Engineering Design Processes

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CELT Design Research

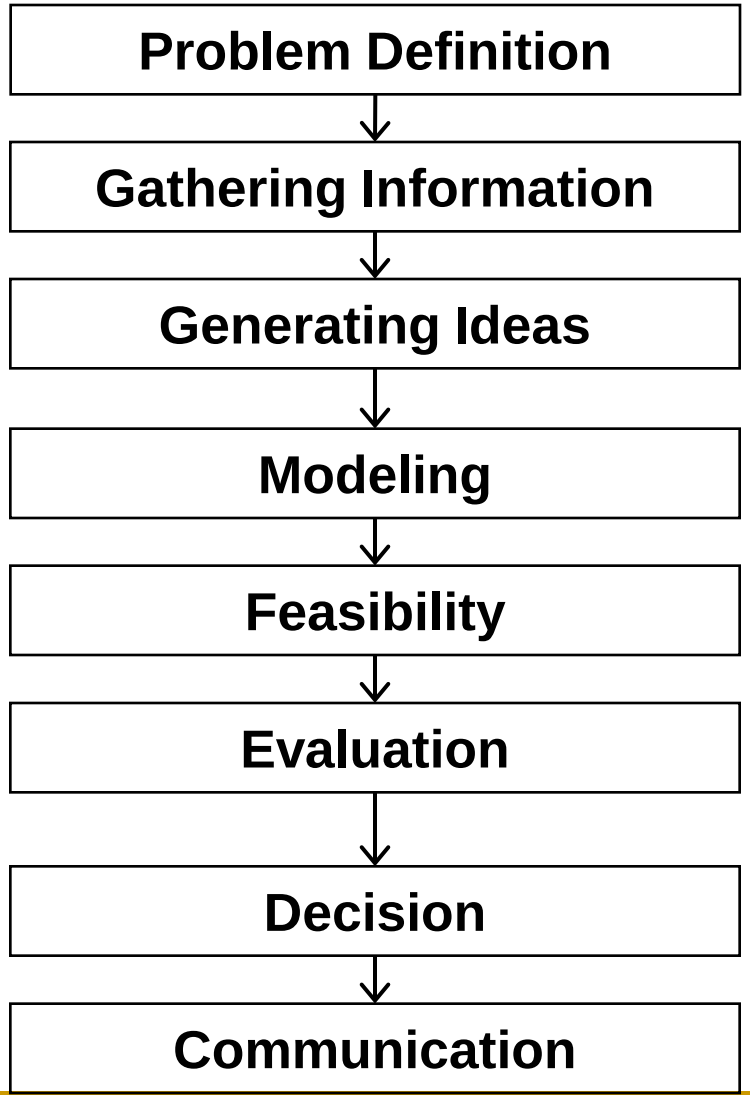
- What do first year students' engineering design processes look like?
- What do senior students' engineering design processes look like?
- What do experts' engineering design processes look like?
- How do they compare?

Design Process Activities

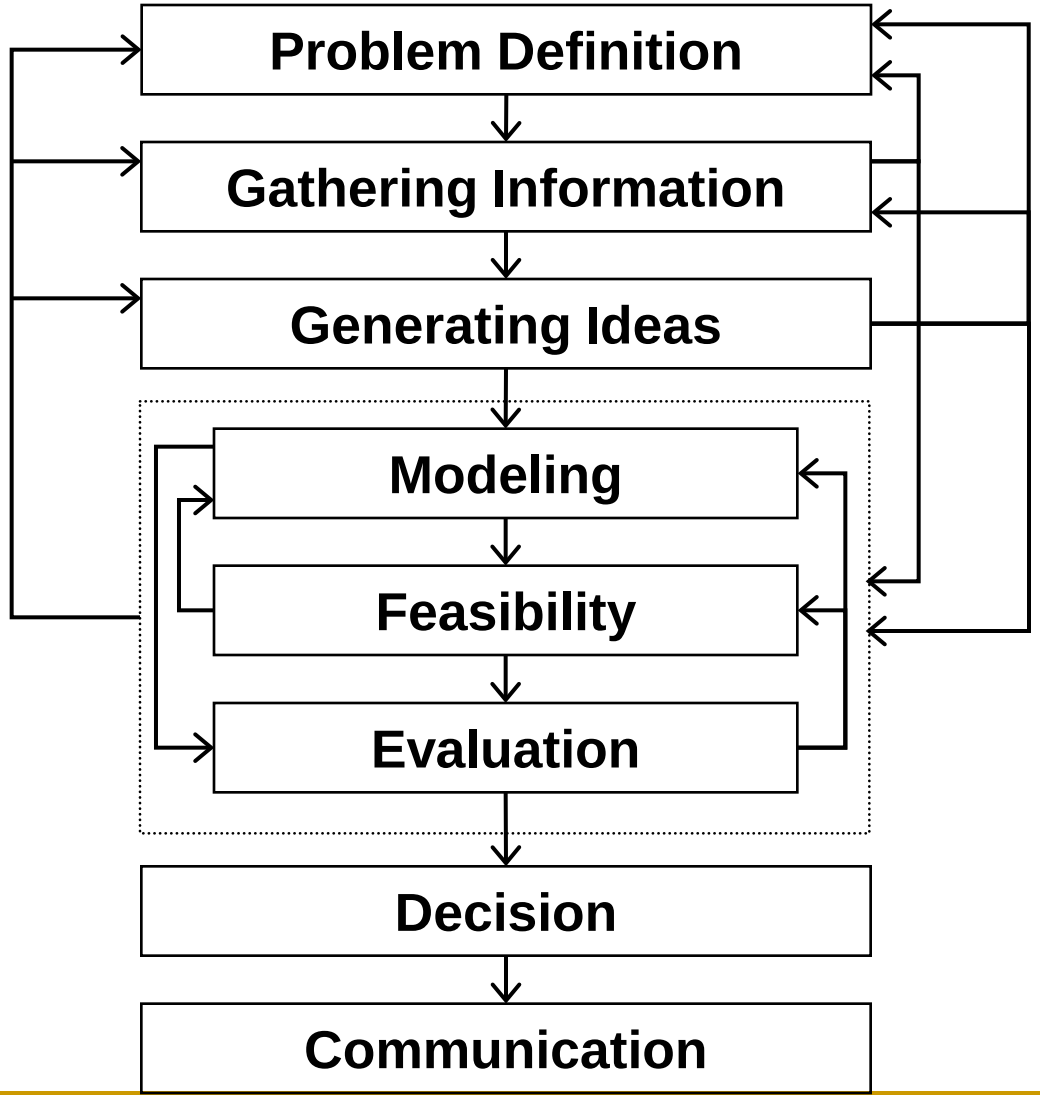
Derived from analysis of 7 engineering texts

Design Activities	Design Stages
(Identification of a Need) Problem Definition Information Gathering	Problem Scoping
Generation of Ideas Modeling Feasibility of analysis Evaluation	Developing Alternative Solutions
Decision Communication (Implementation)	Project Realization

Generic Design Model: A Linear Process?



Generic Design Process: An Iterative Process

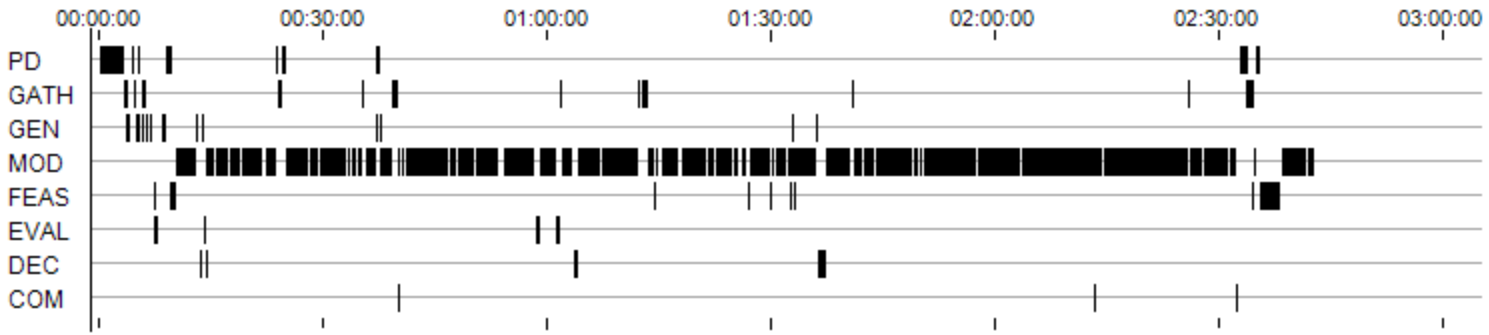


Study Summary

- 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	FEAS:	Feasibility Analysis
GATH:	Gathering Information	EVAL:	Evaluation
GEN:	Generating Ideas	DEC:	Decision Making
MOD:	Modeling	COM:	Communication

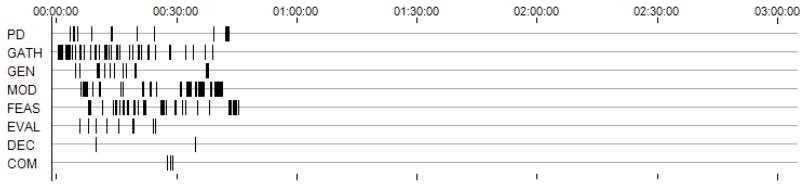
Activity Instructions

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

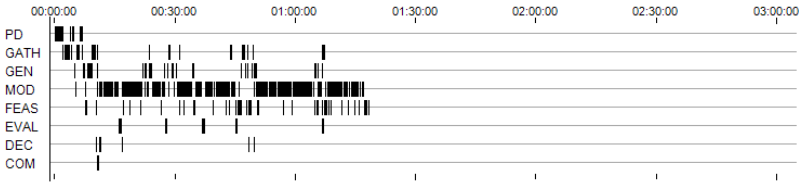
- In the design process timelines shown on the worksheet, what similarities and differences do you see between the freshmen and senior engineering students?
- Do these similarities also involve the quality scores? How so?

Class Discussion

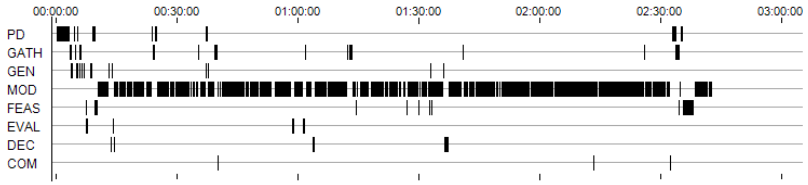
Freshman #1 (Quality Score = 0.37)



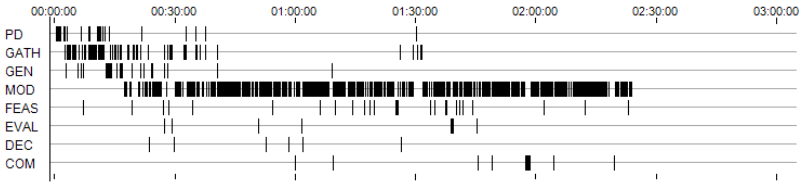
Senior One (Quality Score = 0.38)



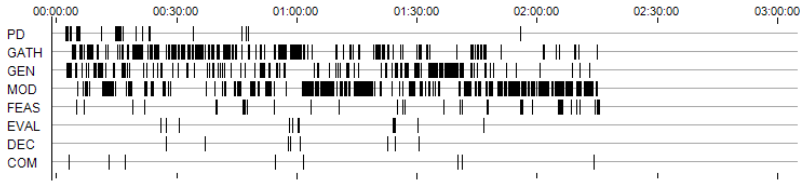
Freshman #2 (Quality Score = 0.45)



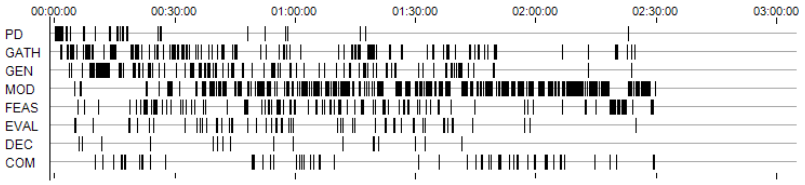
Senior Two (Quality Score = 0.53)



Freshman #3 (Quality Score = 0.62)



Senior Three (Quality Score = 0.63)



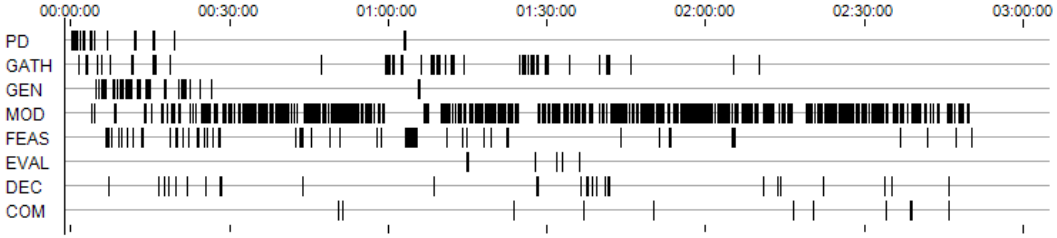
Our Findings: Freshmen vs. Seniors

Compared to freshmen, seniors…

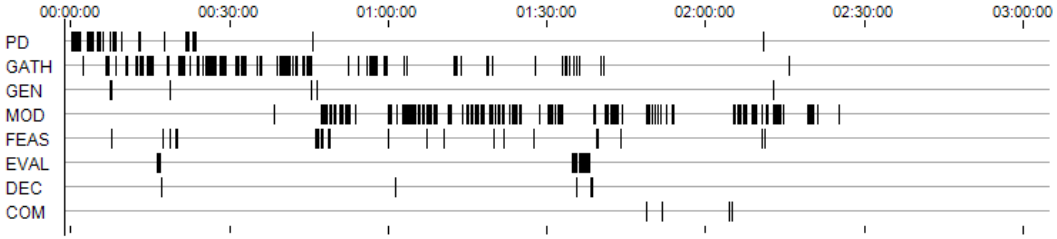
- …have higher quality designs. (whew!!)
- …scope the problem more effectively by considering a broader range of information categories.
- …make more transitions among design steps.
- …spend more time iterating.
- …progress farther in the design process.

Experts

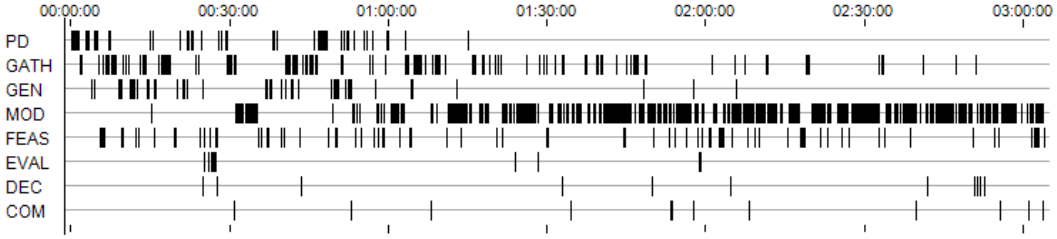
Expert #1 (Quality Score = 0.42)



Expert #2 (Quality Score = 0.55)

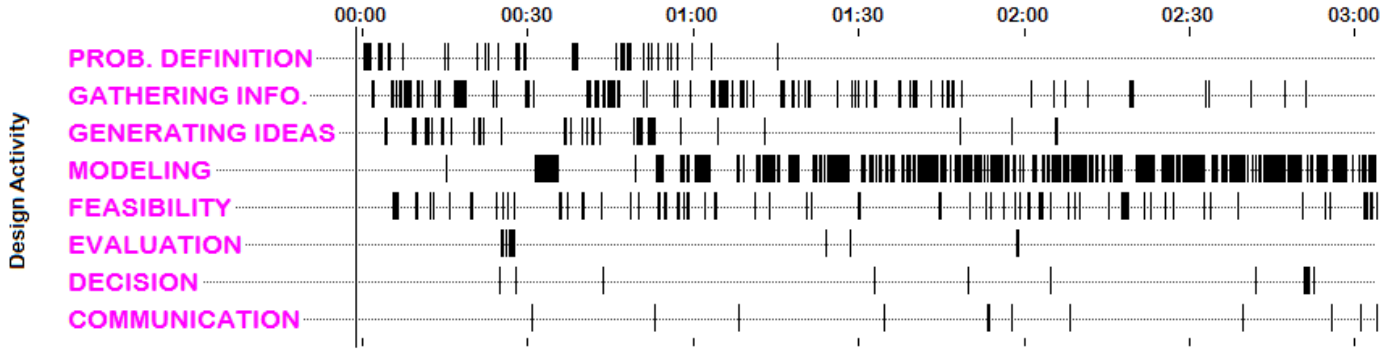


Expert #3 (Quality Score = 0.67)



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

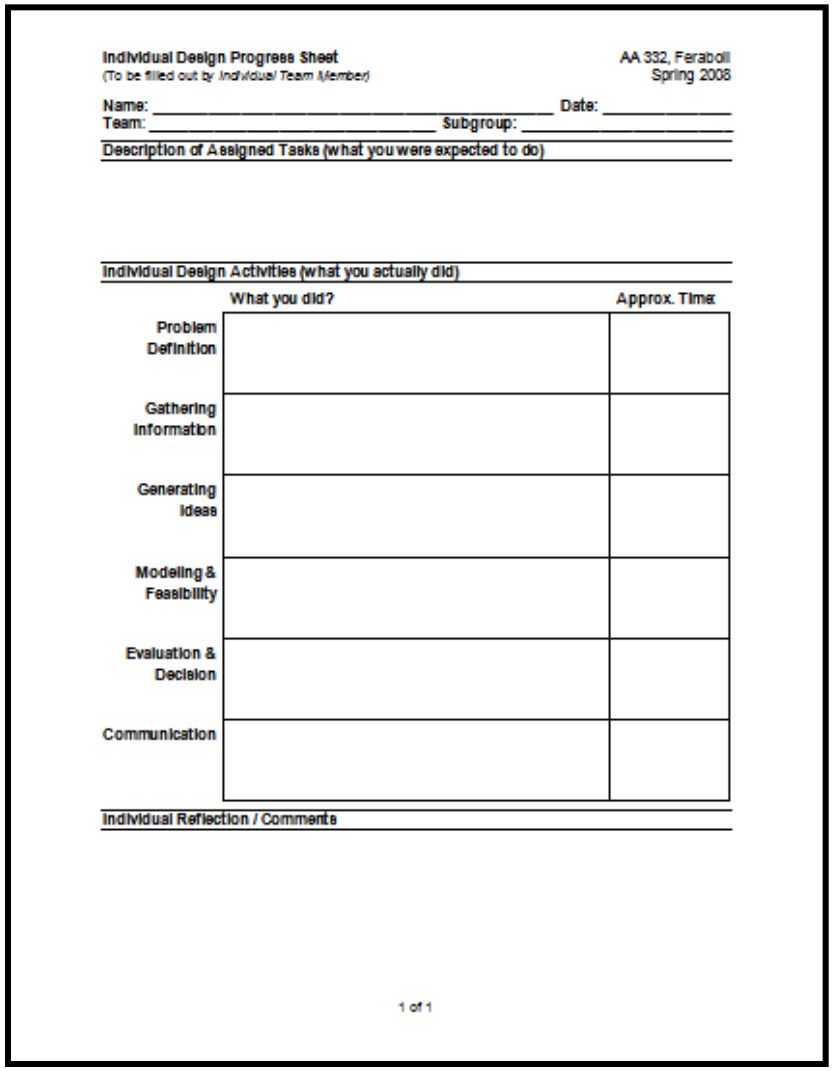
- Individual recording of what you work on
- Aggregation of team's efforts
- Discussion and planning

Goal: Straightforward activity to improve your team's process and product

Design Activities for AA 332

Problem Definition	Defining the problem
Gathering Information	Collecting information
Generating Ideas	Thinking up potential solutions
Modeling & Feasibility	Detailing how to build solution or parts of a solution
Evaluation & Decision	Comparing two or more ideas
Communication	Revealing and explaining the design to others

Individual Design Progress Form



Individual Design Progress Sheet
(To be filled out by Individual Team Member)

AA 332, Feraboli
Spring 2008

Name: _____ Date: _____
Team: _____ Subgroup: _____

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

Individual Design Activities (what you actually did)

	What you did?	Approx. Time
Problem Definition		
Gathering Information		
Generating Ideas		
Modeling & Feasibility		
Evaluation & Decision		
Communication		

Individual Reflection / Comments

1 of 1

- Three Parts
  - Assigned Tasks
  - Individual Design Activities
  - Reflection/Comments
- Instruction sheet available on course web site

Team Design Process Form

Team Design Progress Sheet
(To be filled out by *Design Process Reporter*)

AA 332, Feraboli
Spring 2008

Team: _____ Date: _____

Time in Team Design Activities

	Manufacturing & Procurement	Design & Modeling	Presentation & Compilation	*Row Totals*
Problem Definition				
Gathering Information				
Generating Ideas				
Modeling & Feasibility				
Evaluation & Decision				
Communication				
Column Totals				

What the team worked on

1 of 2

Team Design Progress Sheet
(To be filled out by *Design Process Reporter*)

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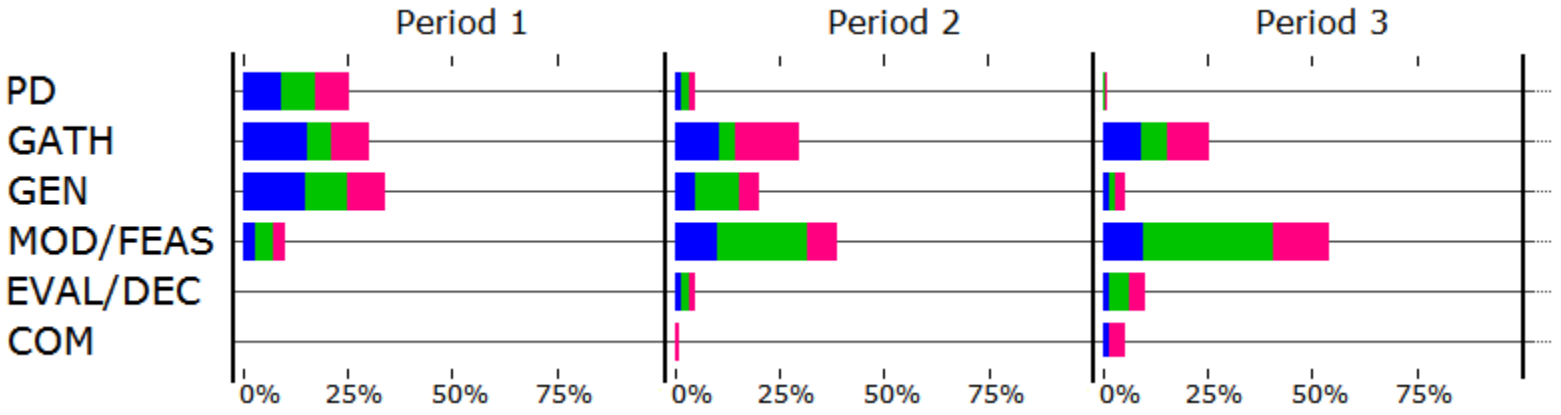
Team Reflection / Comments from Meeting

Team Plan of Action

2 of 2

Visualization of your team's process



Manufacturing & Procurement

Design & Modeling

Presentation & Compilation

Example only!!! Actual times will vary!

Questions?

- Contact:
  - Jim Borgford-Parnell <bparnell@u.washington.edu>