MECH4240 Formats for Reports and Presentations (F16)

A "Review" includes both a report and a presentation. The formats for each are presented below. Reports are due at the time of the presentation unless stated otherwise. In the sections that follow is shown:

- Midterm Review format, which is either a Concept Review (CR) or Preliminary Design Review (PDR). Report format is Section 1.1, and presentation format is Section 1.2.
- Final Review format, which is either a PDR or Critical Design Review (CDR). If you are doing a PDR for your final review, the format stays the same as the midterm and you can update the previous report. CDR report format is Section 2.1, and presentation format is Section 2.2.

You are to 1) make hardcopies of the report as required per the handed-out "checklist" (discuss with technical advisor and sponsor how many are to be made, black and white are recommended to save money, overlord/report grader will always need a black-and-white hardcopy); 2) load the report pdf onto the CANVAS Assignment, 3) deliver your design notebook for grading, 4) include your CODs + deliverables, clip the COD hardcopies to your report (they do not need to be in the pdf sent to CANVAS). Hardcopying costs will be covered by the sponsor in some cases, so see overlord, teaching assistant or technical advisor when ready to make report hardcopies to see if this option is available.

Note that some sponsors or competitions will have their own preferred format, in which case this document does not apply to your project.

1 MECH4240 Midterm Review: Concept Review (CR) or Preliminary Design Review (PDR)

1.1 Overview of CR Report or PDR Report at the Midterm Review

At a CR or PDR you present your work leading to, and including, your best design concept. On the Systems Engineering Vee chart, you should be completing Phase A (Concept Development) and ready for a CR, or, for more advanced groups, you may be well into Phase B (Preliminary Design) and ready for a PDR. The report for the CR or PDR is a detailed MS Word document that adheres to technical writing convention. Examples of good reports are loaded onto the course webpage.

The CR/PDR occurs usually after and near the mid-semester in MECH4240 and includes a discussion of:

- System engineering and consideration of each of the 11 SE functions, with focus on:
  - Documentation of the mission objective (SE function 1)
  - A listing of a well thought out set of requirements (SE function 2), including reference to any relevant standards and codes.
  - A review of your feasible alternative concepts (SE function 3) leading to an architectural design (SE function 3). The feasible alternative concepts can be shown as scanned hand sketches in the report, however the architectural design must be in CAD. (*For those designing a subsystem within a system, the focus here will be on the subsystem concepts with CAD of your best concept*).
  - Presentation of any or all of the following – logical arguments, engineering analyses, mock-ups, prototypes, test results, cost analysis, functional decomposition, decision matrix, house of quality, etc. - that argue for or against each feasible alternative (concept), leading to a single recommended feasible alternative. (SE function 3)
  - Inclusion of some "higher-level" design detail to the recommended feasible alternative, so to transition from a concept to design, specifically here a conceptual design, aka architectural design. If you can add significantly more design detail, then your presentation will be a PDR instead of a CR. Whether

a PDR or CR, include undimensioned 3-D CAD renderings, an architectural design made up of schematics and assembly drawings, with a first-cut at a bill of materials. (SE function 3)

- Management: Present management structure (organizational chart), estimated costs to complete the project and budgeted amount, and proposed and preliminary schedule and milestones. Summary of your goals for the next review (i.e. PDR or CDR).

Since our focus here is on the "big picture" architectural design, subsystems' design engineering effort to date on each subsystem may be limited (if PDR) or nonexistent (if CR), but can be included here or in the section Subsystem Design Engineering (see section description below). Design details, such as fully-dimensioned CAD of parts you will manufacture and accurate Bill of Materials, will be left for the end of semester final report and presentation, and those details will be placed in the section Subsystem Design Engineering.

1.2 Precise Report Format

TITLE PAGE – Include a descriptive project title (e.g. "MECH4240 Concepts Review: A Light Weight Portable Lifting Device"). Make sure the title states the review type (Concept Review or Preliminary Design Review). Also on the title page include corporation number and name, members (denote who is manager, scribe and systems engineer), semester, date, industrial sponsor, technical advisor, overlord, report grader.

SUMMARY or **ABSTRACT** (1 page of text, about 200 words) Briefly state your problem, motivation (i.e. the need), mission objective and methodology. Most of the abstract should specifically state your important accomplishments and results to this point in the project. It gives the reader a clue of what are the most important contributions of the work.

TABLE OF CONTENTS

INTRODUCTION

Introduce the assignment, state and identify the design problem. Identify the "engineering need" or motivation. Provide background information, state-of-the-art and reference literature if appropriate. It should also state, in a paragraph or two, what will be presented in the rest of the report.

MAIN BODY

SYSTEMS ENGINEERING

1. Mission Objective – present a clear statement of the mission objective that all stakeholders have agreed upon and accepted.
2. Architectural Design Development – most of your report content will be in this section and includes:
    a. A review of your feasible alternatives – perhaps shown as hand sketches.
    b. Presentation of any or all of the following – logical arguments, engineering analyses, mock-ups, test results from models or proof-of-concept prototypes, risk analysis, cost analysis, functional decomposition, decision matrix, house of quality, etc. - that argue for or against each feasible alternative, leading to a single recommended alternative.
    c. Inclusion of enough design detail to complete an architectural design based on the single recommended alternative, which is:
        i. *Undimensioned* CAD drawings - 3-D rendered CAD assembly drawings (Solid Edge or Solid Works) of design concept(s) – dimensions are not required yet, show the entire device, subassemblies and views of areas critical to understanding the concept.
        ii. Product hierarchy - A description of the subsystems and components, their interfaces, their logical and physical layout appropriate for a conceptual design.
        iii. First-cut Economic Analysis - Include a first-cut at your Bill of Materials, such as a parts list of the major components, part costs and total cost, and your cost to manufacture. This will be made exact at the CDR (Critical Design Review) at the end of the semester.
    d. A course requirement is that each team demonstrate in either a, b, or c:
        - Usage of modern engineering tools – for example commercial software such as FEA, Working Model, Matlab and/or other simulation software, spreadsheets, data acquisition, CAD (e.g. SolidWorks), etc.

- Application of fundamental engineering analysis methods and/or principles. Choose your calculation carefully, only do what is appropriate and necessary to your project. Discuss with your technical advisor what you plan on presenting here. Put any calculations details in the appendix if they are lengthy.

3. Requirements - List requirements that are derived and those that have originated from the sponsor or other stakeholders. Place these in outline form, the first outline level is the system level, followed by the subsystem level requirements, and component requirements if any at this time. Consider also requirements that are based upon economic, environmental, sustainability, manufacturability, ethical, health and safety, social, and political factors. Also make sure you have investigated any appropriate standards or codes that apply to your system.
4. Concept of Operations (ConOps) – Describe how the system will operate, perhaps the sequence of steps that occur during a mission.
5. Validate and Verify – Formulate a brief, preliminary test plan, to be performed in Phase D to test the system to show that each measurable system requirement is met (this is System Verification). Present brief, preliminary test plan that will demonstrate that the system will function according to the ConOps and satisfy the mission objective (this is System Validation).
6. Interfaces – List the mechanical, electrical, thermal and operational boundaries at this point in time, if any. (Much of this detail will not be determined until after the CR/PDR).
7. Mission Environment – Describe the mission environment and its effect, if any, on the design. Also consider, if appropriate, how the design and its manufacture may affect the environment.
8. Technical Resource Budget Tracking – identify and estimate resource budgets if relevant and necessary - such as mass, volume, power, battery, fuel, memory, etc.
9. Risk Management – Identify risks to safety, performance and program. Perform Failure Mode Analysis if called for.
10. Configuration Management and Documentation. Update your Dropbox folder or equivalent, and baseline the CR/PDR documents. Summarize how drawing approval will be managed (this is more important for the next review where you will have detailed drafts, i.e. the Critical Design Review).

SUBSYSTEMS DESIGN ENGINEERING – document work to date on the individual subsystem design efforts using the engineering design process (at the CR/PDR details may be limited so some subsystems do not need to be presented).

PROJECT MANAGEMENT – Show project management structure (show how tasks are assigned on the basis of multifunctional areas), schedule of milestones and reviews, estimated projected costs, tasks and plans for next review. An Excel spreadsheet (Bill of Materials) detailing all purchases and planned purchases - with columns for item, item description, quantity, standard that applies to COTS parts, source (supplier) and cost – is required. A copy of all purchase orders is required in the appendix if you are purchasing using a university purchasing card. Also include a summary of proposed tasks for the next review.

CONCLUSIONS

Restate your findings, and discuss what you will be doing for the next review.

APPENDIX AND REFERENCES

For example:

- Pages from catalogs and technical description for parts and components to be purchased.
- Information from suppliers, price quotes.
- Reference citations, e.g. textbooks, technical articles, etc.
- Details of calculations described in report that cannot fit into the report.

Attach (clip) all your CODs plus deliverables to the Report! An efficient manager and team will use the CODs plus deliverables to build most sections of the report.

1.3 MECH4240 Midterm Presentation: CR/PDR Power Point Presentation

Like the CR/PDR Report above, the presentation has the introduction, a main body and a conclusion. Use an outline structure, hit the key points, make significant use of e.g. computer graphics, digital photos, x-y plots, animations, equations, Excel spreadsheet and graphing, Power Point graphical features, other software (e.g. FEA, Working Model) and, of course, your CAD drawings. Give your technical advisor a "dry run" at least 2 days before the presentation if possible. It is a course requirement that each student must present at either the midterm and/or final presentation. Consider contacting your industrial sponsor a week before the presentation to tell them about your proposed concept in order to get their "blessing".

Industrial Sponsor Grade (This is a grade given to the whole team)

Your sponsor will grade the team's overall presentation. They are instructed to evaluate the presentation for feasibility of your chosen concept and its potential measure of success toward accomplishing the mission objective, and in so doing meet their own specific project needs. They are also influenced by the quality of the presentation itself.

Here is some additional advice that may improve your team's grade from the sponsor:

- Maintain general adherence to aforementioned format given for the report, but of course with much less detail and lots of graphics. It is not necessary to present all 11 System Engineering Function. Present your feasible alternatives, but focus on your chosen alternative and its architecture.
- Achieve quality in technical writing on the slides.
- Quality and preparedness of your individual oral presentations – be logical, use technical language and be concise, practice the presentations beforehand, dress professionally. Each student must present at either the CR/PDR or PDR/CDR presentation, and your oral communication skills will be assessed by the instructor.
- Graphics – effectiveness of plots and CAD and other figures.
- Time Limitations – stay within the time constraints. Typical presentations should be no more than 30 minutes, optimally 20 minutes. The remaining time should be left for questions from the sponsor.
- Overall demonstration of professional and ethical behavior.

Oral Presentation Grade, Considerations by the Instructor:

Each student must present at either the midterm or final presentation. Grading by the instructor of individual student presentations is based on a rubric for grading is shown on the webpage.

2 MECH4240 Final Review: Preliminary Design Review (PDR) or Critical Design Review (CDR)

2.1 Format for a PDR Report or CDR Report at the Final Review

For teams doing a CDR: At a CDR, focus on a report and presentation of your detailed design. The 11 SE functions are updated from the PDR. The CDR report is a detailed MS Word document that adheres to technical writing convention as presented on the course webpage. You should start this document by modifying and updating the CR/PDR report from the midterm review.
For teams doing a PDR: In this situation you are not ready to present a CDR at the Final Review because you have not completed a detailed design. You may be missing some of the elements of a CDR, such as a complete bill of materials, fully dimensioned CAD drafts, etc. In this situation, adhere to the format in section 1.1 for a PDR report. Update your midterm report, including the 11 SE functions, and add the design detail to your chosen concept that is developed further since the midterm CR report. Generally, the further you progress toward a CDR the better. The rest of this document after the next paragraph does not pertain to you yet since you are doing a PDR.

You are to 1) make hardcopies of the report for the industrial sponsor, technical advisor and overlord (discuss with technical advisor how many are to be made, overlord will always need a hardcopy), 2) load the report onto your dropbox (or equivalent accessible directory) and a pdf onto the Canvas assignment, 3) deliver to overlord or technical advisor your design notebook for grading, 4) deliver your hardcopy CODs + deliverables to overlord or TA, separate from the report and held together with a binder clip. Hardcopying costs will be covered by the sponsor in most cases, so see overlord, teaching assistant or technical advisor when ready to make report hardcopies.

TITLE PAGE – Include a descriptive project title (e.g. "MECH4240 Critical Design Review: A Light Weight Portable Lifting Device"). Also on the title page include corporation number and name, members (denote who is manager, scribe and systems engineer), semester, date, industrial sponsor, technical advisor, overlord.

SUMMARY or **ABSTRACT** (1 page of text, about 200 words).
Briefly state your problem, motivation (need), mission objective and methodology. Most of the abstract should specifically state your important accomplishments and results to this point in the project. It gives the reader a clue of what are the most important contributions of the work. Updated from midterm report.

TABLE OF CONTENTS

INTRODUCTION
Introduce the assignment, state and identify the design problem. Identify the "engineering need" or motivation. Provide background information, the state-of-the-art and you may refer to literature that will be listed in a Reference section. It is also permissible to state, in a paragraph or two, what will be presented in the rest of the report. Updated if necessary from the midterm report.

MAIN BODY
SYSTEMS ENGINEERING (by Systems Engineering team members)
1. Mission Objective – present a clear statement of the mission objective that all stakeholders have

agreed upon and accepted. Hopefully this remains the same as the midterm report.

2. Architectural Design Development. In theory, this section should change little from the midterm report. Simply present the chosen architectural design, with any changes in response to the sponsors comments from the PDR.
    a. Not required if successful at midterm: A review of your feasible alternatives – perhaps shown as hand sketches.
    b. Not required if successful at the midterm: Presentation of any or all of the following – logical arguments, analyses, mock-ups, test results, risk analysis, cost analysis, etc. - that argue for or against each feasible alternative, leading to a single recommended alternative.
    c. Include, but you may or may not need to update if successful at the midterm: Inclusion of enough design detail to complete a conceptual design – this is an architectural design, which includes:
        i. *Undimensioned* CAD drawings - 3-D rendered CAD assembly drawings (Solid Edge) of design concept(s) – dimensions are not required yet, show the entire device, subassemblies and views of areas critical to understanding the concept.
        ii. Product hierarchy - A description of the subsystems and major components, their interfaces, their logical and physical layout appropriate for a conceptual design.
    d. A course requirement is that each team demonstrate in either a, b or c:
        - Usage of modern engineering tools – e.g. commercial software such as FEA, Working Model and other simulation software, spreadsheets, data acquisition, CAD, etc. Update from midterm.
        - Application of fundamental engineering analysis methods, based on simplified analytical models with calculations. Choose your calculation carefully, only do what is appropriate and necessary to your project. Discuss with your instructor what you plan on presenting here. Put calculations details in the appendix. Update from midterm.
3. Requirements - List requirements that are derived and those that have originated from the sponsor or other stakeholders. Place these in outline form, the first outline level is the system level, followed by the subsystem level requirements, and component requirements if any at this time. Consider also requirements that are based upon economic, environmental, sustainability, manufacturability, ethical, health and safety, social, and political factors. Update from midterm.
4. Concept of Operations (ConOps) – Describe how the system will operate. Update from midterm.
5. Validate and Verify – Formulate a test plan, to be performed in Phase D to test the system to show that each measurable system requirement is met (this is System Verification). Present brief, preliminary test plan that will demonstrate that the system will function according to the ConOps and satisfy the mission objective (this is System Validation). Update from midterm.
6. Interfaces and ICD – List the mechanical, electrical, thermal and operational boundaries at this point in time, if any. Update from midterm.
7. Mission Environment – Describe the mission environment and its effect, if any, on the design. Update from midterm.
8. Technical Resource Budget Tracking – identify and estimate resource budgets if relevant and necessary - such as mass, volume, power, battery, fuel, memory, etc. Do not put your bill of materials here. Update from midterm.
9. Risk Management – The systems engineer will be able to identify risks to safety, performance and program. Perform Failure Mode Analysis if called for. Update from midterm.
10. Configuration Management and Documentation. Update Dropbox or equivalent and baseline the midterm documents. Update with the new CDR documents. Summarize how the configuration is managed.

SUBSYSTEMS DESIGN ENGINEERING - At the midterm details were limited here. Focus your CDR report and presentation on your detailed design of each subsystem. In this section you will present dimensioned drawings (drafts according to ANSI/ASME Y14.5 Dimensioning and Tolerancing) sufficient so that parts can be made, completed analyses, assembly drawings and any schematics (e.g. hydraulic, electrical, etc.).

A detailed CDR Economic Analysis, including a complete and accurate bill of materials (this consists of a

parts list, parts costs and total cost, source, applicable standard for COTS parts, and your cost to manufacture) can be placed here or in the Project Management section if you prefer. Make sure you have a column that states the standard for COTS parts, which can often be found on the supplier's website.

PROJECT MANAGEMENT – Show project management structure (show how tasks are assigned on the basis of multifunctional areas), schedule of milestones and reviews, estimated projected costs, tasks and plans for next review. Include a summary of proposed deliverables for the end of next semester.

CONCLUSIONS

State the primary information and results, and plans to complete the project.

REFERENCES

Reference citations, e.g. textbooks, technical articles, etc. This should be a numbered list, e.g.

[1] MECH4240-4250 Class Webpage. http://www.eng.auburn.edu/~dbeale/MECH4240-50/
[2] Zhang, Q., Beale, D., and Broughton, R. M., 1999, "Analysis of Circular Braiding Process, Part 1: Theoretical Investigation of Kinematics of the Circular Braiding Process," ASME J. Manuf. Sci. Eng., 121(3), pp. 345–350.

APPENDIX

- Pages from catalogs and technical description for parts and components to be purchased.
- Information from suppliers, price quotes.
- Details of calculations described in report.

Binder clip all your CODs plus deliverables and deliver to overlord or TA!

Remember :
Include 3-view orthographic projections, fully dimensioned, of all parts that must be manufactured. Drawings should be approved by the designer, drawer, and technical advisor.

Include assembly drawings, schematics of hydraulic, pneumatic and electrical systems if needed.

Complete bill of materials.

Update and refine 3-D solid models, engineering analyses, economic analyses.

Answer any concerns of industrial sponsor from midterm.

2.2 MECH4240 Midterm Presentation: CR/PDR Power Point Presentation

CDR Power Point Presentation

Like the CDR report above, the presentation has the introduction, a main body and a conclusion. Use an outline structure, hit the key points, make significant use of computer graphics, such as digital photos, x-y plots, animations, Excel spreadsheet and graphing, Power Point graphical features, other software (e.g. FEA, Working Model) and, of course, your imported CAD drawings. Give a "dry run" at least 2 days before the presentation to Dr. Beale or your Technical Advisor. It is a course requirement that each student must present at either the midterm and/or final presentation. Consider contacting your sponsor a week before the presentation to tell them about your proposed concept in order to get their "blessing". Remember that the sponsor is grading this, and is most concerned with evaluating your design, its cost, and chance of success. Remember to present your complete pars list, sufficient to purchase all parts. Following the presentation, each group must fill out purchase orders and order parts.

Industrial Sponsor Grade (This is a grade given to the whole team)

Your sponsor will grade the team's overall presentation. They are instructed to evaluate the presentation for feasibility of your chosen concept and its potential measure of success toward accomplishing the mission objective, and in so doing meet their own specific project needs. They are also influenced by the quality of the presentation itself.

Here is some additional advice that may improve your team's grade from the sponsor:

- Maintain general adherence to aforementioned format given for the report, but of course with much less detail and lots of graphics. It is not necessary to present all 11 System Engineering Function. Present your feasible alternatives, but focus on your chosen alternative and its architecture.
- Achieve quality in technical writing on the slides.
- Quality and preparedness of your individual oral presentations – be logical, use technical language and be concise, practice the presentations beforehand, dress professionally. Each student must present at either the CR/PDR or PDR/CDR presentation, and your oral communication skills will be assessed by the instructor.
- Graphics – effectiveness of plots and CAD and other figures.
  Time Limitations – stay within the time constraints. Typical presentations should be no more than 30 minutes, optimally 20 minutes. The remaining time should be left for questions from the sponsor.
- Overall demonstration of professional and ethical behavior.

Individual Student Presentation Grade, Considerations by the Instructor:

Each student must present at either the midterm or final presentation. Grading by the instructor of individual student presentations is based on a rubric for grading is shown at: http://www.eng.auburn.edu/~dbeale/MECH4240-50/Oral_Presentation_Form.pdf .