Building Software Large and Small

Notes from the Field

Dennis Lee

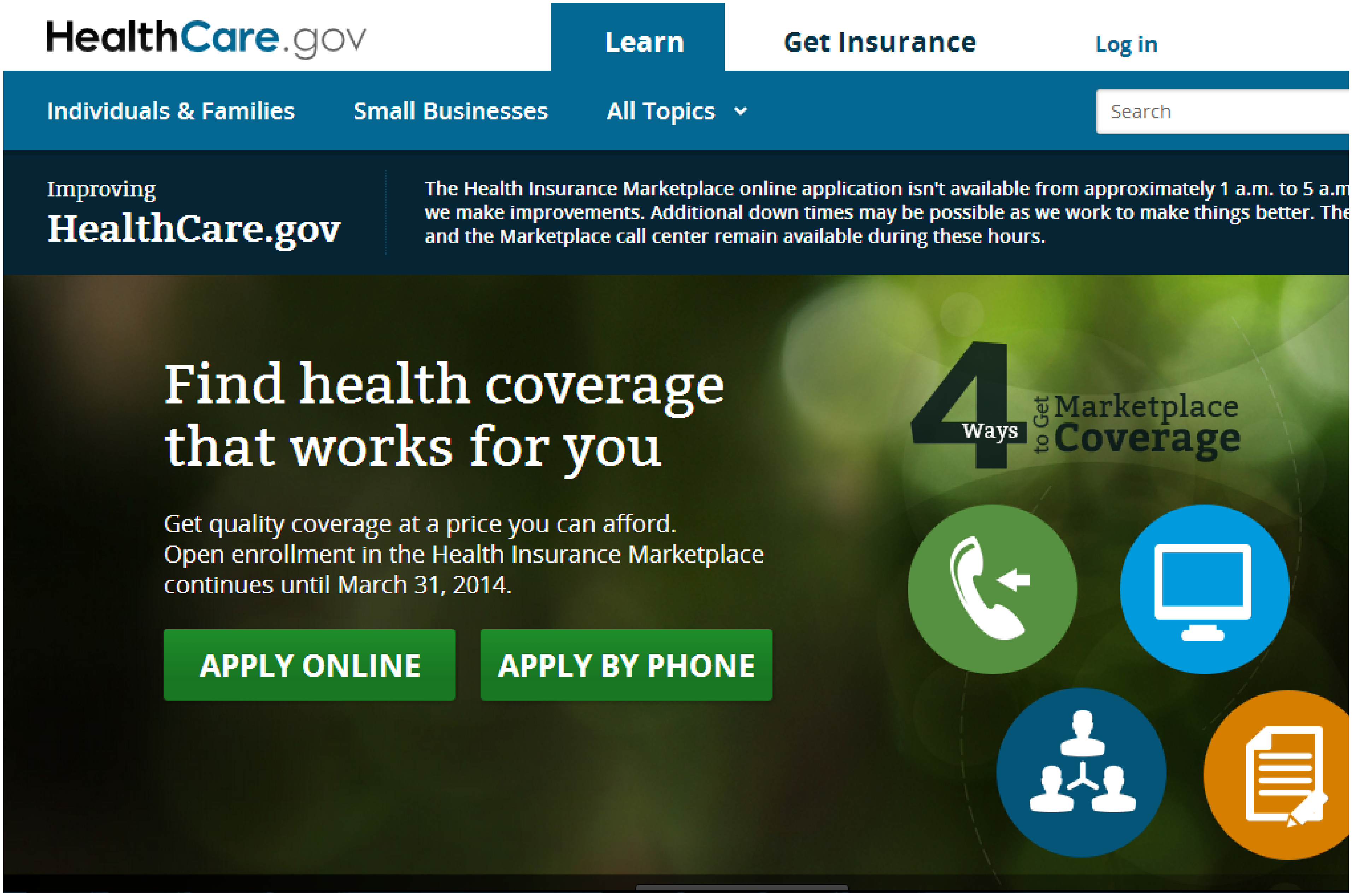
About Me

- Grew up in Philippines
- Cornell University – 1992
- University of Washington – 1999
- Amazon.com – 1999-2006/ 2008-now
- Marchex – 2006-2008
- In China – 2010 – 2013
- Kindle Bookstore - today

My experience at Amazon

- Supply Chain systems (2.5 years)
- Website Merchandising (1.5 years)
- Website Operations (2 years)
- Grocery Delivery Logistics (1.5 years)
- Amazon China Website (3 years)
- Kindle (current)

Software Design Process Fails



Improving HealthCare.gov

The Health Insurance Marketplace online application isn't available from approximately 1 a.m. to 5 a.m
we make improvements. Additional down times may be possible as we work to make things better. The
and the Marketplace call center remain available during these hours.

Find health coverage that works for you

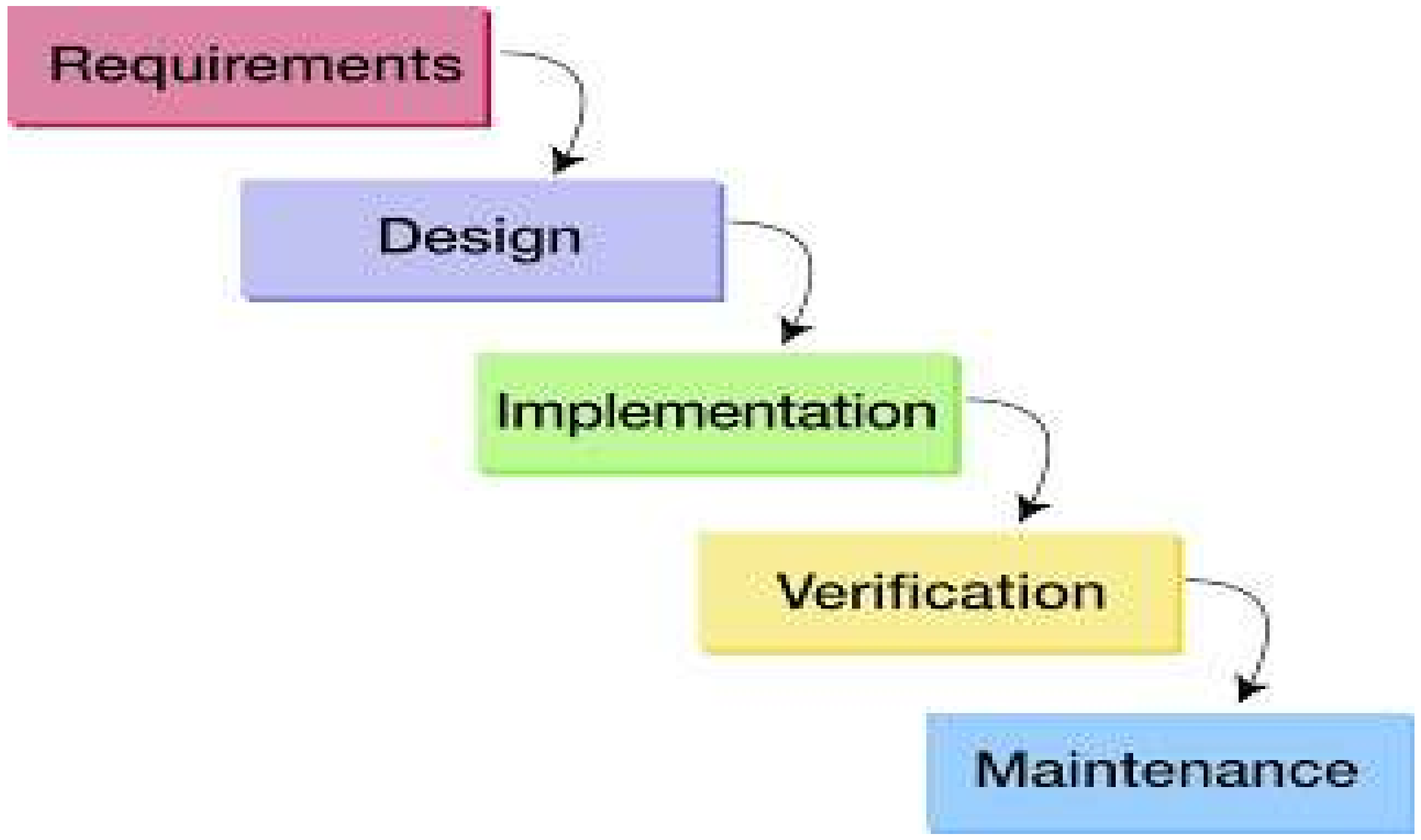
Get quality coverage at a price you can afford. Open enrollment in the Health Insurance Marketplace continues until March 31, 2014.

Theory vs. Practice

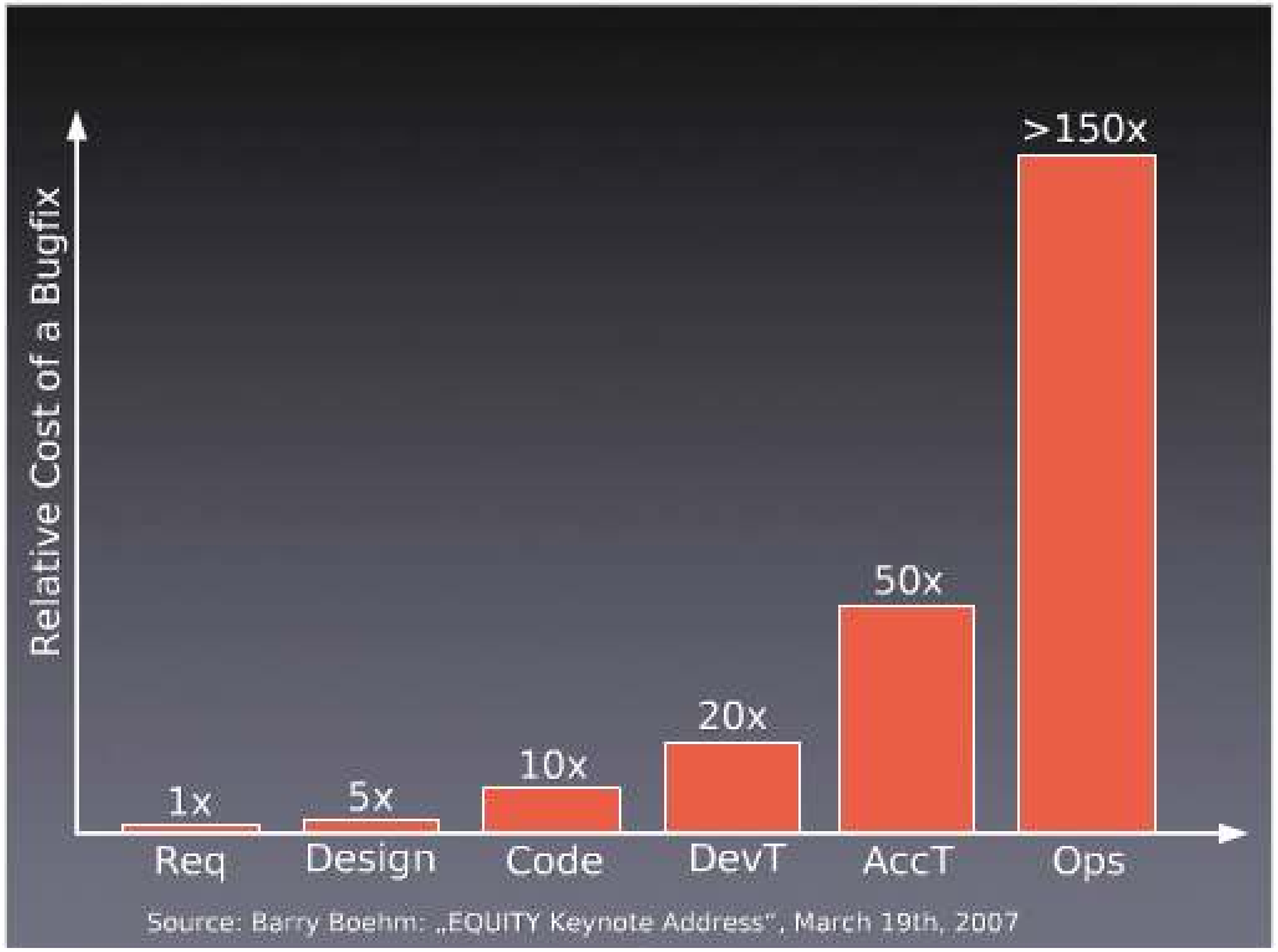
- Theory –
  - Agile – incremental delivery, people over process
  - Waterfall = BAD
- Practice
  - Multi-year projects, Gantt charts, “sprints”, unhappy customers --- effectively waterfall
- Why?

Goal of Software Process

- Deliver an agreed upon working piece of software to the customer at an agreed upon time.



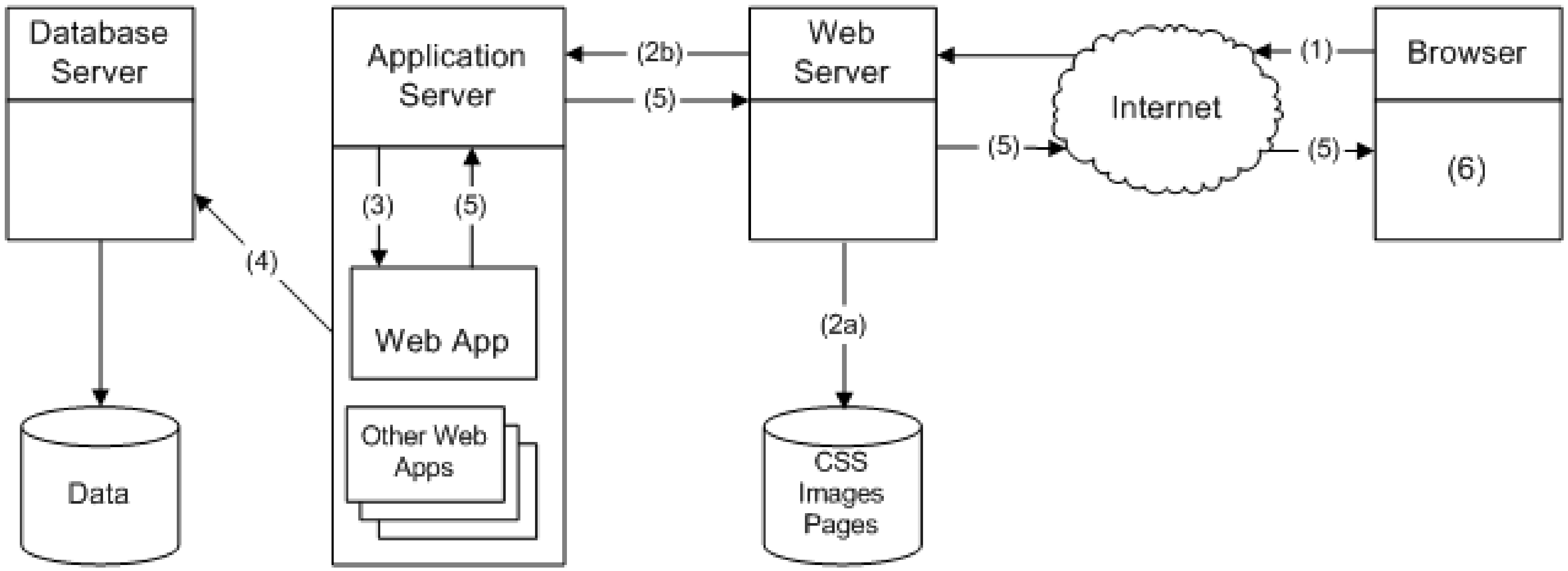
Relative Cost of Bug Fixes



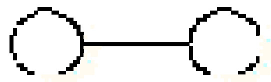
Process

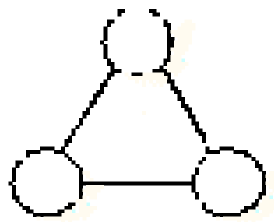
- Goal: Deliver an agreed upon working piece of software to the customer at an agreed upon time.
- Observations:
  - *Bugs found earlier in the development process are less costly to fix*
- Solution:
  - *Invest more earlier in the process to get it right*

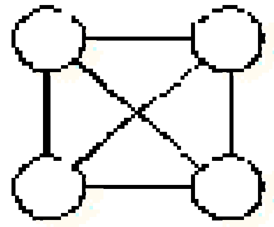
Web Application Architecture

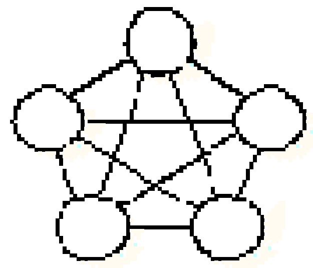


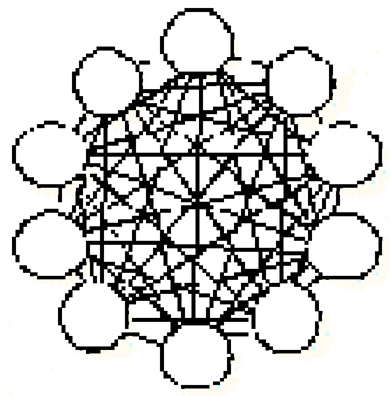
Communication Gets Expensive


Communication paths with two programmers
1


Communication paths with three programmers
3


Communication paths with four programmers
6


Communication paths with five programmers
10


Communication paths with ten programmers
45

Process

- Goal: Deliver an agreed upon working piece of software to the customer at an agreed upon time.
- Observations:
  - Bugs found earlier in the development process are less costly to fix
  - *Different pieces of the system require different skillsets*
  - *Communication is expensive*
- Solution:
  - Invest more earlier in the process to get it right
  - *Break problem into sub-systems and defer having teams talk until needed*

Learning from Mistakes

- Typical System – built quickly to meet pressing need. No time to […]. Just get it out.
- Typical Issues:
  - Doesn’t scale
  - Isn’t flexible enough
  - Design is ugly

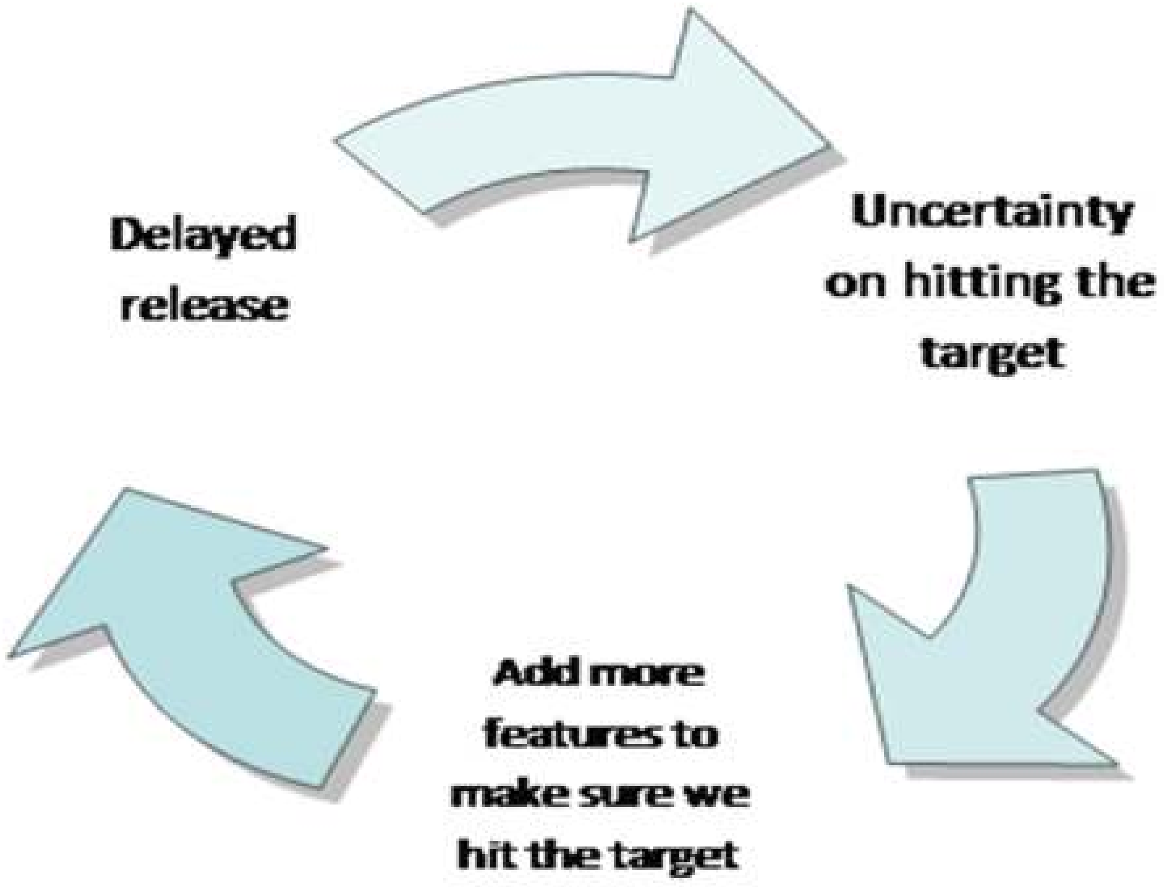
Process

- Goal: Deliver an agreed upon working piece of software to the customer at an agreed upon time.
- Observations:
  - Bugs found earlier in the development process are less costly to fix
  - Different pieces of the system require different skillsets
  - Communication is expensive
  - *Large amount of time is spent to retrofit systems for scalability, flexibility and poorly designed*
- Solution:
  - Invest more earlier in the process to get it right
  - Break problem into sub-systems and defer having teams talk until needed
  - *Design scalability, flexibility, security, testability, etc. into the system up-front*

My First Intern’s Project

- Goal: system to kill the buy box on an item in real time
- Schedule (12 week internship):
  - Ramp up (2 weeks)
  - Build Database (2 weeks)
  - Build Service (3 weeks)
  - Build UI (3 weeks)
  - Integrate and Test (2 weeks)
- What really happens:
  - Things took more time
  - By the end of the internship – everything was “done”– but still need to integrate and Test

Vicious Cycle


Delayed release
Uncertainty on hitting the target
Add more features to make sure we hit the target

Delivering Value

- Value is judged by Customers when they try out the product
- We are likely building the wrong product
- Everything Changes

Summary: No one can predict the future

Process

- Goal: Deliver an agreed upon working piece of software to the customer at an agreed upon time.
- Observations:
  - Bugs found earlier in the development process are less costly to fix
  - Different pieces of the system require different skillsets
  - Communication is expensive
  - Large amount of time is spent to retrofit systems for scalability, flexibility and poorly designed
  - *Integration is non-trivial*
  - *No one can predict the future*
- Solution:
  - Invest more earlier in the process to get it right
  - Break problem into sub-systems and defer having teams talk until needed
  - Design scalability, flexibility, security, testability, etc. into the system up-front
  - *????*

Modified Solution

- ~~Invest more earlier in the process to get it right~~
- ➢ *Deliver value to the customer as early as possible*
- ~~Break problem into independent pieces and defer having the teams talk until needed~~
- ➢ *Invest in cross functional teams that can execute on all levels of the stack*
- ~~Design scalability, flexibility, security, maintainability, testability, etc. into the system up-front~~
- ➢ *Accept that these are "problems from success"*
- ➢ *Invest to make retrofitting as cheap as possible – Quality*

Modified Goal

- ~~Deliver an agreed upon working piece of software to the customer at an agreed upon time~~

- Deliver Value to Customers as quickly as possible

Keeping software quality high

- Code in repository is “ready-to-deploy” all-the-time
- Constantly write new tests and modify tests to adapt.
- Estimated test and refactor tax: 50% of dev time
- Major production issues always have a post-mortem:
  - Always ask – could we have caught this in test?
  - Tests are written
  - Monitoring is updated
- Dedicated people to work on defects
- Interrupt stories if we have a bad quality week
- Infrastructure projects are scheduled with other stories

In Practice – My Teams

- Minimize formal specs
- Deliver often
- Customer focus
- Minimize Work-in-progress
- Lots of experimentation
- Keep the code clean and well tested

Case Study

amazon fresh
HOME GROCERY DELIVERY and much more!
amazonfresh.com

Amazon Fresh Picking Rewrite

- Goal: Improve Efficiency of Picking
- Requirements going in:
  - Gather weight and dimension data for all items
  - Virtually pack items into totes
  - Weigh the tote to check for picking errors
  - Scan check picking supplies (e.g., ice packs)

What did we do?

- Gather weight and dimension data for all items – Yes

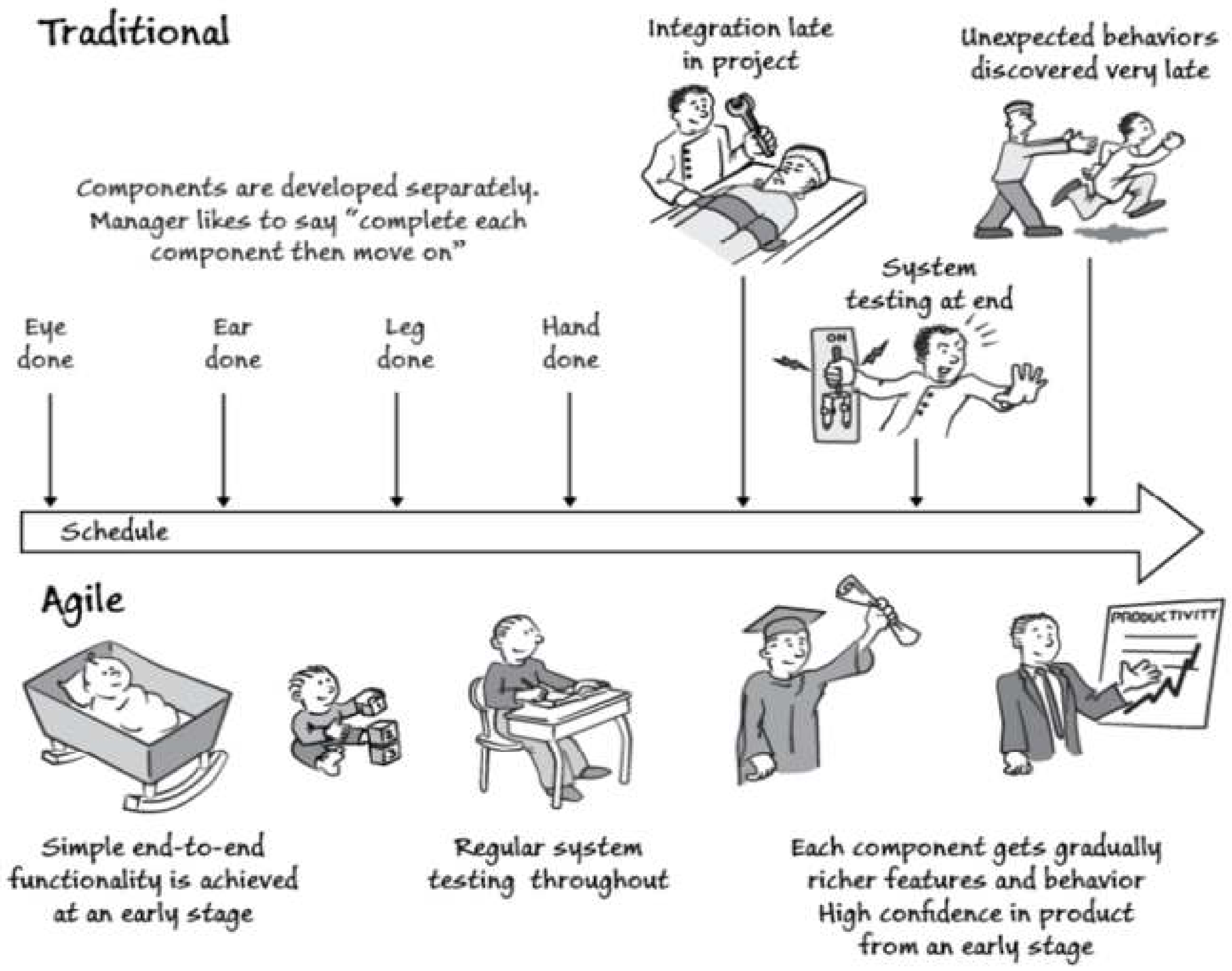
- Virtually pack items into totes - Yes – but…
- Weigh the tote to check for picking errors - No
- Scan check picking supplies (e.g., ice packs) - No

Summary

- Deliver Often
- Limit Work-in-Progress
- Stay in touch with your customers
- Keep Code Clean and Testable

Open Question

- Testing/Verification – can we make it much easier and more natural?
  - Proof systems are a start but it’s still hard to specify
  - Nothing “nags” at you – it’s too easy not to do
  - It still takes too much discipline and “try harder”


Traditional
Components are developed separately. Manager likes to say "complete each component then move on"
Integration late in project
Unexpected behaviors discovered very late
System testing at end
ON
Eye done
Ear done
Leg done
Hand done
Schedule
Agile
PRODUCTIVITY
Simple end-to-end functionality is achieved at an early stage
Regular system testing throughout
Each component gets gradually richer features and behavior High confidence in product from an early stage

from: http://msdn.microsoft.com/en-us/library/jj159336.aspx

Questions?

Contact: dennisl@amazon.com