Engineering Design Processes

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- What do first year students’ engineering design processes look like?
- What do senior students’ engineering design processes look like?
- What do experts’ engineering design processes look like?
- How do they compare?
Design Process Activities
Derived from analysis of 7 engineering texts

<table>
<thead>
<tr>
<th>Design Activities</th>
<th>Design Stages</th>
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</thead>
<tbody>
<tr>
<td>(Identification of a Need)</td>
<td>Problem Scoping</td>
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<tr>
<td>Problem Definition</td>
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<tr>
<td>Information Gathering</td>
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<tr>
<td>Generation of Ideas</td>
<td>Developing Alternative Solutions</td>
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<tr>
<td>Modeling</td>
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<td>Feasibility of analysis</td>
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<td>Evaluation</td>
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<tr>
<td>Decision</td>
<td>Project Realization</td>
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<td>Communication</td>
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<tr>
<td>(Implementation)</td>
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</table>
Generic Design Model: A Linear Process?

- Problem Definition
- Gathering Information
- Generating Ideas
- Modeling
- Feasibility
- Evaluation
- Decision
- Communication
Generic Design Process: An Iterative Process

Problem Definition → Gathering Information → Generating Ideas

Modeling → Feasibility → Evaluation → Decision → Communication
Study Summary

- Data collection:
  - Participants were asked to design something.
  - Asked to speak about what they were doing while they were designing.
  - Participants were videotaped or audiotaped.

- Three levels of expertise:
  - Freshmen (n = 26)
  - Seniors (n = 24)
  - Experts (n = 19)
Design Process Timelines

Freshman (Quality Score = 0.45)

- **PD**: Problem Definition
- **GATH**: Gathering Information
- **GEN**: Generating Ideas
- **MOD**: Modeling
- **FEAS**: Feasibility Analysis
- **EVAL**: Evaluation
- **DEC**: Decision Making
- **COM**: Communication
Activity Instructions

Individually, take a few minutes and do the activity on the worksheet:

- In the design process timelines shown on the worksheet, what similarities and differences do you see between the freshmen and senior engineering students?

- Do these similarities also involve the quality scores? How so?
Class Discussion

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)
Our Findings: Freshmen vs. Seniors

Compared to freshmen, seniors…

- …have higher quality designs. (whew!!)
- …scope the problem more effectively by considering a broader range of information categories.
- …make more transitions among design steps.
- …spend more time iterating.
- …progress farther in the design process.
Experts

Expert #1 (Quality Score = 0.42)

Expert #2 (Quality Score = 0.55)

Expert #3 (Quality Score = 0.67)
Our Findings: Experts and Time

- Experts spend more time solving the problems in all design stages.
- Experts also tend to exhibit a ‘cascade’ pattern of transitions.
- Experts “scope” the problem more effectively...
  - ...gathering more information.
  - ...covering more categories of information.
Professor’s Observation of Successful Teams

Teams that follow a more ‘complete’ design process end up having better quality design solutions.
Why is this relevant for you?

- Where is your team?
  - Moving towards an expert, ‘complete’ process?
  - Stuck in modeling?
  - Linear or iterating?
  - Gathering information adequately?
Monitoring Your Team’s Design Process

Activity

- Individual recording of what you work on
- Aggregation of team’s efforts
- Discussion and planning

Goal: Straightforward activity to improve your team’s process and product
# Design Activities for AA 332

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
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<tbody>
<tr>
<td>Problem Definition</td>
<td>Defining the problem</td>
</tr>
<tr>
<td>Gathering Information</td>
<td>Collecting information</td>
</tr>
<tr>
<td>Generating Ideas</td>
<td>Thinking up potential solutions</td>
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<tr>
<td>Modeling &amp; Feasibility</td>
<td>Detailing how to build solution or parts of a solution</td>
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<tr>
<td>Evaluation &amp; Decision</td>
<td>Comparing two or more ideas</td>
</tr>
<tr>
<td>Communication</td>
<td>Revealing and explaining the design to others</td>
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</tbody>
</table>
Individual Design Progress Form

- Three Parts
  - Assigned Tasks
  - Individual Design Activities
  - Reflection/Comments

- Instruction sheet available on course web site
## Team Design Process Form

### Table: Team Design Progress Sheet

<table>
<thead>
<tr>
<th>Team Design Activities</th>
<th>Manufacturing &amp; Procurement</th>
<th>Design &amp; Modeling</th>
<th>Presentation &amp; Compilation</th>
<th>Row Totals</th>
</tr>
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<td>Problem Definition</td>
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<td>Column 1/2</td>
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</tbody>
</table>

**What the team worked on**

### Team Reflection / Comments from Meeting

**Team Plan of Action**
Visualization of your team’s process

Example only!!! Actual times will vary!
Questions?

- Contact:
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