2.009 Product engineering processes

iteration is the autobahn to improvement
Safety

your product, yourself, your team

inherent part of a product’s design. Not an add on (like product architecture, usability, product form)

stop if you are too tired, stressed, distracted, feeling unwell, or have skipped meals

ask if you are unsure…

if you see something you are uneasy about…
winners of the contest:
safety at work...
5th place
4th place
3rd place
2nd place
and the winner...
A look ahead

upcoming items

user feedback tutorial: 5 PM today in Pappalardo

costing tutorial: 7 PM tonight Pappalardo south conference, 2 people per team

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ID consultations Thursday 6-10 PM. Team area. 30 minute sessions—see schedule on website

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35-307 available for off hours work

notebooks are submitted this week
2.009 Product engineering processes today

technical review pointers

debugging a systematic approach to the art
Alpha prototype definition

the ‘first’ design model that:
functions like the manufactured product
looks and feels like the manufactured product
made of materials similar to manufactured product
is manufactured differently than product
Alpha prototype

the “first” complete prototype: looks right, works right

your first version of the alpha prototype will not work well

technical review is November 16

typically, teams redesign and rebuild before final
    (you must get close enough to know what the issues are)
Alpha prototype
the “first” complete prototype: looks right, works right

some working well

is better than a lot of not much
Technical review
how to think about it?

all show, no tell
be prepared to let reviewers use the prototype
Technical review in 7 days...

examples

work in parallel
keep meetings short
communicate
design, don’t hack
ask
enjoy engineering
Technical review

**intent**

demonstrate/test functional alpha prototype and discuss remaining areas for improvement

assess operation of the product in relation to the product contract

assess the prototype from many viewpoints and prioritize areas for improvement
Technical review

focus

operation

meets contract
ease of use
robustness
quality of experience (sounds good, feels good)
safety

details

mechanical design
interface/human factors
form and aesthetics
electronics design
system integration
assembly and manufacturability
prototype execution
And now…
the principle of Pragnanz is?

“you see the unseen if the structure allows it”
“don’t miss class”

we will make the simplest interpretation of visual information
(lowest information content)
making products understandable and predictable
And now...
4 steps in a structured form-giving process
comprehensible and coherent
Design for manual assembly

remember that?
and now...

a design-for-assembly quiz

analyze the platen lift assembly and answer the questions on the handout

no talking or sharing answers

read the instructions, but don’t look at assembly (on back) until instructed

get as much done as you can in 7 minutes
Debugging
a systematic approach

if it is not tested
it does not work
Debugging

testing plan:
  have one, and document it
design testing plan as you design the system/subsystem specs.
test incrementally
work with a buddy
ask if you have concerns
Debugging

seeing:
expect the unexpected
Debugging process  
(fault diagnostics)

wishing will not make a fault go away

symptoms that mysteriously disappear are not problems solved

debugging requires careful systematic thinking, tackling probable causes in a strategic order

**goal:** a 5 step process to follow when trying to diagnose and fix a problem
Debugging

step 1

when something goes wrong …

stop, observe, and think

document the circumstances
  how was the device being used leading to the failure?
  who observed the problem?
  had something been changed?
  describe the environmental circumstances
  describe the faulty behavior
  What, When, Where, How big?

form a clear symptom statement (object—defect form)
Debugging

example symptom statement

object—defect

Good

the product made a popping sound, emitted a flash of light and smoke

Bad

the product shorted out
identify and recruit the people needed to solve the problem

who are the best people to tackle the problem? Are you the right person? System integrators should be able to help in this process

provide your detailed notes and symptom statement to the individual or task force that will address the problem (team site)

don’t be afraid to think about it
Debugging
step 3

carefully review data and develop an interim plan

- are the initial data sufficient to localize the problem?
  If no, gather more information (often through careful exploration and observation)
  - is a new drawing/diagram needed?
  - is there too much clutter to observe the problem?

- can the problem be isolated or provisions be made so that other team members can continue to work?
- what else needs to happen?
Debugging

step 4

define and verify possible causes

develop hypotheses about what is causing the problem

carefully evaluate each hypothesis against the existing data. Eliminate improbable causes

prioritize remaining probable cause hypotheses, trading off ease of verification with confidence in hypothesis

systematically test each hypothesis by isolating its probable cause and performing appropriate experiments or measurements
Debugging

step 4

remember

there may be more than one cause behind the defect!
Debugging

step 5

once the cause has been identified…

- generate ideas for *permanent* correction of the problem
- select most promising solution and, if appropriate, perform simple sketch model or mockup level tests to verify that it will work
- implement the solution
- carefully verify that the solution has eliminated the fault. Be sure that tests emulate the initial failure conditions
Debugging

step 6

inform team members that the fault has been corrected, summarizing the fault (object—defect), the cause(s), and the solution(s).
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