

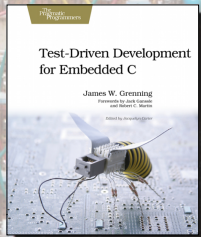


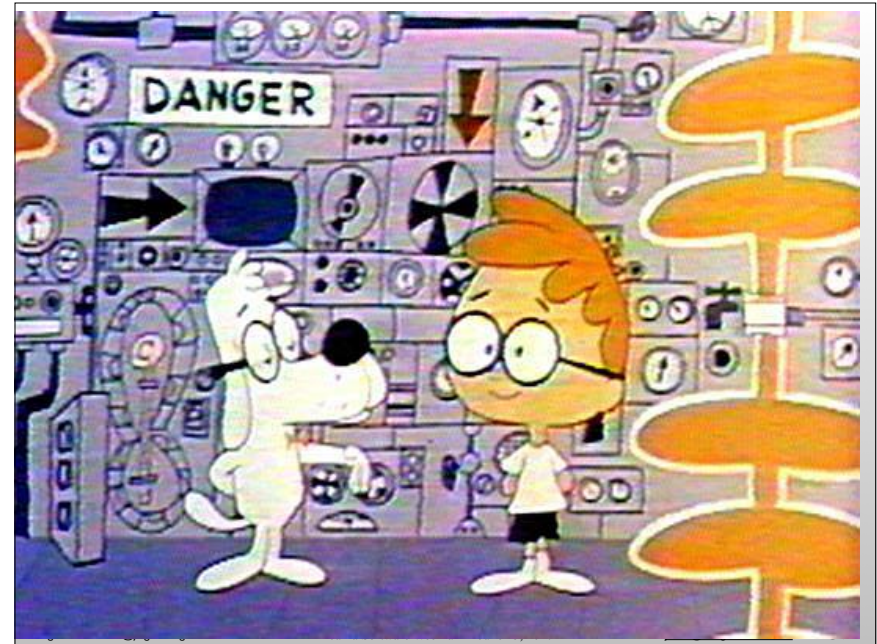
# Agile for Embedded Overview and Pitfalls

James W Grenning  
[wingman-sw.com](http://wingman-sw.com)  
[@jwgrenning](https://twitter.com/jwgrenning)  
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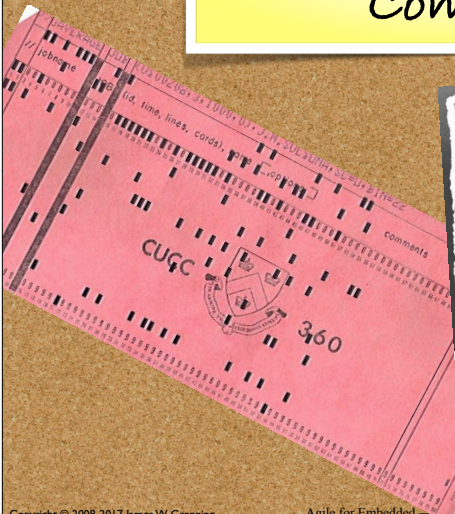


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## I Tried to Avoid Computers

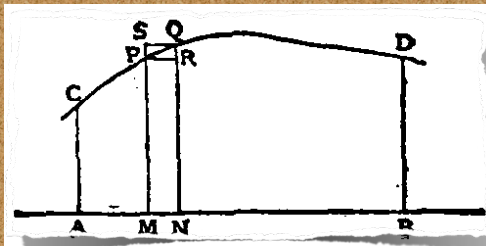


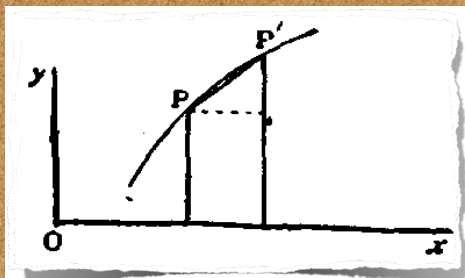



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People will pay me  
to do this?!!

intel.

## 8251A PROGRAMMABLE COMMUNICATION INTERFACE

- Synchronous and Asynchronous Operation
- Synchronous 5-8 Bit Characters; Internal or External Character Synchronization; Automatic Sync Insertion
- Asynchronous 5-8 Bit Characters; Clock Rate—1, 16 or 64 Times Baud Rate; Break Character Generation; 1, 1½, or 2 Stop Bits; False Start Bit Detection; Automatic Break Detect and Handling
- Synchronous Baud Rate—DC to 64K Baud
- Asynchronous Baud Rate—DC to 19.2K Baud
- Full-Duplex, Double-Buffered Transmitter and Receiver
- Error Detection—Parity, Overrun and Framing
- Compatible with an Extended Range of Intel Microprocessors
- 28-Pin DIP Package
- All Inputs and Outputs are TTL Compatible
- Available in EXPRESS and Military Versions

The Intel® 8251A is the industry standard Universal Synchronous/Asynchronous Receiver/Transmitter (USART), designed for data communications with Intel's microprocessor families such as MCS-48, 80, 85, and iAPX-86, 88. The 8251A is used as a peripheral device and is programmed by the CPU to operate using virtually any serial data transmission technique presently in use (including IBM "bi-sync"). The USART accepts data characters from the CPU in parallel format and then converts them into a continuous serial data stream for transmission. Simultaneously, it can receive serial data streams and convert them into parallel data characters for the CPU. The USART will signal the CPU whenever it can accept a new character for transmission or whenever it has received a character for the CPU. The CPU can read the complete status of the USART at any time. These include data, transmission errors and control signals such as SYNCDET, TXEMPTY. The chip is fabricated using Intel's high performance HMOS technology.

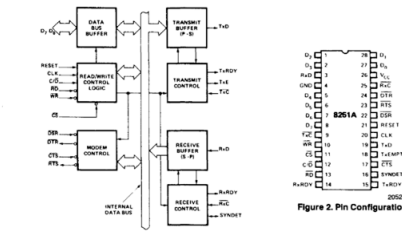
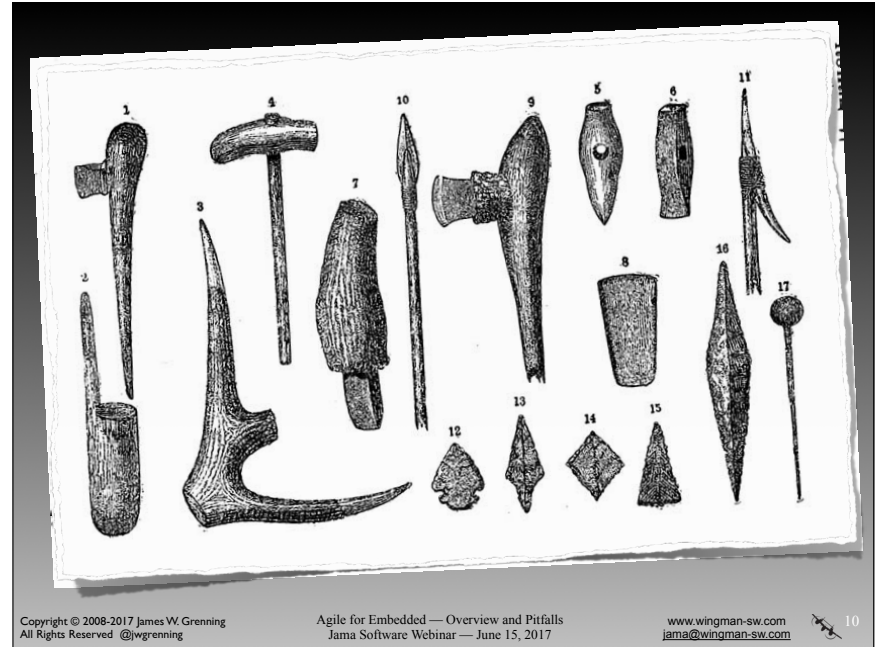


Figure 2. Pin Configuration





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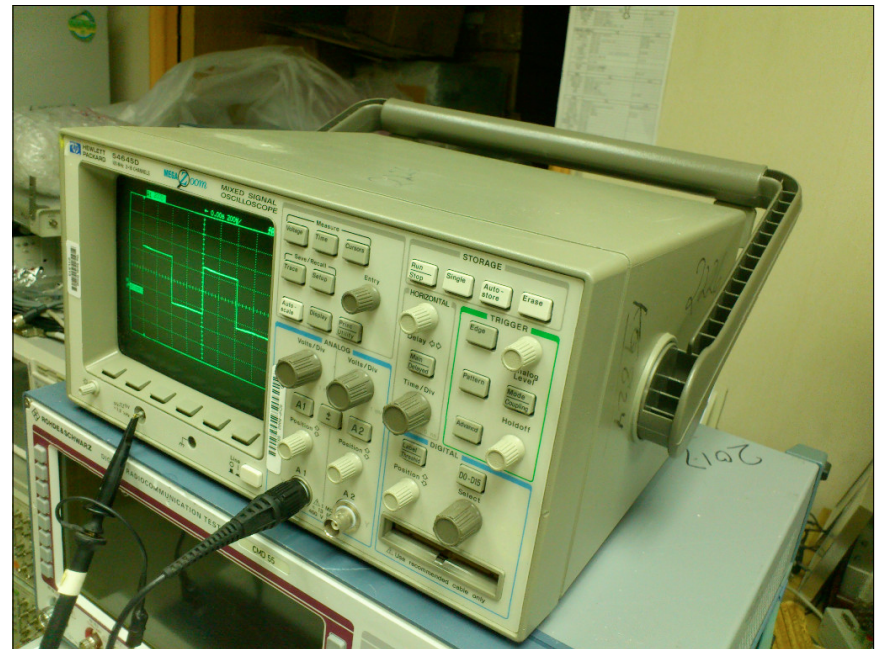
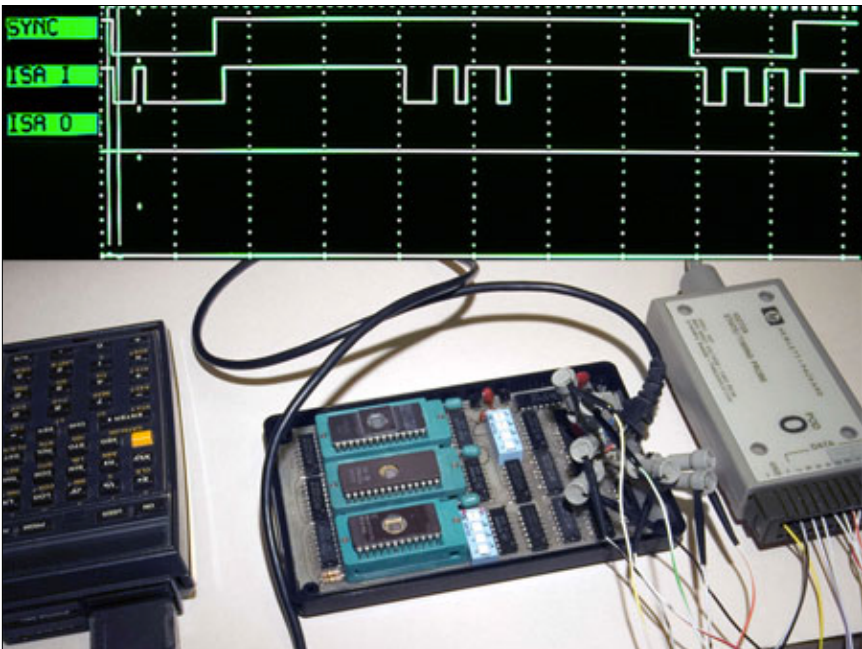


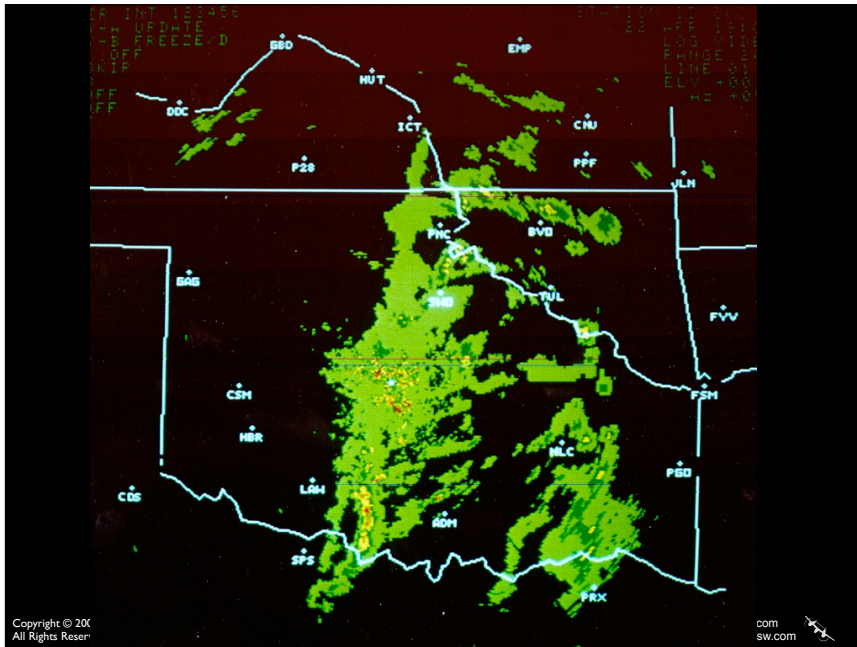
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## My Roots in Agile

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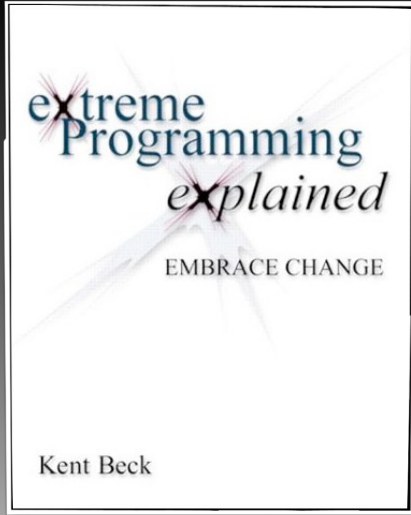
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Kent Beck




Kent Beck



Ron Jeffries



Ward Cunningham



Martin Fowler

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## How Did I Find Myself at Agile Manifesto Meeting?



James, do you want to go to the Lightweight Methods Summit in Snowbird?



Sure Bob, I'll go....



Skiing!

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Did that work?

The industry suffered from defects, delays and frustration.

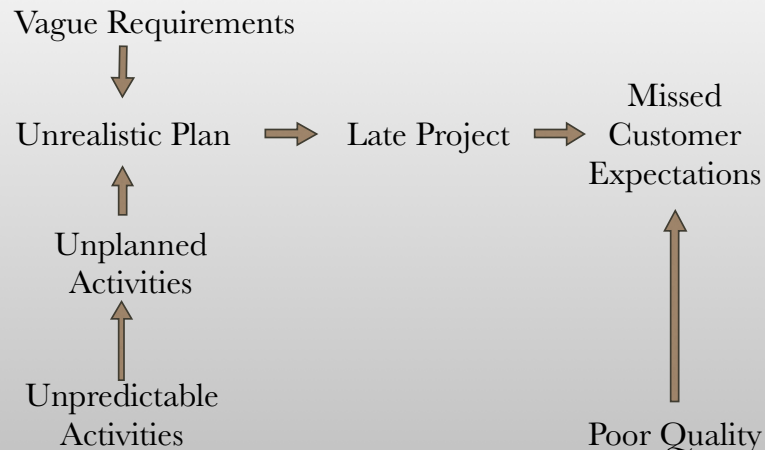
## Manifesto for Agile Software Development

We are uncovering better ways of developing software by doing it and helping others do it.  
Through this work we have come to value:

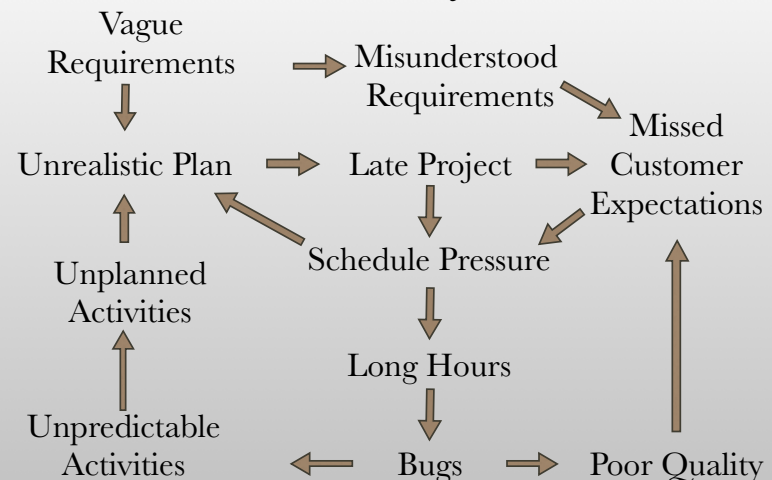
Individuals and interactions over processes and tools  
Working software over comprehensive documentation  
Customer collaboration over contract negotiation  
Responding to change over following a plan

That is, while there is value in the items on the right, we value the items on the left more.

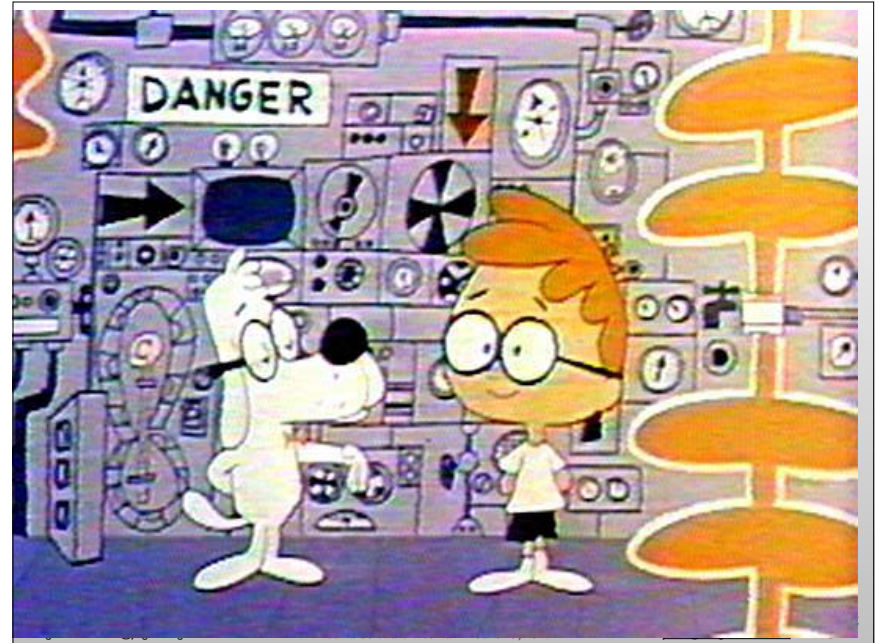
## We Make Our Problems



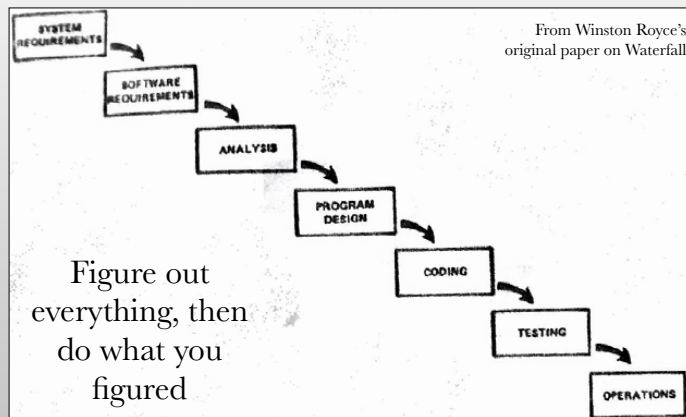
## Positive Feedback Unstable System



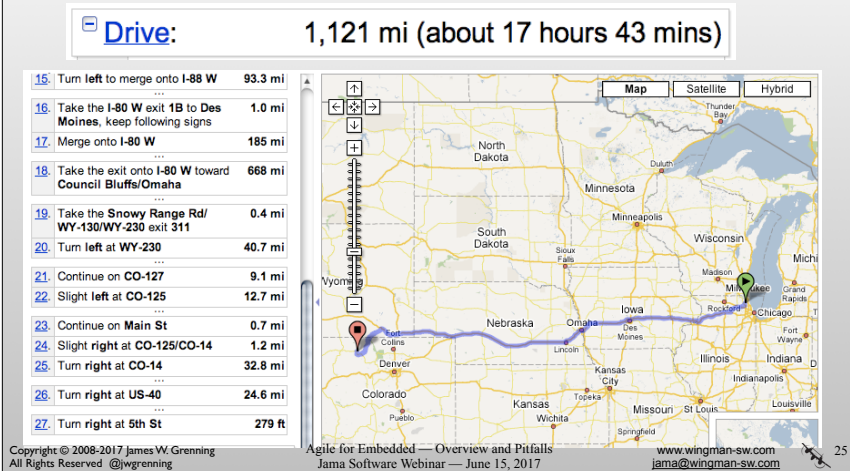
## Agile is Designed to Help Break this Vicious Cycle



## Can Projects be Managed Better?

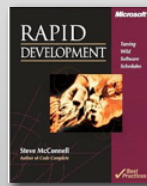


## Figure it All Out, Then Do It



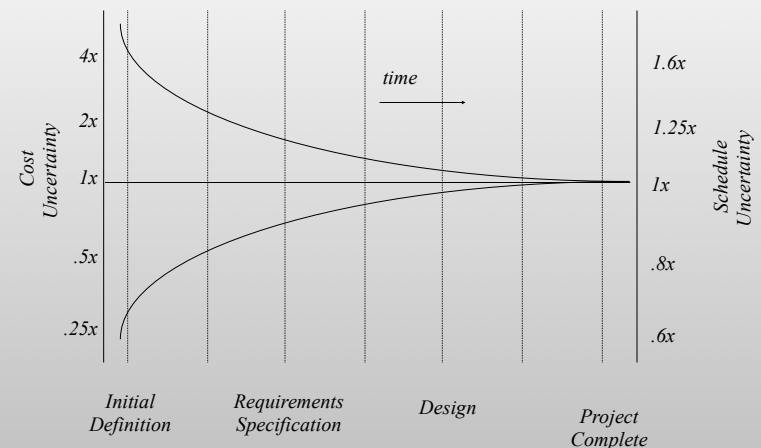
## Steve McConnell from Rapid Development

*“Software projects contain too many variables to be able to set schedules with 100-percent accuracy. Far from having one particular date when a project would finish, for any given project there is a range of completion dates, of which some are more likely and some are less.”*



## Project Cost and Schedule Uncertainty

Barry Boehm, 1995



# What is Agile?

Can we get features and functionality to flow?

## What is Agile?

- *Agile software development is a conceptual framework for undertaking software engineering projects.*

-- wikipedia

- a.k.a. Extreme Programming, Scrum, Feature Driven Development, DSDM, Crystal Clear, Agile Unified Process

## Agile methods are Designed to...

- Manage with Data
- Improve Visibility
- Improve Predictability
- Improve Quality
- Improve Productivity
- Reduce Waste

www.agilemanifesto.org

## Manifesto for Agile Software Development

We are uncovering better ways of developing software by doing it and helping others do it.  
Through this work we have come to value:

**Individuals and interactions** over processes and tools  
**Working software** over comprehensive documentation  
**Customer collaboration** over contract negotiation  
**Responding to change** over following a plan

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## Individuals and Interactions over Processes and Tools



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## Skilled Self-Organizing Teams

- Developers work together to organize the work
- Customer or Product Owner works with the teams to define the product and establish priorities
- Managers usually take an outward focus, removing roadblocks, rather than managing day-to-day tasks and schedules.

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## Collaboration

- Daily standup meeting
- Pair programming, Mob programming or Daily reviews
- Shared code ownership
- Team room

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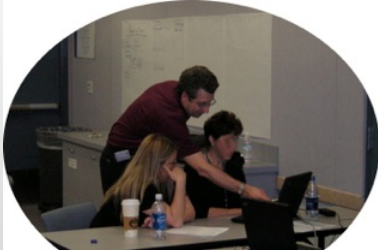
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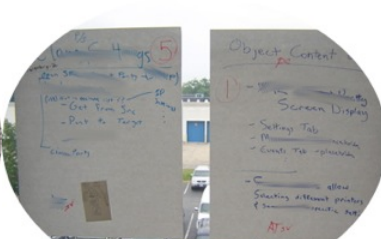


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## Working Software over Comprehensive Documentation



- Each team has different needs
- Less formal documentation might work.
- Prefer executable Documentation



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## Agile is Mostly Silent about Documentation

- Your needs are special
- There is no single prescription



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## Customer Collaboration over Contract Negotiation



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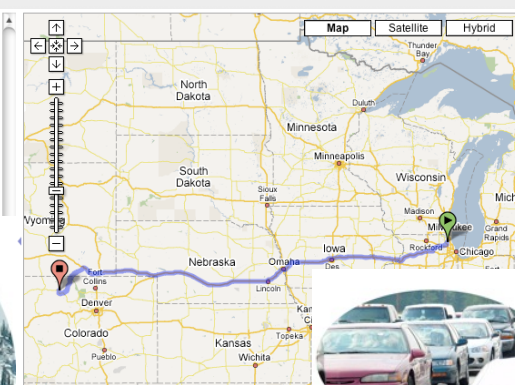
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## Responding to Change over following a plan

**Drive:** 1,121 mi (about 17 hours 43 mins)

15. Turn left to merge onto I-88 W 93.3 mi
16. Take the I-80 W exit 1B to Des Moines, keep following signs 1.0 mi
17. Merge onto I-80 W 185 mi
18. Take the exit onto I-80 W toward Council Bluffs/Omaha 668 mi
19. Take the Snowy Range Rd/ WY-130/WY-230 exit 311 0.4 mi
20. Turn left at WY-230 40.7 mi
21. Continue on WY-130 0.4 mi



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## Agile Approach is more...

- Visible
- Predictable
- Productive
- With a focus on
  - High Quality Work
  - Reduced Waste

## Agile Principles

### Plans

- Visible
- Realistic

### Product

- Customer Focus
- High Quality
- Simple
- Responsive

- Feedback

### People

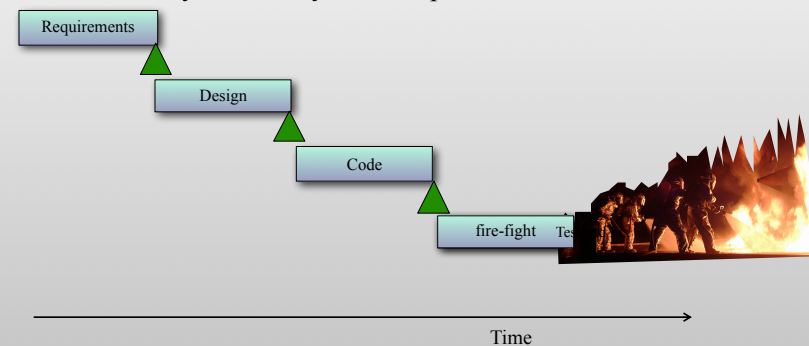
- Communications
- Courage
- Respect
- Honesty

## Iterative and Incremental Development

Projects end, products don't (hopefully)

Requirements analysis is never done  
Design is never done

March May July September November

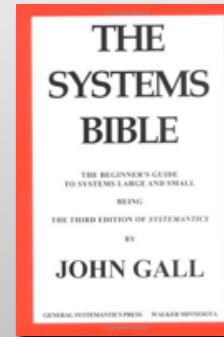


## Why Iterative?

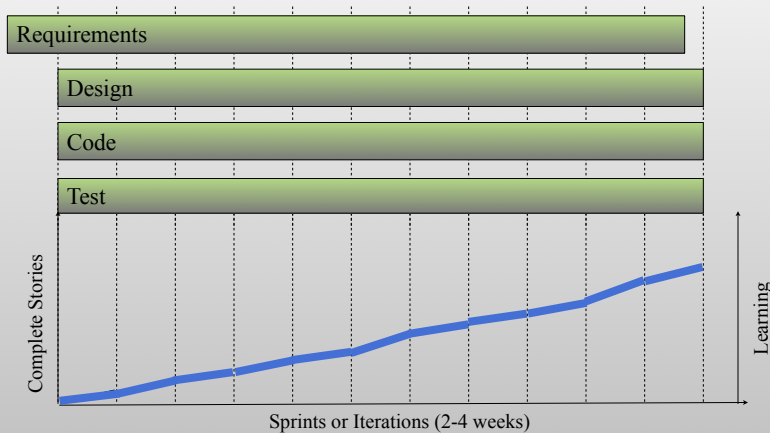
- A system's users seldom know exactly what they want and cannot articulate all they know
- ... There are many details we can only discover once we are well into implementation
- ... as humans we can only master only so much complexity
- ... external forces lead to changes in requirements...

[LARMAN]

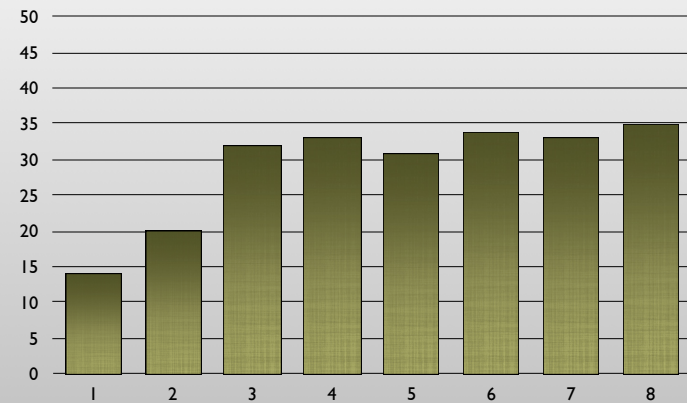
A Complex system that works is invariably found to have evolved from a simple system that worked

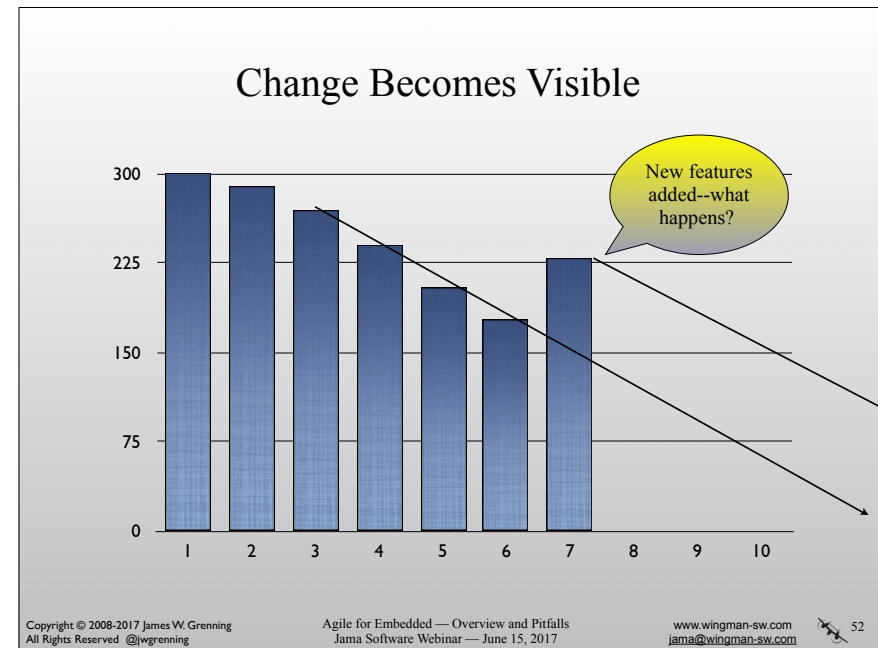
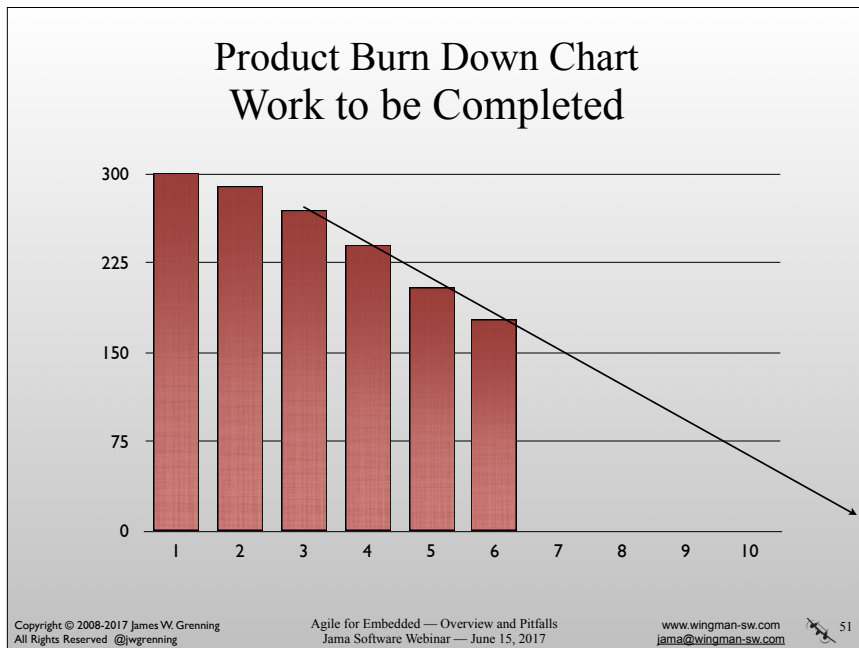
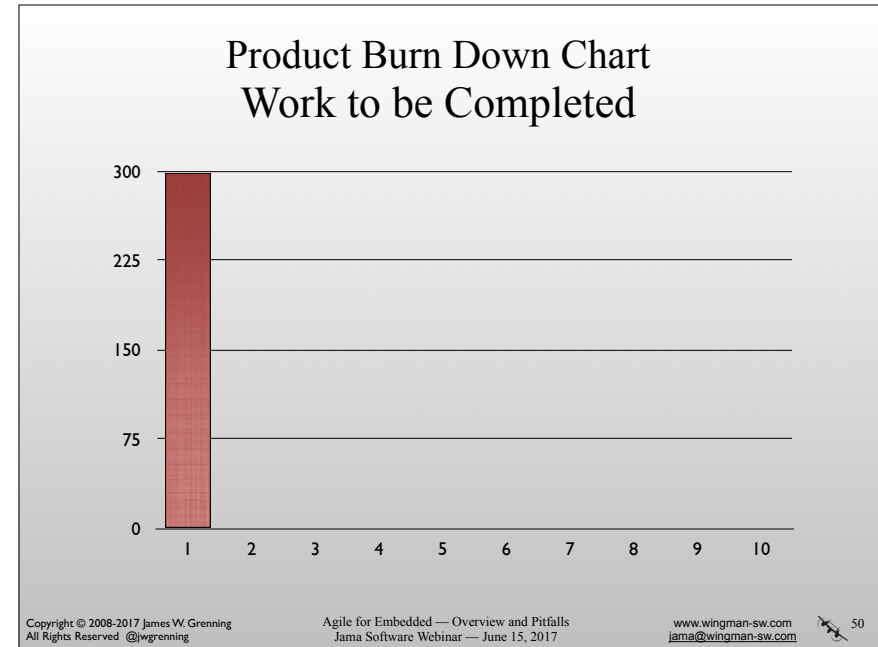


## Project Progress is Measurable Functionality Built and Tested



## Measure Development Velocity Estimated work per Iteration





## Scope Control with Stories and Acceptance Tests



## The Backlog is Made up of Stories

- The short term plan is more detailed.
- Work on it, buying time to refine longer term plan.



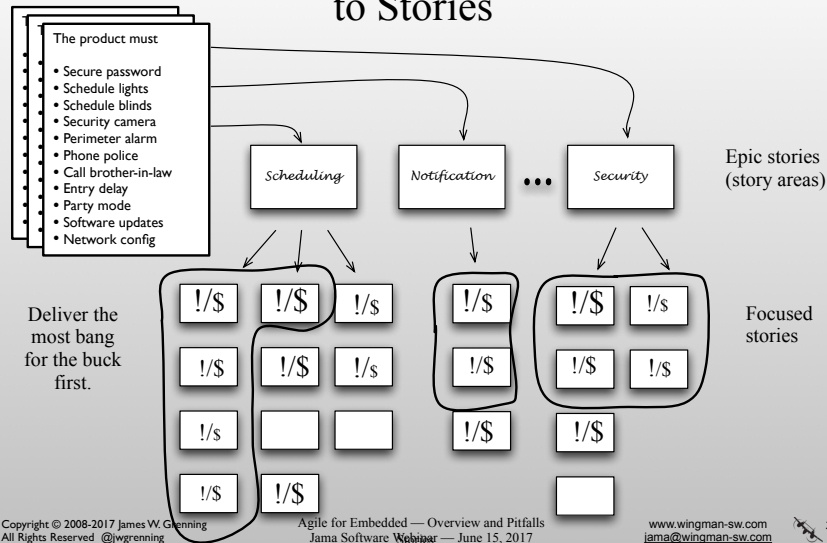
- Generally stories are in the order set by *customer*.
- Engineers can ask to move up stories to reduce risk.
- Stories are tested in the iteration they are implemented; story tests are automated.
- A story is done when it passes its tests.

## Introducing the User Story

- The name of a feature.
- A promise for a conversation. (Ron Jeffries)
- Like the name of a use case, or extension.
  - Acceptance tests provide the details.
- Fine grains help make visible progress and avoid gold plating.
- I call them Product Stories



## High Level *Requirements* to Stories



## Invest in User Stories

Source: Bill Wake

Independent  
Negotiable  
Valuable  
Estimate-able  
Small  
Testable

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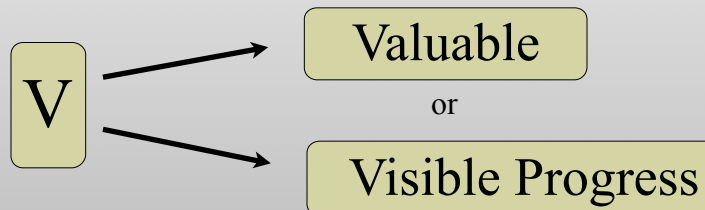
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## Valuable

- The ideal story delivers value to the *customer*.
- May be unrealistic for some embedded stories.
- Sometimes Visible is all you can get.



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## Why Small and Visible?



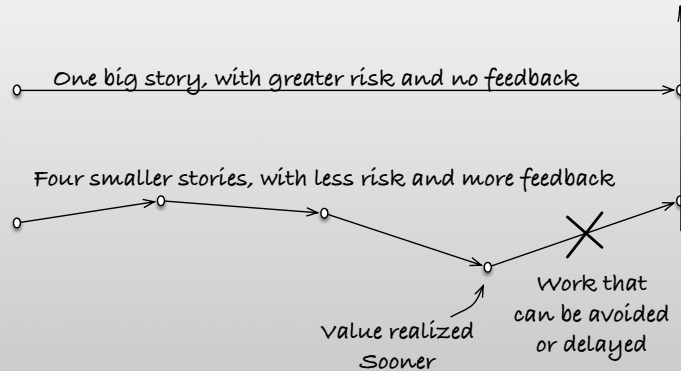
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## What if Part of the Work is not Valuable or Urgent?



## Stories are a Vertical Slice of Functionality

- They cut across subsystem boundaries
- They *can* include
  - UI (graphics, preliminary or polished)
  - System behavior
- They have an agreed upon definition of *DONE*.
- Prefer visible work over engineering tasks
- But sometimes a story is more horizontal, or isolated to an layer

## Consider the *Customer*

Who benefits from the story

Hardware engineer

Identify Flash Device

To verify address logic

Why is it valuable

## Make Work Visible Find a Natural Order

- USB device detected
- Device identified as a flash drive
- Erase flash memory device
- Read from flash memory device
- Write to flash memory device
- Open an existing file
- Read from an existing file
- Open a file for writing
- Write to the file

# Story Mapping

Story Mapping Helps  
Discover the Natural Delivery Order

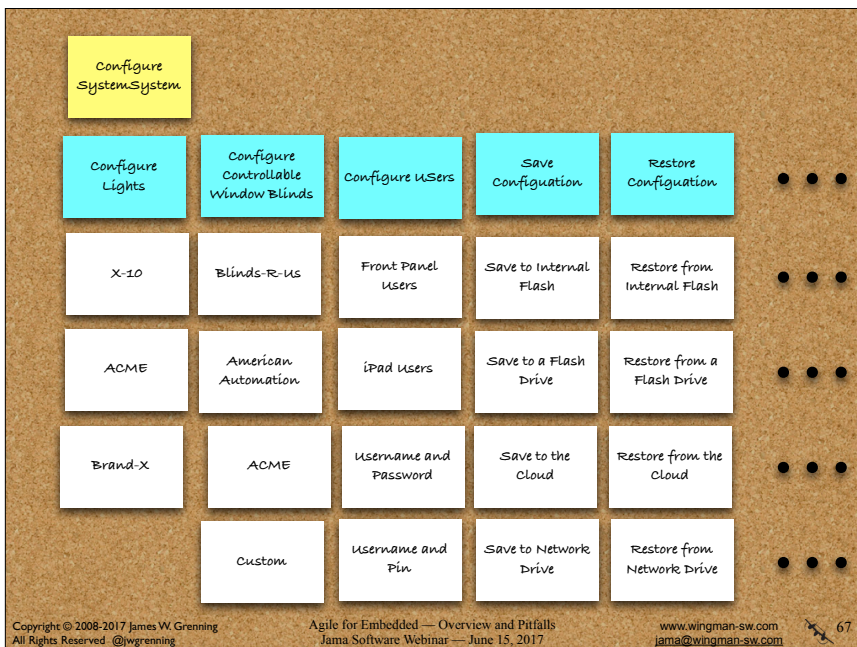
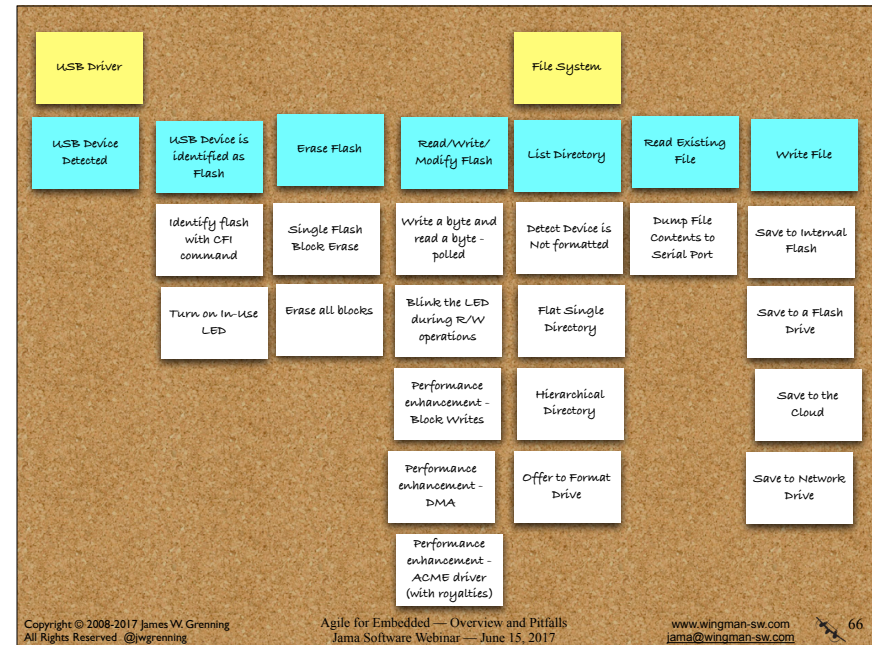
• Thanks Jeff Patton - [http://www.agileproductdesign.com/blog/the\\_new\\_backlog.html](http://www.agileproductdesign.com/blog/the_new_backlog.html)

Photo thanks to Patafisik [http://commons.wikimedia.org/wiki/File:Puzzle\\_pieces\\_1.JPG](http://commons.wikimedia.org/wiki/File:Puzzle_pieces_1.JPG)

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## Stories and Acceptance Tests

- Stories lack detail
- Details are provided in automated acceptance tests
- The test are like executable use cases
- Test either pass or fail

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## Completed Stories Have Passing Acceptance Tests

HomeAutomationTests.LightScheduler.

**TestSuite**

SUITE RESULTS

Test Pages: 14 right, 0 wrong, 0 ignored, 0 exceptions    Assertions: 156 right, 0 wrong, 7 ignored, 0 exceptions

TEST SUMMARIES

SLIM:/Users/JAMES/WORKSPACE/REPOS/rscc/TddC-SDD/TRUNK/TddC-SDD\_cslim

35 right, 0 wrong, 0 ignored, 0 exceptions    [InitTest](#)

5 right, 0 wrong, 0 ignored, 0 exceptions    [LightShouldComeOnAtTheRightTime](#)

5 right, 0 wrong, 0 ignored, 0 exceptions    [LightShouldNotComeOnAtTheWrongTime](#)

7 right, 0 wrong, 0 ignored, 0 exceptions    [LightShouldTurnOnAndOff](#)

7 right, 0 wrong, 0 ignored, 0 exceptions    [MultipleRandomScheduledLights](#)

7 right, 0 wrong, 0 ignored, 0 exceptions    [RandomLightChangesOperationTimeEachDay](#)

6 right, 0 wrong, 0 ignored, 0 exceptions    [RandomizeSingleLightsSchedule](#)

8 right, 0 wrong, 2 ignored, 0 exceptions    [ScheduleEveryDayButItsNotTimeTest](#)

8 right, 0 wrong, 2 ignored, 0 exceptions    [ScheduleEverydayButAndItsTimeTest](#)

12 right, 0 wrong, 3 ignored, 0 exceptions    [ScheduleEverydayOnThenOffTest](#)

26 right, 0 wrong, 0 ignored, 0 exceptions    [ScheduleForExactDayMatch](#)

7 right, 0 wrong, 0 ignored, 0 exceptions    [ScheduleTwoLightsEveryday](#)

11 right, 0 wrong, 0 ignored, 0 exceptions    [ScheduleWeekdayTest](#)

12 right, 0 wrong, 0 ignored, 0 exceptions    [ScheduleWeekendTest](#)

## When the Story Test is Ready Before the Development Finishes

HomeAutomationTests.LightScheduler.

**TestSuite**

SUITE RESULTS

Test Pages: 13 right, 1 wrong, 0 ignored, 0 exceptions    Assertions: 154 right, 2 wrong, 7 ignored, 0 exceptions

TEST SUMMARIES

SLIM:/Users/JAMES/WORKSPACE/REPOS/rscc/TddC-SDD/TRUNK/TddC-SDD\_cslim

35 right, 0 wrong, 0 ignored, 0 exceptions    [InitTest](#)

5 right, 0 wrong, 0 ignored, 0 exceptions    [LightShouldComeOnAtTheRightTime](#)

5 right, 0 wrong, 0 ignored, 0 exceptions    [LightShouldNotComeOnAtTheWrongTime](#)

7 right, 0 wrong, 0 ignored, 0 exceptions    [LightShouldTurnOnAndOff](#)

7 right, 0 wrong, 0 ignored, 0 exceptions    [MultipleRandomScheduledLights](#)

7 right, 0 wrong, 0 ignored, 0 exceptions    [RandomLightChangesOperationTimeEachDay](#)

6 right, 0 wrong, 0 ignored, 0 exceptions    [RandomizeSingleLightsSchedule](#)

8 right, 0 wrong, 2 ignored, 0 exceptions    [ScheduleEveryDayButItsNotTimeTest](#)

8 right, 0 wrong, 2 ignored, 0 exceptions    [ScheduleEverydayButAndItsTimeTest](#)

12 right, 0 wrong, 3 ignored, 0 exceptions    [ScheduleEverydayOnThenOffTest](#)

26 right, 0 wrong, 0 ignored, 0 exceptions    [ScheduleForExactDayMatch](#)

7 right, 0 wrong, 0 ignored, 0 exceptions    [ScheduleTwoLightsEveryday](#)

11 right, 0 wrong, 0 ignored, 0 exceptions    [ScheduleWeekdayTest](#)

10 right, 2 wrong, 0 ignored, 0 exceptions    [ScheduleWeekendTest](#)

## When Things Break

HomeAutomationTests.LightScheduler.

**TestSuite**

SUITE RESULTS

Test Pages: 3 right, 11 wrong, 0 ignored, 0 exceptions    Assertions: 129 right, 27 wrong, 7 ignored, 0 exceptions

TEST SUMMARIES

SLIM:/Users/JAMES/WORKSPACE/REPOS/rscc/TddC-SDD/TRUNK/TddC-SDD\_cslim

35 right, 0 wrong, 0 ignored, 0 exceptions    [InitTest](#)

4 right, 1 wrong, 0 ignored, 0 exceptions    [LightShouldComeOnAtTheRightTime](#)

5 right, 0 wrong, 0 ignored, 0 exceptions    [LightShouldNotComeOnAtTheWrongTime](#)

5 right, 2 wrong, 0 ignored, 0 exceptions    [LightShouldTurnOnAndOff](#)

5 right, 2 wrong, 0 ignored, 0 exceptions    [MultipleRandomScheduledLights](#)

5 right, 2 wrong, 0 ignored, 0 exceptions    [RandomLightChangesOperationTimeEachDay](#)

5 right, 1 wrong, 0 ignored, 0 exceptions    [RandomizeSingleLightsSchedule](#)

8 right, 0 wrong, 2 ignored, 0 exceptions    [ScheduleEveryDayButItsNotTimeTest](#)

7 right, 1 wrong, 2 ignored, 0 exceptions    [ScheduleEverydayButAndItsTimeTest](#)

10 right, 2 wrong, 3 ignored, 0 exceptions    [ScheduleEverydayOnThenOffTest](#)

19 right, 7 wrong, 0 ignored, 0 exceptions    [ScheduleForExactDayMatch](#)

5 right, 2 wrong, 0 ignored, 0 exceptions    [ScheduleTwoLightsEveryday](#)

6 right, 5 wrong, 0 ignored, 0 exceptions    [ScheduleWeekdayTest](#)

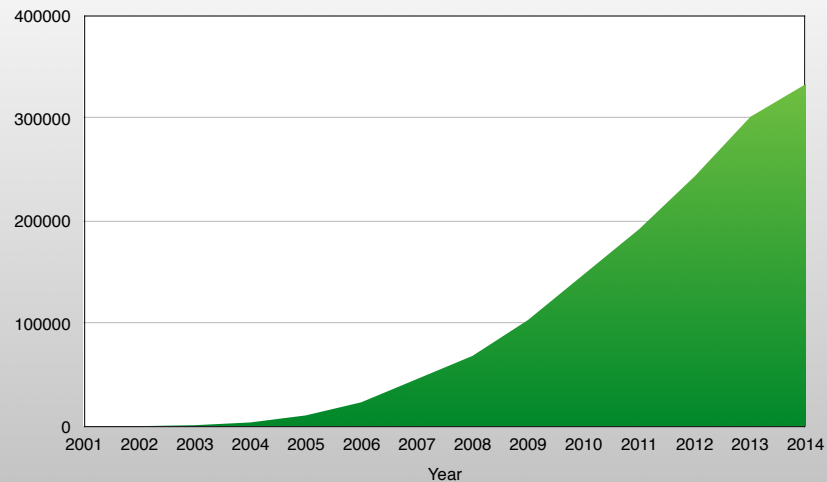
10 right, 2 wrong, 0 ignored, 0 exceptions    [ScheduleWeekendTest](#)

TEST OUTPUT



## How are We Doing in Agile's 16th Year?

## Certified Scrum Masters



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## What is Scrum?



Ken Schwaber

*Scrum exposes every inadequacy or dysfunction within an organization's product and system development practices. The intention of Scrum is to make them transparent so the organization can fix them.*

From an interview with Ken Schwaber on agilecollab - <http://www.agilecollab.com/interview-with-ken-schwaber>

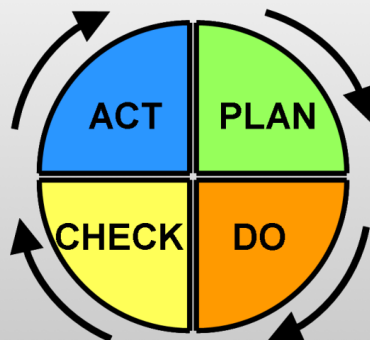
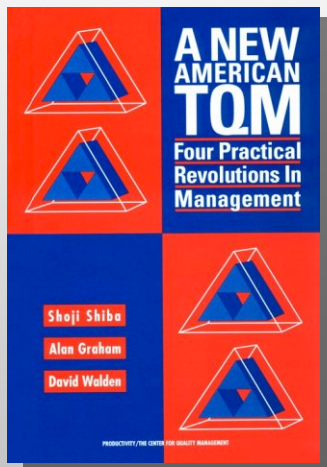
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## Like in the 80s! Short Cycle Improvement



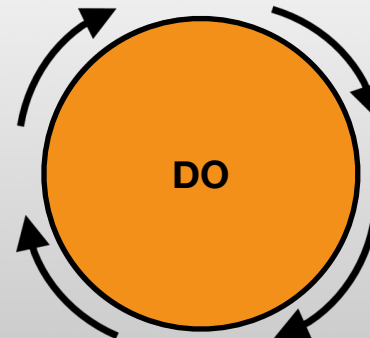
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## Except without the Difficult Improvement Part



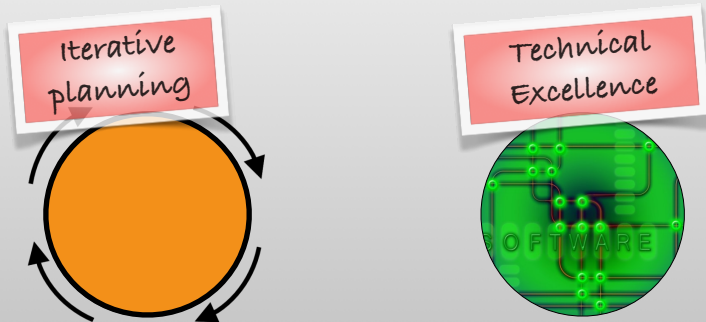
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## Agile's Two Halves Miss Any, Miss a Lot



## Agile's Three Halves Miss Any, Miss a Lot



## Remember what Ken Said?



Ken Schwaber

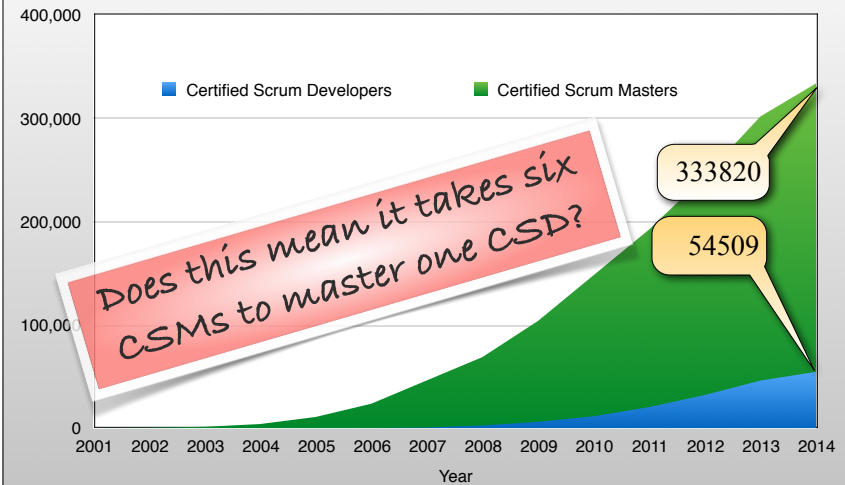
"The intention of Scrum is to make them [the problems] transparent so the organization can fix them."

unfortunately, many organizations change Scrum to accommodate the inadequacies or dysfunctions instead of solving them.

Did that work?

The industry **STILL** suffers from defects, delays and frustration.

So Far the Marriage is Unequal





## Quora Question: In a nutshell, why do a lot of developers dislike Agile?



Miles [redacted] I'm a programmer.

Written Jul 5, 2016 · Upvoted by [redacted], 15+ years as a software developer, and [redacted], CEO at [redacted] Software (2006-present)

This story is 100% true.

Omitted: Rant on something called Agile

446.4k Views · View Upvotes

Upvote 3.6k

Downvoted

Comments 89+

## Quora Question: In a nutshell, why do a lot of developers dislike Agile?



James Grenning, Tried to avoid programming in the early 70's, then got hooked. Loving it since.

Updated Nov 5 · Upvoted by Marcelo De Zen, 15+ years as a software developer., Magnus Falk, 10 years a programmer & tester in large distributed systems, and Kenrick Chien

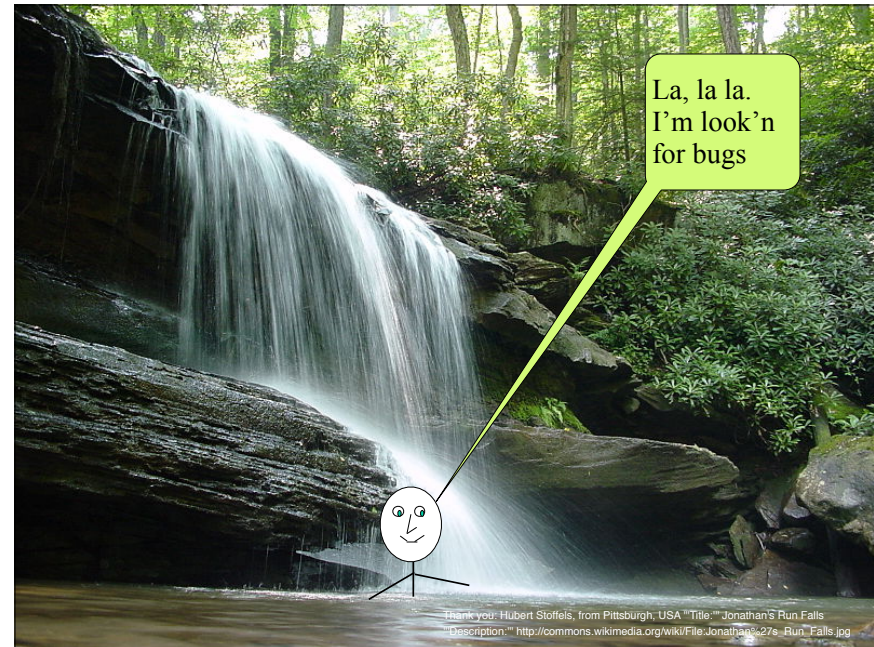
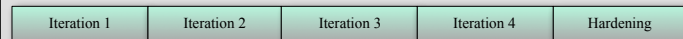
Omitted: Explanation of how Agile is misunderstood

137.4k Views · View Upvotes

Upvotes 556

Comments 32+

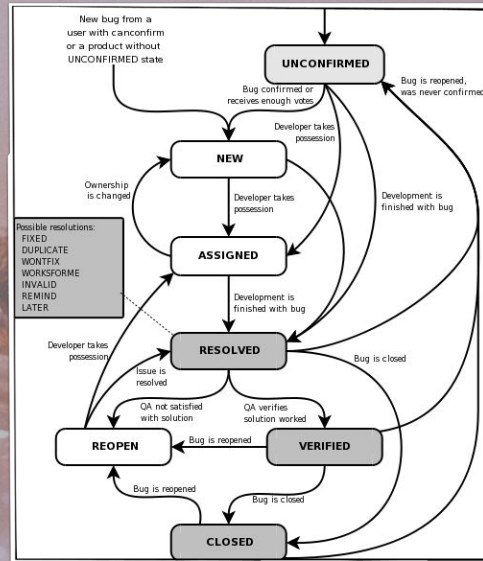
# Everything is Going Smoothly



# What Happens We Save Test Until the End?



## A Bug's Life



From <http://www.softwaretestinghelp.com/bug-life-cycle/>

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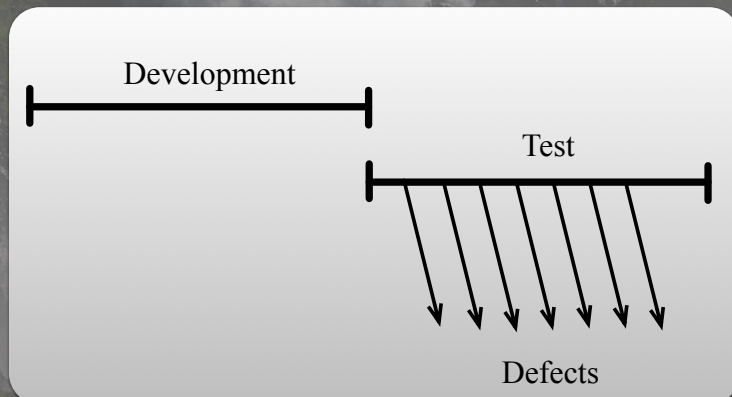
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[jama@wingman-sw.com](mailto:jama@wingman-sw.com)

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## Do Your Work Degrade into a Fire Fight?

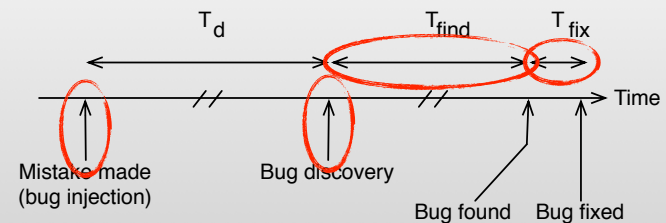
Why Does This Happen??

## This Work Flow is Designed to Allow Defects



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## The Physics of Debug Later Programming (DLP)



- As  $T_d$  increases,  $T_{find}$  increases dramatically
- $T_{fix}$  is usually short, but can increase with  $T_d$

<http://blog.wingman-sw.com/archives/16>

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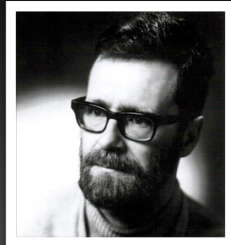
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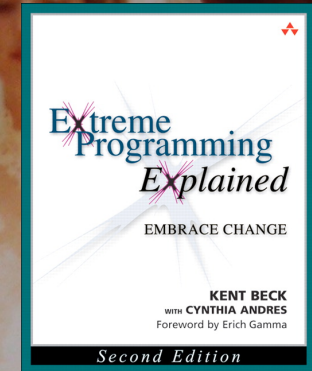
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## Edsger Dijkstra

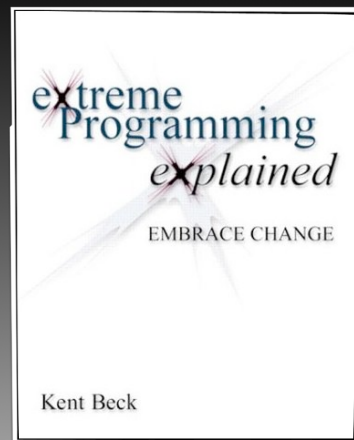
*If you want more effective programmers, you will discover that they should not waste their time debugging, they should not introduce the bugs to start with.*



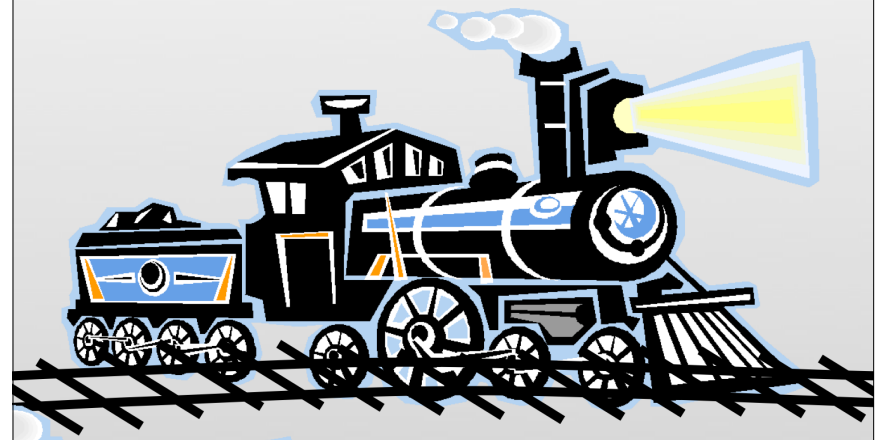
## The Marriage of Scrum and XP

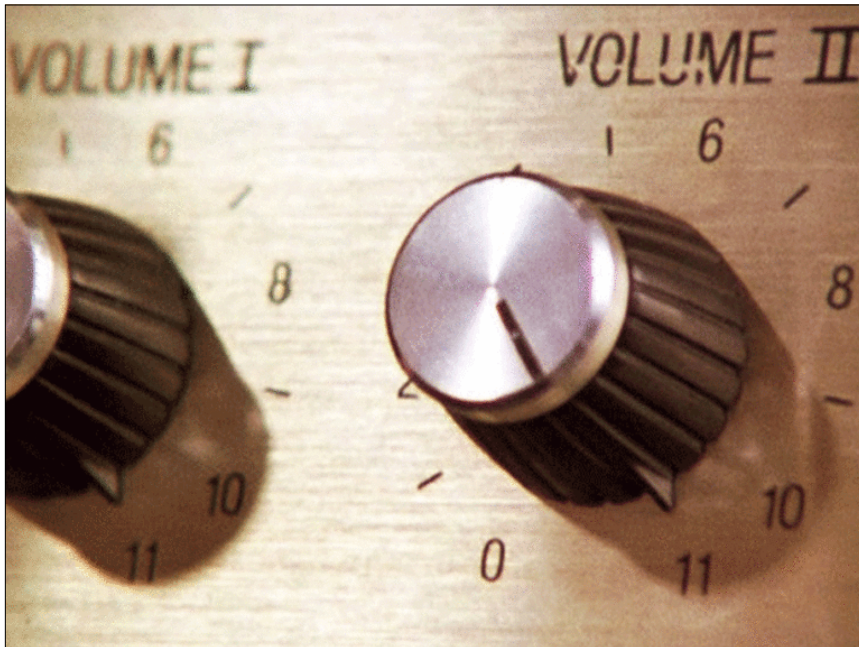


XP Identifies values and engineering practices needed for growing computer software

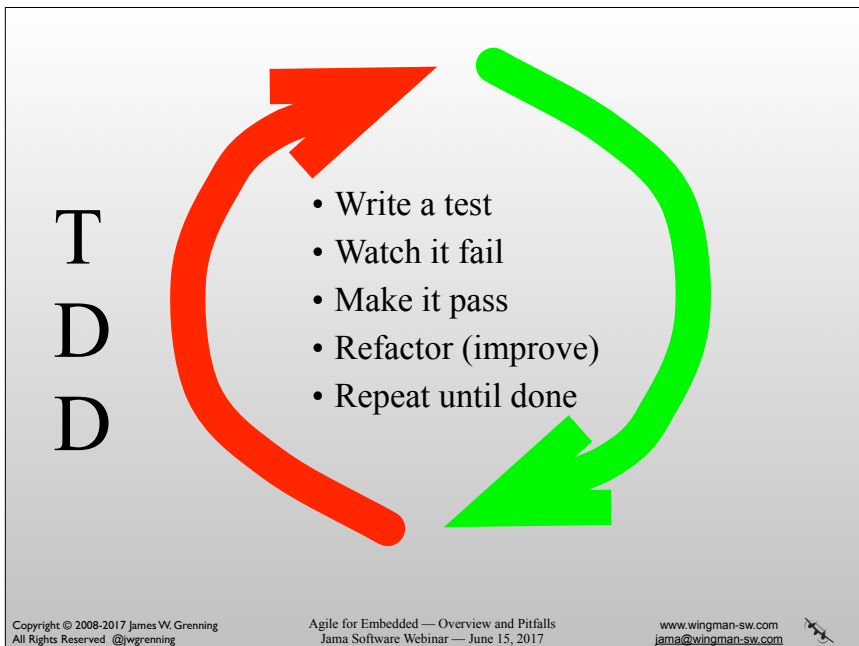


## Yeah but I'm an engineer





- Quality is important → Focus on it every day
- Testing is good → Test all the time
- Reviews are good → Review all the time
- Customer input is good → Talk to your customer every day
- Planning is important → Keep the plan alive, plan to replan

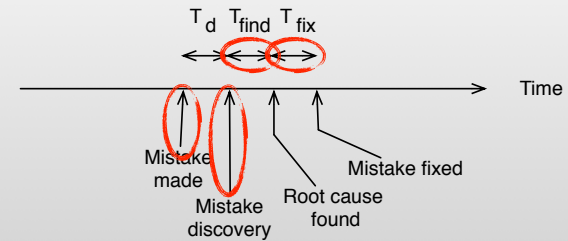


## Development and Test are a Continuum Preventing Defects



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## The Physics of Test Driven Development



- When  $T_d$  approaches zero,  $T_{find}$  approaches zero
- In many cases, bugs are not around long enough to be considered bugs.
- See: <https://wingman-sw.com/articles/the-physics-of-test-driven-development>

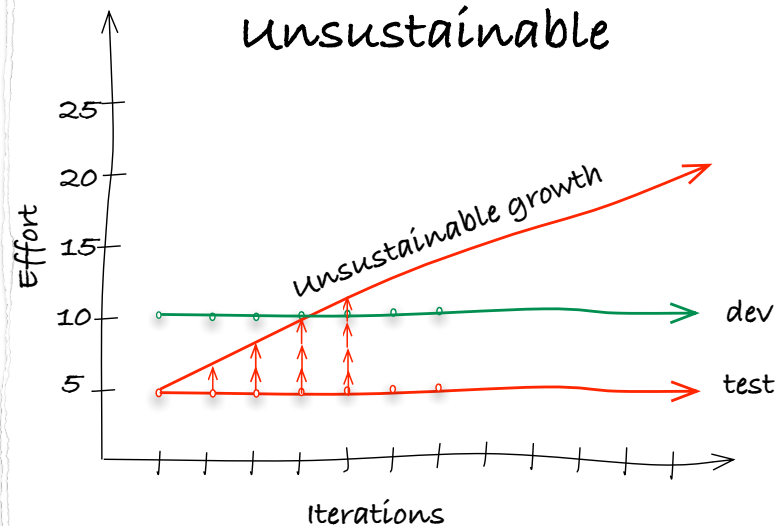
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## Manual Test is Unsustainable



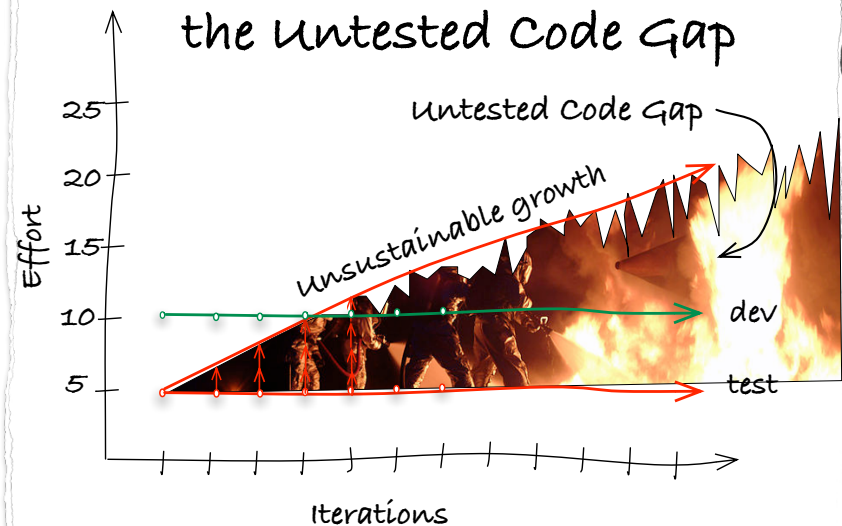
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## Risk Accumulates in the Untested Code Gap



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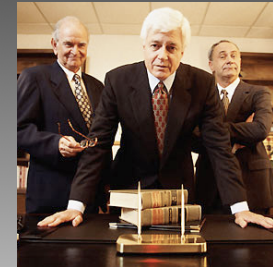
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Why does code  
quality matter?

The Lawyers are  
coming



## Toyota settles acceleration case after \$3 million jury verdict

CNNMoney

By Chris Isidore @CNNMoney October 25, 2013: 2:27 PM ET



Toyota has already agreed to pay **\$1.1 billion to settle a class-action suit** by owners who saw the resale value of their cars decline. A little more than half of the settlement went toward installing a "**brake override**" system in affected vehicles. That settlement does not cover cases in which personal injury or death occurred. According to financial filings, the automaker still faces more than 700 acceleration cases.

News & Analysis

## Toyota Case: Single Bit Flip That Killed

Junko Yoshida

10/25/2013 03:35 PM EDT

89 comments

"We've demonstrated how as little as a single bit flip can cause the driver to lose control of the engine speed in real cars due to software malfunction that is not reliably detected by any fail-safe,"  
- Michael Barr, CTO, co-founder of Barr Group

[http://www.eetimes.com/document.asp?doc\\_id=1319903](http://www.eetimes.com/document.asp?doc_id=1319903)

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You don't want to create  
this website

## Toyota Economic Loss Settlement Website

[Home](#) | [FAQ](#) | [Important Dates](#) | [Case Documents](#) | [File Claim](#) | [Contact Us](#) | [Stay Informed](#) | [En Español](#)

### Welcome to the official website for the Toyota Motor Corp. Unintended Acceleration Marketing, Sales Practices, and Products Liability Litigation

Please be advised that on July 24, 2013, the Court granted final approval to the Settlement. The final orders and final judgment can be found on the Case Documents page. Please be advised that appeals to the Settlement have been filed. This will delay full implementation of the Settlement, and any monetary benefits to be sent to class members, only if all appeals are resolved in favor of the Settlement.

We will continue to update this site as information becomes available.

Please be advised that the parties have finalized the consumer matrix per the Plan of Allocation. The matrix can be viewed by clicking [here](#) or by clicking on Case Documents above.

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United's 'Glitch' Disrupts More Than A Trillion Miles of Traveling Yesterday and Today

Don't think we are not attracting the attention of lawyers or the government regulators

US aviation authority: Boeing 787 bug

More trouble for Dreamliner as Federal Aviation Administration warns glitch in control system

Toyota recalls 625,000 hybrids over software glitch

Exclusive - VW recall letters in April warned of an emissions glitch

Glitch Freezes NYSE Trading for Hours

Technical issues had to do with trading

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## We're the Government We're Here to Help

demonstrated. Congress has taken note of the rising threat of car hacking, too, with two senators introducing a bill earlier this week to set minimum cybersecurity standards for automobiles.

“introducing a bill?”

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Why doesn't your team use  
TDD and Refactoring and the  
other technical practices of  
Extreme Programming?

# We're different!

# We can't use Agile!

## Agile's Three Halves Miss Any, Miss a Lot



## Challenges for Agile and Embedded

- Stories and incremental scope control
- Breaking dependencies on hardware
- Applying outside of software
  - Mechanics, hardware, ASIC development
- Not unique to embedded, though prevalent
  - Your own preconceived notions
  - Organizational resistance



<https://hakanforss.wordpress.com/2014/03/10/are-you-too-busy-to-improve/>

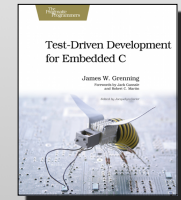
## Coming Soon

### Webinar

Test-Driven Development and Engineering Practices for Embedded

### Web Delivered Training — July

TDD for Embedded C — [wingman-sw.com](http://wingman-sw.com)



## Questions?

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