2.009 Product Engineering Processes

you have to work hard to get your thinking clean to make it simple.
Steve Jobs, 1955-2011

thinking is the hardest work there is, which is probably the reason why so few engage in it.
Henry Ford, 1863-1947
2.009 Product engineering processes

Today

Product architecture structure the problem
What’s now workflow

Three ideas presentation
September 26, during class
3 ideas per section

Mockup review
October 20
2 mockups per section

Assembly review
November 2 & 4
1 assembly

Final presentation
December 12
1 alpha prototype

Sketch model review
October 6
3 models per section

Final selection
October 24-27
1 concept per team

Technical review
November 17
1 (almost) prototype
Assembly review

Overview

digital submission 11 PM, Tuesday November 1 (red, green, blue, yellow)
digital submission 11 PM, Thursday November 3 (pink, orange, purple, silver)
Images (up to 10), CAD files, list of who-did-what, product contract
product variations
storyboards, circuit designs, etc.
Assembly review

Overview

10 minute presentations/discussion
Wednesday November 2 (red, green, blue, yellow)
Friday November 4 (pink, orange, purple, silver)

project your contract (or large mounted poster)

show your most current work
not a homework assignment!

can work in pairs, everyone must contribute
no make work!
avoid meaningless detail
keep working to understand user needs
keep doing tests
Professional Ethics

wait wait, don’t tell me: bluff the listener

Graph 1:
- VisualLab: 50
- Software: 30
- Eng. students less honest: 50

Graph 2:
- Count of students: 0, 1, 2, 3
- Number of students: 0, 1, 2, 3
But first…

A mini quiz

put your name on the index card

list two words you should avoid when referring a design during a critique
Product architecture

Definition

the organization or chunking of the products functional elements, and the definition of the interfaces between these elements.

functional and physical decomposition
Product architecture

Purpose

The architecture and product specifications together define the structure/framework of the product.

The architecture is an important vehicle for organizing and focusing team activities.

Chapter 10 (5th edition)
Product architectures

Two fundamental types

Modular

Integral
Product architecture 1
Hand power tools

Several different tools for same customer segment

Reverse engineering exercise
Blank piece of paper, name on top of page
Draw the circuit for the drill
Collect papers after 4 minutes
Please DO NOT look at your neighbor’s work
Product architecture 1

Hand power tools

Several different tools for same customer segment

Modular product architecture

- Modules are functionally self contained
- Component interfaces well defined
- Low packing density
- High volume, commodity elements
Product architecture 2

Hand power tools

Individual tool designed for a specific market

Integrated product architecture
components designed or adapted for the specific product
geometric or functional relationships tightly coupled
## Product architecture

**Drill performance comparisons**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Integral Modular</th>
</tr>
</thead>
<tbody>
<tr>
<td>weight</td>
<td>1.2 (2.0 with batteries)</td>
</tr>
<tr>
<td>charge time</td>
<td>0.2</td>
</tr>
<tr>
<td>power/weight</td>
<td>2.5</td>
</tr>
<tr>
<td>purchase price</td>
<td>~8-10</td>
</tr>
</tbody>
</table>
Product architecture 3

Hand power tools

Several different tools for same customer segment
Modular architecture

Advantages

Task allocation and out-sourcing

Economies of scale

Reuse/standardization for developing new products

Maintenance

Adaptation/mass customization (combinatorial design)
Integrated architectures

Advantages

**Performance**: modularity can mean performance sacrifices especially when performance is $f$(size, shape, mass)

It is easier to optimize overall system with an integrated architecture
Product architecture decision
Key role in defining what the product can be
Product architecture decision

Key role in defining what the product can be

often linked with corporate identity
Product architecture

Innovation through a new architecture

first sold in?
1998

change color and style for ‘price of evening dress’
$10,000
~1800 lb.
0-37 mph in 6 seconds, ~80 mph max.
40 mpg combined
Finally

reminders

codes of conduct (feedback 5 PM, email final to me noon Thursday)
peer review (9 PM today)

assembly 11 PM Nov. 1, (red, green, blue, yellow)
assembly 11 PM Nov. 3, (pink, orange, purple, silver)

in-class presentations Nov. 2, Nov. 4
(having design variations is a good thing)

technical review with alpha prototypes, Nov. 17
Finally

reminders

tonight, 7 PM in Pappalardo!
  mediating design decisions. SIs, Yodas, and all

Yoda workshop (8 PM in 3-434)

think about what you need work on/prepare so team can
  make a good, informed decision