2.009 Product engineering processes

a chair is to sit on

2.009 Product engineering processes
today

mockups resolve key risks
form and human use product usability, vision
customer needs know your core proposition

What's now?
workflow

Down-select
context

your team proposed how many sketch model concepts?
3A, 3B

why the section A, B thing?

rigror in breadth
(some directions will play out better than others)

what is our team’s overall product development goal?

think strategically: risk profile in investment
mix of high and low
high likelihood of successful outcome in the end

Team down-select: 6 to 4
think strategically

top tier
probably has great potential as presented,
unless many of us are missing something
(or have poor judgment)

middle tier
may or may not have good potential,
may or may not have been well understood

lower tier
probably has less potential as presented,
unless more of us are missing something or misunderstanding
(standard deviation?)

Team down-select: 6 to 4
think strategically

scenario 1:
2 top tier, 2 middle or lower tier
top + top + middle + middle
top + top + middle + lower (misunderstood)
top + top + middle/lower + new
top + top + middle/lower + new

scenario 2:
1 top tier, 3 middle or lower tier
top + middle + middle + new
top + middle + lower (misunderstood) + new
top + middle/lower + new + new
Down-select: 6 to 4

**Project success factors**
- Strong connection to user need
- Potential for impact/benefit
- Contact with users or qualified representatives of user
- Clear team vision for product
- Appropriate scope (substantive to engage/challenge team, not outrageously big)
- Understanding of technology, context
- Innovative, not inventive
- Understand market and competition
- Ability to test
- Demonstrable
- Working in Pappalardo lab, where you can get help

2.009 Product engineering processes today

**Mockups** resolve key risks
- Form and human use, product usability, vision
- Customer needs, know your core proposition

What's now?

**Textbook viewpoint**

Mockup phase

**What is a mockup?**

Engineering drawings or renderings, geometric models, spreadsheets, simulations, or physical models used to realistically resolve fundamental issues and risks associated with a concept.

Mockup phase activities

**Modeling**
- Concept development
- Physical mockups
- Needs/market analysis
- Feasibility analysis

Mockup phase decompose the problem

- Physical operation, implementation
- Engineering BLP
- Sketch model, idea sketch
- Sketch model, appearance model
- Form, human factors
- Behavioral simulation
- Alpha prototype
- Analytical, needs/experience
- Feasibility estimate interviews
Types of mockups along different axes

- Visual (renderings and appearance models)
- Ergonomic (functional human interfaces)
- Engineering BLP (functional physical models)
- Analytical (solid models, simulations, spreadsheets)

Visual mockups look like the real thing

clearly illustrate what the product will look like
evaluate customer appeal and how the product will fit into its use environment
may be used in interviews or focus groups

Ergonomic mockups

test and validate human factors decisions

Engineering BLPs

- key operational principle
- resolve key technical issues and functionality
- test components
- verify analytical models

Analytical mockups predict how the product will behave

- engineering analysis, CAD, CAE
- economic analysis

2.009 Product engineering processes today

- mockups resolve key risks
- form and human use: product usability, vision
- customer needs: know your core proposition
Eliciting key needs

**techniques**

**secondary research:**
- benchmarking

**option generation:**
- observation: every customer complication or adaptation is a potential product opportunity
- exploratory interviews: one-on-one sessions, where a respondent answers a set of pre-planned questions on a subject. The outcome is a long list of comments, some important, some not, that need to be translated into customer needs

*inappropriate:* written surveys—too little context, poor for hidden needs

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Exploratory interviews

eliciting key needs

walk me through a typical session performing a task
what do you like about existing products?
what do you dislike about existing products?
what issues would you consider when purchasing?
what improvements would you make?

Eliciting key needs

interacting with the customer

go with the flow
use props (competitive products, sketch models)
discourage technology speculation or detailed design
have customer demonstrate use whenever possible
watch carefully for unexpressed or non-verbal needs

Eliciting key needs

interacting with the customer

don’t lead users to the answer that you want!
Eliciting key needs
who should be interviewed?

the target customer or user!
look for lead users (innovators and early adopters)
people who experience needs ahead of the marketplace,
struggle with existing products, or invent their own solutions
to meet needs

Eliciting key needs
translating raw data into needs

express needs in terms of what product has to do

<table>
<thead>
<tr>
<th>guideline</th>
<th>customer data</th>
<th>need (correct)</th>
<th>need (incorrect)</th>
</tr>
</thead>
<tbody>
<tr>
<td>what, not how</td>
<td>protect batteries from accidental shorting</td>
<td>protect batteries around battery contacts*</td>
<td>cover battery contacts with sliding door</td>
</tr>
</tbody>
</table>

Eliciting key needs
translating raw data into needs

use positive statements when possible as they will be
easier to translate into specifications

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<tbody>
<tr>
<td>positive, not negative</td>
<td>it does not matter if it's wet, I still need to do my work*</td>
<td>operates normally in the rain</td>
<td>is not disabled by the rain</td>
</tr>
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Eliciting key needs
translating raw data into needs

express need with same specificity as the raw data to
avoid losing or introducing information

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<tr>
<td>same specificity</td>
<td>I drop the product all the time*</td>
<td>the product operates normally after repeated dropping</td>
<td>the product is rigged</td>
</tr>
</tbody>
</table>

Eliciting key needs
translating raw data into needs

avoid must and should, as these imply priority

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<tbody>
<tr>
<td>do not prioritize</td>
<td>I really hate it when the product dies without warning*</td>
<td>the product indicates power reserve</td>
<td>the product must indicate power reserve</td>
</tr>
</tbody>
</table>

Mockup review
Core 3-6 needs on product contract

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Design Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portable electronic device for skiing enthusiasts</td>
<td></td>
</tr>
<tr>
<td>Material: composite materials</td>
<td></td>
</tr>
<tr>
<td>Coating: epoxy, transparent</td>
<td></td>
</tr>
<tr>
<td>Length: 50 cm</td>
<td></td>
</tr>
<tr>
<td>Power: rechargeable</td>
<td></td>
</tr>
</tbody>
</table>

design attributes and specifications: Friday
2.009 Product engineering processes today

Mockups resolve key risks

Form and human use

Product usability, vision

Customer needs know your core proposition

Resolve concept

Mockup review

Define scope

Identify needs

Target needs

Analyse competition

Preliminary concepts

Sketch models

(Select concepts)

Concepts

(3-ideas)

Product vision

Form and human use

Form follows function

Form follows function, Louis Sullivan

Form and human use

Obvious articulation avoids damage

Circles, positive and negative forms imply motion

Objects separate on parting lines

Understand ergonomic needs

Form and human use

Form follows function
Form and human use
form follows function

direct metaphors in interfaces are better
understand color associations

Form and human use
form follows function
avoid mixed messages, arbitrary details

Form and human use
form follows function
black recedes, conceals

Form and human use
form follows function
smooth invites touching
don't touch nasty bits

Form and human use
form follows function
communicate key attributes

Form and human use
form follows function
think about possible misuse
And finally, wrap up

**odds and ends**

think ahead to the next milestone: Thursday, Oct 22

staff feedback is compiled online

peer review 1, team review A due 9 PM Wed!

notebooks this week in lab, digital Thursday PM

read chapter 18 for Wednesday