2.009 Product engineering processes

you are capable, competent, creative, careful. *prove it.*

fortune cookie
2.009 staff meeting
2.009 Product engineering processes today

debugging a systematic approach to the art
A look ahead

upcoming items

Yoda workshop: 10 PM today in Pappa

ID consultations: Thursday 6:30-10:30 PM in team area. 30 minute sessions. See schedule on website

designing to excite users: Thursday 7 PM in Pappa
Extra shop hours this week

Wednesday 6-9 PM (full shop)

Thursday 6:30-10 PM (team area)

Friday 9-5 PM (full shop, dog day)

Saturday 10-5 PM (team area)
Design for manual assembly

remember that?

too busy sneezing to write them all!
make toast the right orientation

![Bar chart showing the number of students for design considerations.](chart.png)
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 please 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 diagnosing and fixing a problem while working in a large team
Debugging
step 1

when something goes wrong …

stop, observe, and think

document the circumstances

how was the device being used?
who observed the problem?
had something been changed?
describe the 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
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
Debugging

step 2

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…
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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