the bad news is time flies
the good news is that you’re the pilot

Michael Altshuler
2.009 Product engineering processes today

time estimation resource budgeting
scheduling project management—you’re about to grow!
but first ...
list the 4 components of a specification

$m + u + v + o$

“o is for OMG”
Mockup review
concept names and presentation order within section

let me know concepts name and order by 9 PM Wednesday (that’s tonight!)
Mockup review

demonstration location (Pappalardo portion)

Red A: StepBAC, Stylists (team area)
Red B: Blink, Dante (controls lab 3-062)
Green A: Chair winch, Spuree (team area)
Green B: Tact-eye, Stair-climbing walker (stairs, south foyer)
Silver A: Silent shout, Catalyst (team area)
Silver B: FireFeel, Magnetar (welding area)
Blue A: Smooth Talker, Thermoglove (conference room south, lab end)
Blue B: Safe Ryde, SmartCan/Passenger (stairs, north foyer)
Yellow A: Aqualens, Survivor (team area)
Yellow B: Beacon, Breathable (Killian court)
Pink A: AirSpace, EarWave (conference room south, elevator end)
Pink B: Grab, Coda (team area)
Orange A: Mason frame, CareFresh (parking lot, south end, compressor)
Orange B: B-lit, B-quenched (team area)
Purple A: Nyx, Handcuffs (controls lab 3-062, cot)
Purple B: Animo, fun gloves (team area)
Time estimation

Origami experiment

put your name and time estimate on the handout
do not look at the back side of the page!
Time estimation
Origami ball experiment

put your name and time estimate on the handout
do not look at the back side of the page!

when I start timer, turn over the handout
make the ball, work independently
record your actual time (no fudging please)
go to course website
enter and submit data
hand in paper estimate
Time estimation

Experiment results
Time estimation

Take-home message

task time estimate = expected time x multiplier

multiplier $f$ (familiarity, complexity, process uncertainty)
Time estimation

Visual model: 9 hours
Time estimation

Preliminary solid model: 6 hours
Time estimation

Sketch model: 2.5 hours
Time estimation

String dynamometer: 20 hours
Time estimation

Robot rabbit mockup: 30 hours

1953

1962

space program mercury 1958-63
Electric scooter

Electric scooter prototype: 110 hours fabrication + lead time

all examples: fabrication time only!
Project scheduling

Step 1: task list and milestones

by project (course/program)
Project scheduling
Step 1: task list and milestones

by project (course/program)
by development phase/concept (system integrators)

<table>
<thead>
<tr>
<th>Mockup tasks</th>
<th>Estimated time</th>
</tr>
</thead>
<tbody>
<tr>
<td>refine needs</td>
<td>2 days</td>
</tr>
<tr>
<td>refine benchmarking</td>
<td>1 day</td>
</tr>
<tr>
<td>refine concept</td>
<td>6 days</td>
</tr>
<tr>
<td>refine attributes</td>
<td>1 day</td>
</tr>
<tr>
<td>preliminary contract</td>
<td>1 day</td>
</tr>
<tr>
<td>resolve risk 1</td>
<td>6 days</td>
</tr>
<tr>
<td>resolve risk 2</td>
<td>6 days</td>
</tr>
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</table>

why 6 days?
total: **23 days**

<table>
<thead>
<tr>
<th>Milestones</th>
<th></th>
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<tbody>
<tr>
<td>team review</td>
<td>Oct. 18</td>
</tr>
<tr>
<td>mockup review</td>
<td>Oct. 19</td>
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</tbody>
</table>

time to review: **6 days**
Project scheduling
Step 2: task sequencing

sequential

refine concept → resolve risk 1

parallel

refine concept

resolve risk 1

together

refine concept

resolve risk 1
## Project scheduling

**Step 2: sequence based upon interdependencies**

<table>
<thead>
<tr>
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<th>refine needs</th>
<th>refine benchmarking</th>
<th>refine attributes</th>
<th>refine contract</th>
<th>refine concept</th>
<th>resolve risk 1</th>
<th>resolve risk 2</th>
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</tbody>
</table>

need info (row)  
provide info (col.)
Project scheduling

Step 3: Visualization

Gantt charts (tasks, resources, milestones)
Project scheduling

Step 3: Visualization

Critical path
Pert charts (program evaluation and review technique)
Project scheduling
managing a deadline crunch

- start early
- manage/change deliverable scope
- freeze decisions based on timeline
- increase work load
- outsource or engage additional resources

reallocate resources to critical path
(eliminate secondary items)

eliminate parts of critical path
Scheduling

Step 1: task list and milestones

by project

by milestone/concept

by sub-problem: risk 1 (weekly task forces)

<table>
<thead>
<tr>
<th>Risk 1 tasks</th>
<th>Estimated time</th>
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<tbody>
<tr>
<td>brainstorm options</td>
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<tr>
<td>develop options</td>
<td>1 days</td>
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<tr>
<td>analyze options</td>
<td>1/2 day</td>
</tr>
<tr>
<td>design mockup</td>
<td>1 day</td>
</tr>
<tr>
<td>build mockup/test bed</td>
<td>2 1/2 days</td>
</tr>
<tr>
<td>run experiment and document</td>
<td>1 days</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Milestones</th>
<th></th>
</tr>
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<tbody>
<tr>
<td>task force progress review</td>
<td>Oct. 17</td>
</tr>
<tr>
<td>team review</td>
<td>Oct. 18</td>
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</table>
Section schedule preparation
Gantt charts starting after the mockup review!

key milestones
list tasks and estimate completion times
sequence tasks based upon dependencies
allocate resources and draft a Gantt chart

draw Gantt chart on team white board!
Wrap up
miscellaneous items

Gantt chart software linked on home page

Send email with concept names and order 9 PM tonight!

Mockup logistics online will be updated with venues