cost and schedule for the project. The PDR addresses overall preliminary design information and technical program risks associated with each system and reviews technical, cost and schedule impacts. At the conclusion and acceptance of each design review the overall risk level of the project should be reduced when compared to the previous step.

This is not an arbitrarily imposed assignment. Design reviews are so important that many companies hire private consulting firms to conduct reviews on critical projects to ensure objectivity. Design reviews are required for all federally funded projects – e.g. any project funded by the Department of Defense (DOD). According to DOD requirements, the preliminary review is used “…to ensure that a system is ready to proceed into detailed design and can meet stated performance requirements within cost (program budget), schedule (program schedule), risk, and other system constraints.”

**A – PRESENTATION**

**Audience:** Technical (Other engineers)

**Format:** Design Review (Questions during and after the presentation)

**Slides:** All slides (except title) must have the slide number in following format: [current slide # / total #of slides in main presentation, i.e. not backup slides]. Each slide must have the name of the presenter(s) in the lower left corner.

**Time:** 50 min total (during your lab time) plus 10 minutes for final questions (or 40 minutes uninterrupted and 20 mins Qs & As). Be sure you plan enough time for the question period.

**NOTE:** This length is a hard time limit. You will be given a 5-minute warning and then stopped when your time is up. If there were long delays due to questions during the presentation, your time may be extended by a short amount that is taken out of the final question period.

**Participation:** All team members must present their own sections (or part thereof), and hence all team members must speak on the section(s) that they contributed in.

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Attendance: You are required to attend all reviews in your section and participate as an active peer reviewer for the other PDR presentations in your section.

Dress Code: Business Professional (Hawaiian)

Evaluation: Based on the presentation evaluation criteria posted to the course website. A fillable Excel scoresheet or google link will be provided (to you and/or the TA) before the reviews by your instructor. This has the rubrics for scoring the presentation.

Below is a suggested outline for the PDR presentations:

1) Project Level Presentation review (for context); recommended slides:
   - Mission Statement, Objectives, Success Criteria System-level Requirements and Constraints, Timeline, Budget (high level – details later) with an appropriate level of detail to understand the context of the technical details presented later, and Risk & Risk Mitigation Charts
   - Mission Operational System Architecture (mission overview, strategy review)

2) Project Systems Engineering Presentation; recommended slides:
   - Big Picture of Design (preferably a Solid Model) with all Subsystems Identified (for the Subsystems use at least text-notes and arrows)
   - Overall System Functional Flow Block Diagram (FFBD)
   - Major Trades (design concepts)
   - System Level Integration & Testing Plan
   - Mass & Volume Budgets (system level)
   - Power Budget (system level)
   - Configuration and Change Management
   - Safety Engineering
   - Remaining Issues and Concerns
   - Overall Gantt Chart (in Section 4)
   - Overall Risk & Risk Mitigation Chart (in Section 5)
   - Overall Budget (in Section 5)

3) Subsystem Level Presentation; recommended slides:
   - System FFBD showing Highlighted Subsystem
   - Subsystem Team Roles & Responsibilities
   - Top-level Requirements & Constraints for Subsystem
   - Subsystem Derived Requirements
   - Major Trades (design concepts)
   - Requirements vs Implementation
   - Functional (Flow) Block Diagram with External Interfaces (show subsystem as an integrated domain)
   - Subsystem Design Alternatives (at least 3 per Subsystem) and use of Decision Making Matrices (DMMs) to select the best alternative
   - Subsystem Mass & Volume Budgets (if applicable)
   - Subsystem Power Budget (if applicable)
   - Description (including schematics, list of components, etc.)
   - Results of Analyses (Performance, etc.)
   - Risk Analysis (include identified subsystem-level risks and mitigations)
- Testing Plan
- Subsystem Schedule using WBS and Gantt Chart
- Remaining Issues and Concerns

4) **Operations (if applicable); recommended slides:**
- Ground Segment (GS) Architecture
- Team Roles & Responsibilities
- Top Level Requirements & Constraints for Ground Segment & Ops
- Derived Requirements
- Major Trades (design concepts)
- Requirements vs Implementation
- Functional (Flow) Block Diagram with External Interfaces
  (show subsystem as an integrated domain)
- Description (including components, etc.)
- Results of Analyses (Performance, etc.)
- Risk Analysis (include identified subsystem-level risks and mitigations)
- Site Selection (if applicable)
- Testing Plan
- GS Schedule using WBS and GANTT Chart (make sure it’s readable)
- Remaining Issues and Concerns

5) **Project Management System Level Presentation; recommended slides:**
- Team Organization
- System-level Schedule using WBS and Gantt Chart (make sure it’s readable –
  break into pieces over multiple slides if necessary)
- Hardware Acquisition Status/Plan (long lead items)
- Risks Management (include identified system-level risks and mitigations)
- Financial Budget
- Documentation List
- Remaining Issues and Concerns

6) **Conclusion**

7) **Backup Slides**

**B – PRELIMINARY DESIGN REPORT**

**Report Instructions**

The report shall be printed, 12-point, Times font in *justified text*, 1 inch margins, page number and team name in footer, and project name in header. Tables Titles and Figure Captions may use 11-point (or 10-point) font, but must be consistent. The report shall not exceed 50 pages (excluding cover sheet, auxiliary pages such as table of contents, list of figures, list of tables, references and appendices, etc.). Every student on the team shall contribute to the written report. Each section or sub-section shall be identified by its author (initials will do if they are defined in the beginning of the report).

The report shall be submitted only in soft-copy. Soft-copy of the report shall be submitted in MS Word (.doc or .docx) or PDF format as per you section instructor’s preference and shall not exceed 15 MB. **Send soft-copy of the PDR report via email to your section instructor or submit through Laulima as per your section instructor’s**
preference. All drawings, photos, budgets and schedules shall be included in the soft-copy. A copy of the slides used during the PDR presentation shall be submitted no later than with the soft-copy of the report (either pdf or ppt format – not gslides).

The main report shall use standard technical report numbering for sections (1, 1.1, 1.1.1, 1.1.1.1, etc. – see Section 2 of instructions, in the following, as example). Narrative points can be identified by bullets, or letters, etc.). Throughout the report, do not just make assertions—rather, back up the assertions with evidence. Use first order mathematical and physics estimates as well as references from journal articles, books, or other sources that are well respected. Just be sure to properly cite all of your references.

We recommend that, to save space, you use paragraph indentations as was done for these instructions, rather than have a blank line between paragraphs. Also, do not put a page break between sections.

Note that the preliminary sections (listed in italics in the format in the following) shall use Roman numeral page numbers (i, ii, iii, iv, etc.), while the main report (starting with Introduction) shall use standard page numbering (1, 2, 3, etc.). The appendices shall have a page break between them and use the appendix letter in the page numbering (A-1, A-2, B-1, B-2, B-3, etc.).

Remember that this is a professional report and should not look like a homework assignment.

Report Guidelines, Format and Structure

The format and structure of your report is as follows (NOTE: Sections marked with “*” do NOT count towards report page limit. The suggested maximum page limits shown in [ ] add up to more than 50 pages, so choose where you want to use your allocated pages). For some projects or subsystems, not all requested items might be relevant or important – use your best judgment on what to include in your report to stay within the page limits.:

Title Page* [1 page]

Include project title, submission response number (PDR-F22-S#-P# where the # is the number of the section, 1 or 2, and the project team number within the section), team name, names of all team members (and identification of initials for writing credit), ME 481, Department of Mechanical Engineering, University of Hawai‘i at Manoa, date, and instructor’s full name & title (Dr. A. Zachary Trimble, Dr. Trevor C. Sorensen).

Executive Summary* [1 page maximum]

State your design concept concisely, including system overview and description of your operations concept (how it will work). This should give the reader all the important information and findings of the report (including financials and schedule) without having to read any further. Summarize both the project and the contents of the report. In other words, you must capture the reader’s interest; summarize the purpose, importance and impact of the project; and inform the reader what they can expect to learn about the project from this report. It should incorporate your mission statement. Because of its content and location this section is the most widely read section of the document. The entire report should be well written and carefully proofread, but this section should get at least triple
checked – first impressions matter. Incorporate into the executive summary the project mission statement in italics. The mission statement should be a smooth part of your executive summary and not an after-thought or add on. A short Executive Summary usually does not (and should not) include figures or tables.

Table of Contents*
List of Figures and Tables (with page numbers)*
Acronyms and Abbreviations*

1 Introduction [3 pages maximum]
   All reports should have an introduction. One purpose of the introduction is to introduce the problem. Do a short synopsis of your problem statement (discussing purpose of the project, relevance, need for it, etc.), i.e., provide motivation for the work presented in the report and relevant background information placing it in context with previous efforts and state-of-the-art. Provide an overview of related work. The introduction should include at least five references to related papers and books.

2 Technical Overview [40 pages maximum]
   This section should include a detailed description of strategies and concepts—the focus should be on the selected strategy and concept, but where necessary when defending your decisions or expounding on the benefits of your design you will need to describe other concepts and strategies that you considered to prove you selected the best design and thought of all the alternatives (e.g., the use of DMMs). Discussion of all design considerations (cost, weight, function, performance, schedule, risk, etc. – use budgets) Summary of engineering analyses—the details should be provided in appendices. Description of any bench level experiments that were used to verify the prototype or modules. Discussion of manufacturing—complete engineering drawings should be presented in the appendices. Discussion of original contributions. Discussion of performance budgets, schedule and risks. Use the sections below to form your arguments.

2.1 Objectives and Requirements
   - Provide:
      2.1.1. Mission Statement (repeated in Executive Summary)
      2.1.2. Objectives and Success Criteria
      2.1.3. Constraints
      2.1.4. Top-Level System Requirements Overview

2.2 Conceptual Design
   - Present major system-level design trade studies and design candidates/alternatives
   - Discuss your conceptual design as presented in your proposal and how and why it has evolved since then
   - Make an argument to prove how your selected design was the best among all concepts (e.g., using the DMMs)

2.3 Baseline Design
2.3.1 Top Level System
   - Discuss your baseline design including:
      2.3.1.1. System Architecture
      2.3.1.2. Operations Concept
      2.3.1.3. Big Picture of Design with Subsystems Identified
2.3.1.4. Top-level Functional Flow Block Diagram
2.3.1.5. Mass & Volume Budgets – (total system)
2.3.1.6. Power Budget (total system)
2.3.1.7. Other budgets as necessary

2.3.2 Subsystems
  2.3.2.1 Subsystem A
    - Subsystem Team Roles & Responsibilities
    - Top-level Requirements & Constraints for Subsystem
    - Subsystem Derived Requirements
    - Major Trades (design concepts)
    - Requirements vs Implementation
    - Subsystems DMMs
    - Functional (Flow) Block Diagram with External Interfaces
    - Subsystem Mass & Volume Budgets (if applicable)
    - Subsystem Power Budget (if applicable)
    - Description (including schematics, list of components, etc.)
    - Results of Analyses (Performance, etc.)
    - Risk Analysis (include identified subsystem-level risks and mitigations)
    - Testing Plan
    - Subsystem Schedule using combined WBS and Gantt Chart
    - Remaining Issues and Concerns

3 Management and Cost Overview [15 pages maximum]
  - Include organizational chart and indicate each team member’s tasks
  - Project WBS (remember numbering)
  - System-level Schedule (Gantt Chart with numbered WBS)
  - Hardware Acquisition Status/Plan (long lead items)
  - Risks Management (provide risks list with mitigation)
  - Configuration and Change Management
  - Financial Budget and Funding Plan
  - Documentation List
  - Remaining Issues and Concerns

4 Conclusion [1 page maximum]
  - A concise recap of the most important facts and information

References*
  - Properly cite all references used in the text (use a specific style guide that is appropriate for your project. E.g. AIAA, ASME, IEEE.)
  - These should be primarily scholarly articles. Journal and conference papers, books, etc.
  - Internet references are strongly discouraged because they usually are not reliable. If you do use Internet sources, use reputable sites and source them correctly.

Appendices*
  NOTE that the appendices have a different page numbering; each Appendix must start on a new page to avoid confusion in the page numbering. Number your figures and tables in the appendices the same way you will number the pages in the appendices.
A – List of Requirements
- Using a table, list the top-level and derived programmatic and technical requirements including assigned requirement number, original & permanent identification number, description (use “shall”), priority (M, D, L), verifiability & method (A[alysis], I[nspection], S[imulation], T[est]), and parent and children requirements.

B – Budget
- Create a detailed and itemized budget with subtotals and totals. Include funding sources. Note: other appendices, such as trade studies, supporting algorithms and analyses, etc. can be added as needed
PDR Report Assessment Rubric

- Executive Summary 5
- Introduction 5
- Technical Overview 50
  Subsection point breakdowns depend on the project. A potential example is:
  - MS, Objectives, Top-Level Requirements & Constraints 5
  - Conceptual Design 5
  - Baseline Design 20
  - Subsystems 20
- Management and Cost Overview 10
- Conclusion 5
- Overall Quality, Conciseness, Effectiveness, and Compliance 15
- Appendices 10