Engineering Design Processes

Notes and Handouts
Purpose:
Design has long been considered a central activity of engineering. The goal of this classroom presentation is to help engineering students to become more conceptually and metacognitively aware of engineering design processes.

Agenda:
The intended time for this classroom presentation is 60 minutes.

Topics for this workshop include:
- How engineering students and practicing professionals solve engineering problems
- Discuss relevance to AA 332
- Develop and understand design processes

Goals:
1. Give a background of CELT’s Design Research
2. Participants leave with something helpful
Activity 1 Worksheet

Freshman #1 (Quality Score = 0.37)

Senior One (Quality Score = 0.38)

Freshman #2 (Quality Score = 0.45)

Senior Two (Quality Score = 0.53)

Freshman #3 (Quality Score = 0.62)

Senior Three (Quality Score = 0.63)

Design Activity Timeline

PD: Problem Definition  MOD: Modeling  DEC: Decision
GATH: Gathering Information  FEAS: Feasibility  COM: Communication
GEN: Generating Ideas  EVAL: Evaluation

ACTIVITY:
In the design process timelines shown above, what similarities and differences do you see between the freshmen and senior engineering students? Do these similarities also involve the quality scores? How so?

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________________________________________________________________________

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________________________________________________________________________
**Instructions for Individual Design Progress Sheet**

The purpose of this activity is to help you monitor both your individual and team’s design process. The *Individual Design Progress Sheet* helps you identify the design activities you are currently emphasizing in your work. By observing your design process, the intent is for you to evaluate how well you are doing as well as suggest any possible changes to how you allocate your time and effort.

**General Instructions**

- Be sure to include your name, your assigned subgroup, and your team’s identifier.
- The date will be helpful for keeping these records in order. It might help to make the date the same as your team’s weekly meeting.
- Each team member should submit an *Individual Design Progress Sheet* to the team’s Design Process Reporter at least one day before the weekly team meeting.
- For accuracy in reporting your design hours, keep daily notes about what you did and for how long.

**Description of Assigned Tasks (what you were expected to do)**

In the section titled “Description of Assigned Task(s),” you should describe the specific tasks that you or your subgroup was assigned to work on at the last team meeting. Be succinct but include important details. Do not use this section to report whether the tasks were completed or not.

**Individual Design Activities (what you actually did)**

In the section titled “Design Activities,” you will record the actual tasks that you worked on over the week. For each task, you should identify what activity category in which it best fits (refer to the provided *Design Activity Definitions Sheet*) and record a brief description of that task.

For each design activity, you should also record how the total time you spent working on tasks involving the design activity. Be as specific as possible (e.g., 1.5 hours).

If you worked on the same task with another person, you should both report hours. Do not worry about double-counting; the goal is to record person-hours.

**Individual Reflection / Comments**

This section is for you to reflect on the work you have completed over the past two weeks. In particular, you should focus your reflection on the design process. As a guide, here are some questions to consider:

- What design activities did you spend the most / least time in? Why?
- How well did you do at allocating your time among different tasks? the design activities?
- Were there any difficulties in determining what design activity you were performing?
- Consider the tasks you were assigned. Were they appropriate? Did you feel prepared to work on them?
- Did you learn anything that your other team members should know about?
**Individual Design Progress Sheet**  
(To be filled out by *Individual Team Member*)

**Name:** ___________________________________  
**Team:** ___________________________________  
**Subgroup:** ____________________________  
**Date:** __________________

**Description of Assigned Tasks (what you were expected to do)**

**Individual Design Activities (what you actually did)**

<table>
<thead>
<tr>
<th>What you did?</th>
<th>Approx. Time:</th>
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</thead>
<tbody>
<tr>
<td>Problem Definition</td>
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<tr>
<td>Gathering Information</td>
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<tr>
<td>Generating Ideas</td>
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<tr>
<td>Modeling &amp; Feasibility</td>
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<tr>
<td>Evaluation &amp; Decision</td>
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<tr>
<td>Communication</td>
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<tr>
<td>Implementation</td>
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</table>

**Individual Reflection / Comments**
Instructions for Team Design Progress Sheet

The purpose of this activity is to help your team monitor its progress on both the project and your team’s design process. The Team Design Progress Sheet is a consolidation of information from your teammates’ Individual Design Progress Sheets, (i.e. how much time was spent by your team on relevant design activities, what was completed, and so on). The intent is for the team to use this information to evaluate its overall performance and for planning any possible changes in how to best allocate the team’s time and effort.

General Instructions

− The Team Design Progress Sheet should be filled out by the Design Process Reporter using the information from the Individual Design Progress Sheets.
− Each team must submit a Team Design Progress Sheet to the instructor every week. You should do this within a day or two of your weekly team meeting.
− The sections “What the Team Worked On” and “Time in Team Design Activities” should be completed before the weekly team meeting. The remaining two sections will be filled out collectively by the team.
− Be sure to include your team’s identifier.

Time in Team Design Activities

In the section titled “Time in Design Activities,” you will record the total time the team spent in the various design activities. In addition to reporting the total time for each design activity, you will also record how the time was distributed into the three subgroup areas:
− Manufacturing & Procurement
− Design & Modeling
− Presentation & Compilation

Do your best at identifying what subgroup the activities best fit into. Do not rely solely on the subgroup the team member is assigned to.

What the Team Worked On

The section titled “What the Team Worked On” should contain a summary of the various tasks that the team worked on over the past week. This data can be compiled from the entries in the “Individual Design Activities” section of the team’s Individual Design Progress Sheets.

There is no need to record who did what tasks. Brief descriptions of the tasks are sufficient.

Do not list tasks that were assigned but not worked on.

Team Reflection / Comments from Meeting

This section should be filled out at the team meeting. At the team meeting, the team should look over the previous two sections and reflect upon the work that the group has completed over the past week. Individual members should consider what they mentioned in the “Reflection / Comments” section of their Individual Design Progress Sheet. The resulting discussion should be recorded in this section.

As a guide, here are some questions to consider:
– Looking at your previous plan of action, what assigned tasks were completed or not completed? Were any activities added that weren’t part of the assigned plan?
– How is progress on the project going?
– How well did the team do at allocating its time among different tasks, and design activities?
– What design activities did you spend the most / least time in? Why?
– How is the team’s progress related to the design activities performed by the team?

**Team Plan of Action**

This section should be filled out at the team meeting. At the meeting, the team should decide what actions and tasks need to be completed over the next week or more. This discussion should also consider what design activities should be emphasized. The settled upon plan should be listed in detail in this section.

Specific details to include in your plan of action include:
– What tasks should be completed next?
– When should the tasks be completed? Are there priorities to these tasks?
– Which individual or subgroup should be assigned to a task?
– How should the team allocate time among the tasks and design activities?
# Team Design Progress Sheet
(To be filled out by Design Process Reporter)

**Team:** __________________________________________  **Date:** __________________

## Time in Team Design Activities

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<thead>
<tr>
<th></th>
<th>Manufacturing &amp; Procurement</th>
<th>Design &amp; Modeling</th>
<th>Presentation &amp; Compilation</th>
<th><strong>Row Totals</strong></th>
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<tbody>
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<td>Problem Definition</td>
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**Column Totals**

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**What the team worked on**
## Design Activity Definition and Examples Table

<table>
<thead>
<tr>
<th><strong>DESIGN ACTIVITY</strong></th>
<th><strong>DEFINITION</strong></th>
<th><strong>EXAMPLE(S)</strong></th>
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</thead>
</table>
| **PROBLEM DEFINITION** | Defining the problem  
− What is it that I have to do? | − Reading, re-reading, or rehashing the wingbox project description  
− Identifying requirements and constraints |
| **GATHERING INFORMATION** | Collecting information  
− What does a wingbox look like?  
− Are there recommended ways to design one? What else do I need to know? | − Asking professor for information  
− Researching other wingbox designs  
− Reading lecture notes and handouts  
− Gathering information about materials (cost, weight, strength, etc.) |
| **GENERATING IDEAS** | Thinking up potential solutions  
− Let’s try this. | − Conceptual design phase  
− Coming up with an initial idea and “Playing around” |
| **MODELING & FEASIBILITY** | Detailing how to build solution or parts of a solution  
− Let’s work this through?  
Assessing possible or planned solutions  
○ Can we build it? Can we buy these materials? | − Sketch a few concepts in CAD  
− Detail design phase  
− CAD of individual components, joints  
− Hand calculations to estimate stresses, dimensions, costs, weights, failure load  
− Verifying workability in general  
− Determining whether a solution meets the Problem constraints |
| **EVALUATION & DECISION** | Comparing two or more ideas:  
− Which design best meets our goals?  
Selecting one idea or solution  
− Should we go ahead with plan XY? | − Specifying or debating tradeoffs among alternative solutions  
− Making final selections of materials to use, design choices, joining methods  
− Specifically eliminating all other options |
| **COMMUNICATION** | Revealing and explaining the design to others  
− This is how and why we did it. | − Discussions with professor  
− Presenting results  
− Writing final report |
| **IMPLEMENTATION** | Putting together what was designed | − Assembling the wingbox or its components |
Engineering Design Processes Bibliography


