Critical Design Review

PowerPoint Outline

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What is the Purpose of the Critical Design Review

1. The purpose of the PDR is to present the “requirements” and conceptual design of your project.
2. The purpose of the CDR is to present the “design” of your project.
3. The next phase of the project should be implementation of this design, not further design.

CDR Logistics

Your presentation may use Microsoft Power Point, Google Slides, or Prezi. If you choose to use Prezi have a plan for submitting on BeachBoard and to not make the audience dizzy. Dizziness may occur when you need to jump back and forth between slides in order to answer questions.

It is important that you follow the CDR outline exactly!

You have a maximum of TBD minutes for your CDR presentation.

Each person in the group should present their own work. Be familiar with the material, do not read it from the overhead or from a sheet of paper.

Speak clearly, with authority, and eloquently. Practice the presentation to ensure all topics are covered in the time allotted.

Project Overview

Title Page

| Presenter: PM  
Grading: PM  
1 slide |

The title page should include what you are presenting (i.e., Critical Design Review), the name of the project, and the project members and their responsibilities. Add a professional touch to your presentation by including a Stylized Photo, Illustration, or 3D Model of the product.

Executive Summary

| Presenter: PM  
Grading: Project  
4-5 slide |

Think design competition. The executive summary should be from 4 to 5 slides (no more) and provide a quick overview of the project. The slides should be titled: Project Objectives and Mission Profile (1 - 2 slides), The Design (1 slide), and Project Features (1 - 2 slides). The “Design” slide should be an annotated Photo, Illustration, or exploded 3D model showing the major subsystems/components of your design. The “Project Features” should talk to the key and/or innovative design features of your project.
Requirements and Constraints

| Presenter: PM  
| Grading: PM and System Engineer  
| 1 – 2 slides |

Present a table mapping Program/Project L1 Requirements and Constraints as defined in the “Project Planning and Requirements” Document with Tests (by number) defined in the Verification and Validation document.

Quality Control and Safety

| Presenter: Quality Control Manager  
| Grading: PM and Quality Control Manager  
| 1 – 2 slides |

Review and **show compliance** with constraints on the project imposed by The Robot Company and Project Stakeholders. Specifically include company (i.e., University) safety standards and those safety standards associated with the product (e.g., Children’s Toys).

System Design

| Presenter: MST  
| Grading: Project and MST Manager  
| 1 - 2 slides |

This is typically a single slide providing a detailed System Block Diagram(s) of the design. This is an updated and more detailed version of the block diagram presented at the PDR. Identify connectors, numbers of wires in a bus, and when practical, the names of the wires and busses. When presenting, walk the audience through each subsystem/component block and how they are interconnected (i.e., subsystem and interface descriptions).
**Subsystem Design**

**Modeling Results**

<table>
<thead>
<tr>
<th>Presenter: Engineer who conducted the modeling task(s)</th>
<th>Grading: Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 3 slides <em>(based on number of significant experiments performed)</em></td>
<td></td>
</tr>
</tbody>
</table>

Slide 1 is a table showing the title of all modeling completed to date and planned for the future. Completed tasks should provide name and [link to Blog post](#).

Following slides should showcase a few modeling tasks. Refer to Model Grading Scale to help you to determine which modeling tasks to highlight. Show what you did to arrive at a design solution to a system, subsystem, and/or component design problem. Did experimental results and observations meet Design Requirements? For example; show how you went from requirements, to a trade-off study, to a simulation and then to a set of experiments in order to select a component.

<table>
<thead>
<tr>
<th>Fuzzy Scale</th>
<th>Model</th>
<th>Description and Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+ A-</td>
<td>Full-scale Prototype and Scale Models</td>
<td>Models of critical subsystems of your system are built. For example, models of the track and lift features of a truck eVTOL.</td>
</tr>
<tr>
<td>A+ B+</td>
<td>Experiments</td>
<td>Experimental measurements or testing of key features or components of your robot. For example, your control of a quad-ducted fan vehicle.</td>
</tr>
<tr>
<td>A- B-</td>
<td>Computer Simulations</td>
<td>Computer models of key features of your design using tools like SolidWorks, Captain, Matlab, Simulink, Mathios, LabView.</td>
</tr>
<tr>
<td>A- B-</td>
<td>Analytical Models and Back of the Envelope Calculations</td>
<td>Mathematical models of elements of your design.</td>
</tr>
<tr>
<td>B+ C-</td>
<td>Trade-off Studies</td>
<td>Quantitative trade-off studies (needed to clearly defined level 1 and 2 requirements).</td>
</tr>
<tr>
<td>D- F</td>
<td>Qualitative Studies and Wild Conjectures</td>
<td>You may have to get creative if you want a score this low.</td>
</tr>
</tbody>
</table>

**Interface Definition**

<table>
<thead>
<tr>
<th>Presenter: MST</th>
<th>Grading: Project and MST Manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 slides</td>
<td></td>
</tr>
</tbody>
</table>

The first slide is an updated version of the interface matrix presented at the PDR (1 slide). The second slide is the “Cable Tree” (i.e. wire harness, wiring diagram, etc.) developed in concert with the E&C and MFG showing how the wires, cables, and connectors will be integrated into the final product. *I do not simply want an illustration but really want you to think about it how you are going to develop a clean design without “wire spaghetti.”*

If your project has an ICD, it would go here (additional 1 - 2 slides): top level explanation of MST communication, E&C connections, MFG mating and fastening → to be covered in detail later in the presentation during respective sections.)
Mission Command and Control

Projects using the Arxterra App and Control Panel: The software design is a collaborative effort by the system and electronics/control engineers. The first slide should provide a general block diagram of the software system, followed by the Arduino software modules responsible for communicating with the Arxterra App, specifically Command and Telemetry decoding and encoding.

Note: what is seen by the user (not Robot3DoT modules)
Defining/Setting-up the custom commands in Arduino IDE and the function handlers
Show the UI on the phone application/control panel

Other Projects: Highlight commands being implemented by the user at a top level. Provide any feedback systems that are user-facing. This could be through notification LEDs, haptic feedback, etc. at the system level (E&C will expand on the details during the respective section to follow).

User Input (Command) → [black box] → Notifications (Telemetry)

Electronics Design

This section of the presentation should bring attention to the Electronic Components and serve as an introduction to this field. You should present some details about the custom parts in your design as well as the ICs you chose and why you chose them. As an example you should provide information which IMU you used or which type of rotary encoder you used (where applicable). This should lead into the firmware portion of the presentation.

Firmware

For each part you presented in the introduction should mention how the firmware is going to control it. Flowcharts as well as software block diagrams fall into this section. You should go into detail about a key aspect (such as shifting the center of gravity or reading of EMG sensors). Pseudo-code and/or flowcharts as well as short C++ samples help illustrate the firmware. All C++ code samples should include comment.
PCB Schematic

Presenter: E&C
Grading: E&C Manager
2-3 slides

This is a sequence of slides showing the progression of the design from Fritzing diagram (optional), to physical breadboard photo (1 slide), to schematic (1 slide).

PCB Layout

Presenter: MFG
Grading: MFG Manager
1 slide

This slide should visualize the layout of the PCB. For this you want to review the PCB Design grading scale. If available you may also want to show the prototype/production PCB. If the PCB is already integrated into the prototype then show this during the demonstration section of the CDR.

Hardware Design

Presenter: MFG
Grading: MFG Manager
2-4 slide

This sequence of slides are SolidWorks generated 3D Models of the design. Annotation is recommended. If available the Manufacturing Engineer may show Prototype/Production Parts. If integrated into the prototype then show during demonstration section of the review.

Verification & Validation Test Overview/Summary (not the plan itself)

Presenter: MST
Grading: Project, MST Manager
3-4 slide

On the first slide show a few bullet points on your strategy for verifying that your design meets design requirements and how you will validate (i.e., the mission plan) that you built the right product for the mission (1 - 2 slides). The next set of slides should present your projects verification test plan as an overview/summary, not the tables in a horribly unreadable form. (Note: the test plans should be provided for verification and validation at the conclusion of the presentation in a printed form next week.)
**Project Status**

**Power Allocation**

<table>
<thead>
<tr>
<th>Presenter: MST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grading: MST Manager</td>
</tr>
<tr>
<td>1 slide</td>
</tr>
</tbody>
</table>

Single slide outlining the updated useable capacity of the power source selected for the project. Typically represented in a tabulated format, it should include an expected current drawn, measured current drawn, percent uncertainty, and margin for each resource consuming power. Lastly, it should contain total expected current, total margins, project allocation, and contingency clearly showing the power source selected will support the project.

**Mass Allocation**

<table>
<thead>
<tr>
<th>Presenter: MST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grading: MST Manager</td>
</tr>
<tr>
<td>1 slide</td>
</tr>
</tbody>
</table>

This slide is comparable to the previous power allocation slide however, dedicated to the updated mass of the project. Also in a tabulated format, it should contain the expected weight, measured weight, percent uncertainty, and margin for each respective resource being used in the project. Lastly, it should contain total expected weight, total margins, project allocation, and contingency.

**Other Resource Allocations**

<table>
<thead>
<tr>
<th>Presenter: MST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grading: MST Manager</td>
</tr>
<tr>
<td>0+ slides (project dependent)</td>
</tr>
</tbody>
</table>

Any other resources tracked by the system engineer. For example, 3DoT projects using a 3D printer have a 6 hr. (2/2/2) resource requirement that must be tracked.

**Cost Report**

<table>
<thead>
<tr>
<th>Presenter: PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grading: President</td>
</tr>
<tr>
<td>1 slide</td>
</tr>
</tbody>
</table>

This slide should contain an updated table listing all of parts being used for the project. Like the two previously mentioned allocation slides, this chart should contain the expected cost, actual cost, percent uncertainty, and margin for each item listed in the table. Lastly, it should show the total expected cost, total margins, project allocation, and contingency.
Updated Schedule

This slide should contain an updated schedule (1 slide), generated through programs like ProjectLibre or Microsoft Project, showing the system and subsystem tasks that have been completed or are still in progress. It is important to include the project’s critical path (1 slide) (visually representing the critical path in the schedule diagram is recommended). You can lead this section of the presentation with the Work Breakdown Structure (WBS) if you’d like, however it is unnecessary/understood at this point in the course.

Burndown and Percent Complete

Slides summarizing schedule status including percentage complete and a burndown diagram.

Project Report Checklist
By Amber Scardina

Here are some things to remember when editing your cost report, schedule, and burndown:

1. Top Level Schedule must show critical path
2. Top Level and Subsystem schedule must be unique to your individual project
3. Cost must include the approved budget and any purchased goods must be updated. (I want to know how much has been spent currently on each project)
4. Please label your axis on your burndown
5. Show a vertical line on the burndown where your project is currently.

-------- End of PowerPoint Presentation --------
Demonstration

Project Demonstrations

This is your chance to show off your project hardware and software. Although typically an in-class demonstration, you may show a video if this is impractical (UFO-Abducted) and/or you would like to showcase your product in its mission environment.

Additional Grade

CDR Presentation Grade

The good news is that you do not have to do anything for this section of your grade. At the end of the presentation we (the review board) will be assigning points based on the professionalism/quality of the presentation, if the presentation followed the outline, and the perceived project readiness. Specifically, is your project where it needs to be at this time of the semester? Finally, your grade is modified by a “degree of difficulty” multiplication factor. In almost all cases this is 1.0.

Your entire presentation should be from 24-37 slides. Your presentation should take no more than TBD minutes.