2.009 Product engineering processes

a chair is to sit on
What’s now? workflow

Three ideas presentation
September 23, during class
3 ideas per section

Sketch model review
October 3
3 models per section

Mockup review
October 17
2 mockups per section

Final selection
October 22-24
1 concept per team

Assembly review
Oct. 30 & Nov. 1
1 assembly

Technical review
November 14
1 (almost) prototype

Final presentation
December 9
1 alpha prototype
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

more detail
you MUST focus on the hard parts, not everything

need + product vision
product cost: how much can it be? is it doable?
Workflow

Each stage builds on prior effort.

Homework

For real

100%
Team down-select: 6 to 4
review ranking data

let’s look at a top tier
Team down-select: 6 to 4
review ranking data

what does this actually mean?
Team down-select: 6 to 4
what does it mean?

**top tier**
perhaps has good potential as understood, unless many of us are missing something or misunderstood

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

**lower tier**
probably has less potential as understood, unless many of us are missing something or misunderstood
Team down-select: 6 to 4
review ranking data

upper tier seems good! but…

a good sketch model phase can tell you an opportunity should not be highly ranked!

think carefully about your written feedback
don’t keep working on something that you are confident does not have potential: keep searching! (implementation or opportunity?)
why raise the bar?

Anders Haggman, Doctoral Candidate
Professor Maria Yang
Team down-select: 6 to 4
only continue on what you believe in!

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 + middle + 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

the only scenario I don’t recommend:
new + new + new + new
Team down-select: 6 to 4

project success factors

strong connection to user need (how real is it?)
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 or small)
understanding of technology, context
innovative, not inventive
understand market and competition
ability to test
demonstrable
working in Pappalardo lab, where you can get help
Team down-select: 6 to 4

project success factors

FNAP

facts, not assertions please!

the action of stating something or exercising authority confidently and forcefully.
Team down-select: 6 to 4
mix and match!
a chair is to sit on
Mockup phase
Petra, 2.009 2015
Mockup phase

Rhino, 2.009 2017
Mockup phase
Otto, 2.009 2014
Mockup phase

decompose the problem

user (vision, need, usability)

operational principles (technical and business)

feasibility estimate

behavioral simulation

functional sketch model

alpha prototype

engineering BLP

form sketch model

idea sketch

UI model

user 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

you need to have this!
Ergonomic mockups test and validate human factors decisions
Analytical mockups predict how the product will behave

engineering analysis, CAD, CAE

economic analysis
Engineering BLPs
key operational principle

resolve key technical issues and functionality

test components

verify analytical models
2.009 Product engineering processes today

mockups resolve key risks

customer needs know your core proposition
Process
textbook viewpoint

1. define scope
2. identify needs
3. analyze competition
   (3-ideas)
4. target needs
5. preliminary concepts
   (sketch models)
6. solve key risks
7. resolve concepts
   (mockup)
8. refine needs
9. preliminary contract
   (select concepts)
Needs and contract

mockup review

define scope → identify needs → target needs → preliminary concepts → solve risks → resolve concepts

(3-ideas) → analyze competition → (sketch models) → (select concepts) → (mockup)

refine needs
preliminary contract
# Product contract

**guiding document for key needs, core value proposition**

**Product Description**: Portable electric device for lifting automobiles

**Intended Customer**: Back yard mechanics

**Market**: Automotive accessories

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<th>Engineering Specifications</th>
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Eliciting key needs

techniques

secondary research:
benchmarking

option generation:
observation: every customer compensation 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

inappropriate: written surveys—too little context, poor for hidden needs
Exploratory interviews
interacting with potential users

with a problem in mind …

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 potential users

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

don’t lead users to the answer that you want!

how do you like MY idea?
empathizing with users and user centric design
Eliciting key needs

OK, so I’ve talked to potential users

Now what?

you have a long list of comments, some important, some not, that need to be translated into customer needs
Eliciting key needs
translating raw data into needs

cluster customer statements into themes
Eliciting key needs
translating raw data into needs

express needs in terms of what product has to do

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translating raw data into needs

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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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translating raw data into needs

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

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<td>is not disabled by the rain</td>
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## Mockup review

### Core 3-6 needs on product contract

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Mockup review

**design attributes and specifications**

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**Wednesday**

it could get a bit messy!
But first …

odds and ends

staff feedback for sketch models is compiled online

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

notebooks this week in lab, digital Thursday PM

if you realign your sections, please let me know!

user-centric, empathetic design: Thursday at 7 PM