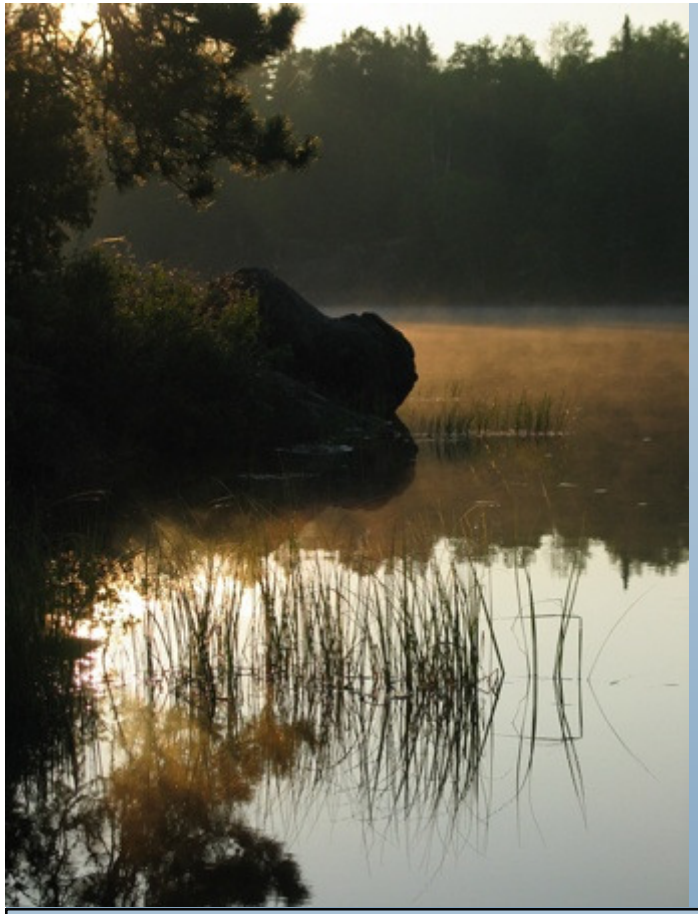


l e a n

software development

Stop-the-Line Quality

Lessons from Lean

mary@poppendieck.com Mary Poppendieck www.poppendieck.com

The Toyoda's

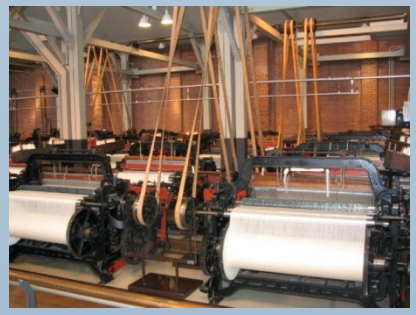
Sakichi Toyoda (1867-1930)

Kiichiro Toyoda (1894-1952)

Eiji Toyoda (1913-Present)

Sakichi Toyoda (1867-1930)

- ✓ Extraordinary inventor of automated looms
- ✓ Crucial Idea: ***Stop-the-Line***



Kiichiro Toyoda (1894-1952)

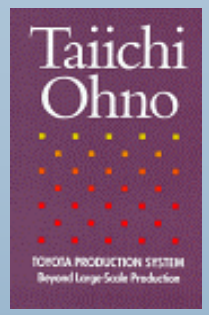
- ✓ Bet the family fortune on automotive manufacturing
- ✓ Crucial Idea: ***Just-in-Time***

Eiji Toyoda (1913-Present)

- ✓ 50 years of Toyota leadership
- ✓ Championed the development of ***The Toyota Production System***

The Toyota Production System

Taiichi Ohno

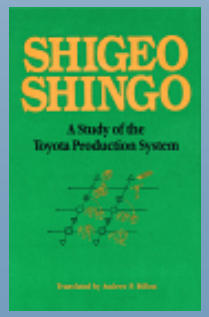


The Toyota Production System, 1988 (1978)

- ✓ Eliminate Waste
  - × Just-in-Time Flow
- ✓ Expose Problems
  - × Stop-the-Line Culture

Taiichi Ohno (1912-1990)

Shigeo Shingo

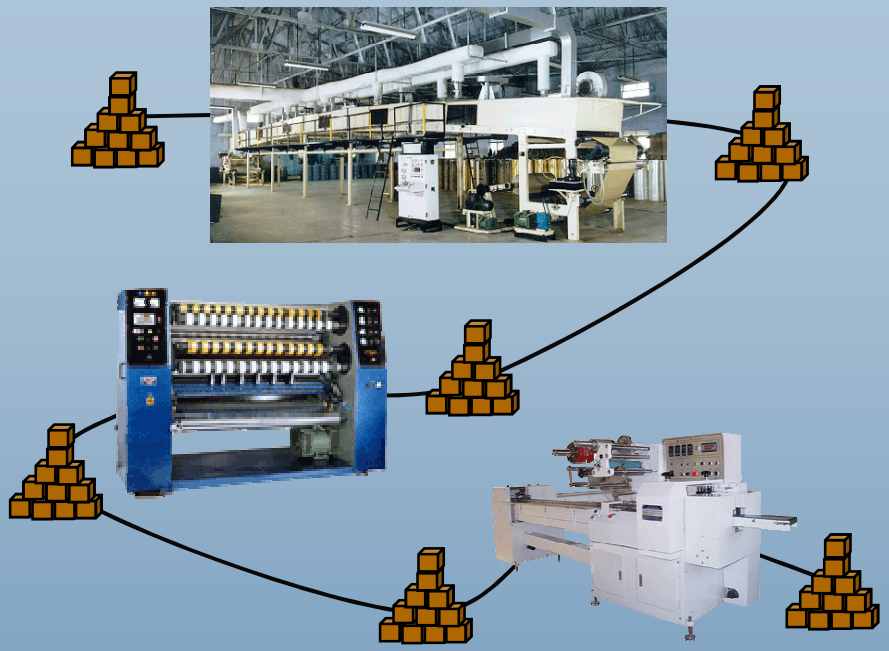


Study Of 'Toyota' Production System, 1981

- ✓ Non-Stock Production
  - × Single Digit Setup
- ✓ Zero Inspection
  - × Mistake-Proof Every Step

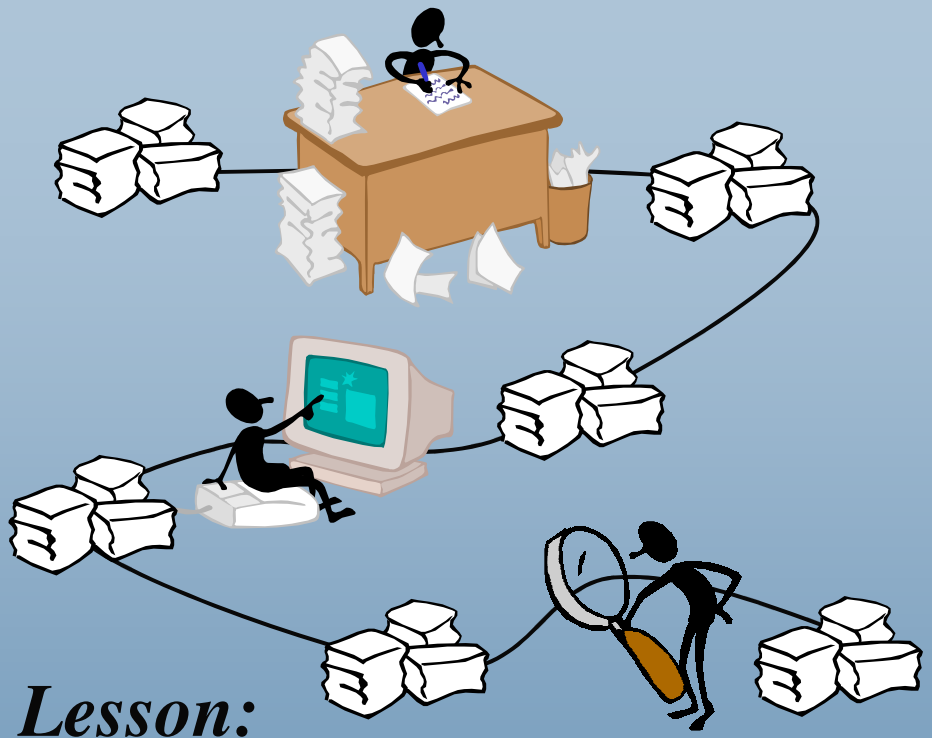
Shigeo Shingo (1909 – 1990)

Just-in-Time Flow



Lesson:

Stop trying to maximize machine productivity.



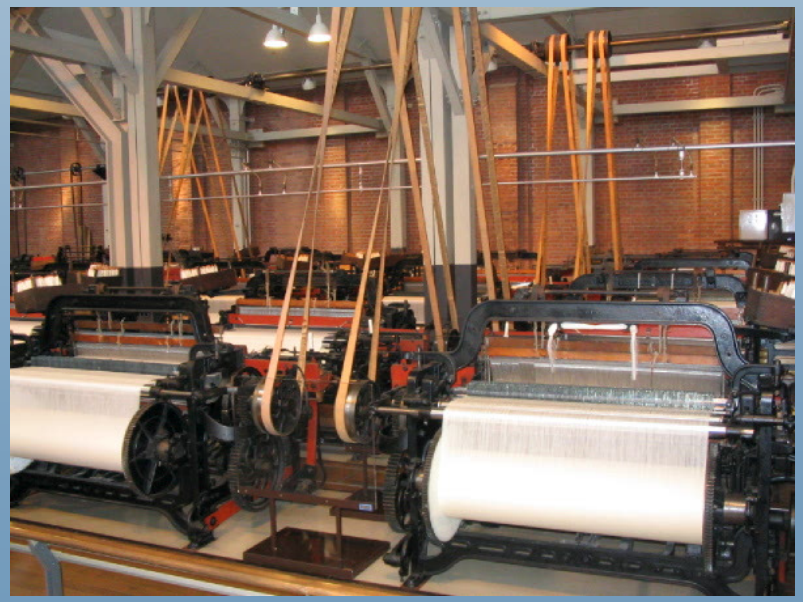
Lesson:

Stop trying to maximize "resource" utilization.

Stop the Line Culture

1920's:

- ✓ Idea: Unattended looms
- ✓ Invention: Looms that stopped the moment a thread broke.



Lessons:

- ✓ The greatest productivity comes from not tolerating defects.
- ✓ Create ways to detect defects the moment they occur.

Engaged People

"Only after American carmakers had exhausted every other explanation for Toyota's success –

an undervalued yen, a docile workforce, Japanese culture, superior automation –

were they finally able to admit that Toyota's real advantage was its ability to harness the intellect of 'ordinary' employees."

"Management Innovation" by Gary Hamel, ***Harvard Business Review***, February, 2006

Systems Thinking

Software is rather useless

– all by itself

Software is embedded

In hardware

In a process

In an activity

*The product [or process] must be developed as a **system**.*

The system is going to be around for a LONG time.

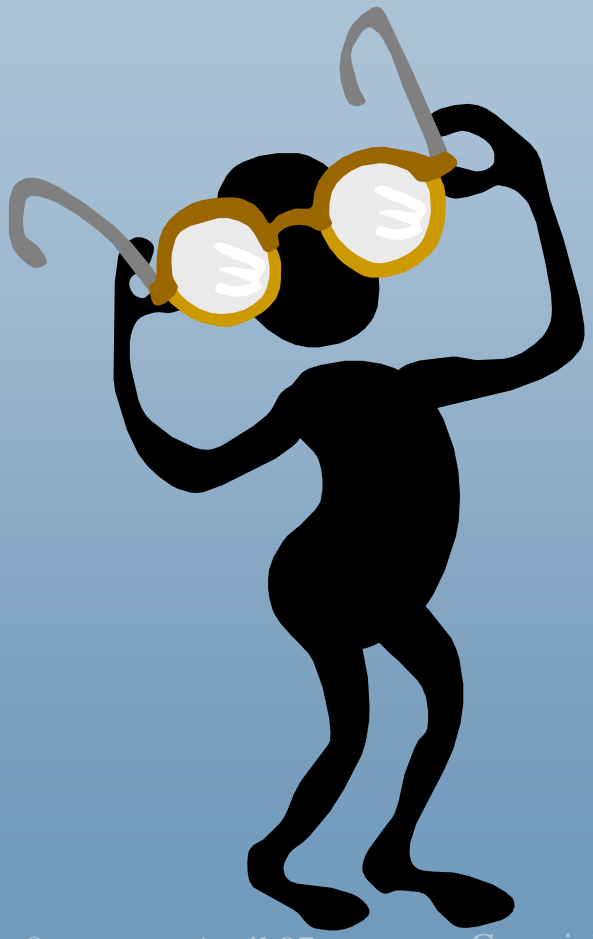
Saving money in development at the expense of production makes no sense.

60-80% of coding occurs after first release to production.

Developing a change-tolerant system is fundamental.

Lesson 1: Learn to See Waste

Put on Customer Glasses



MUDA

anything that

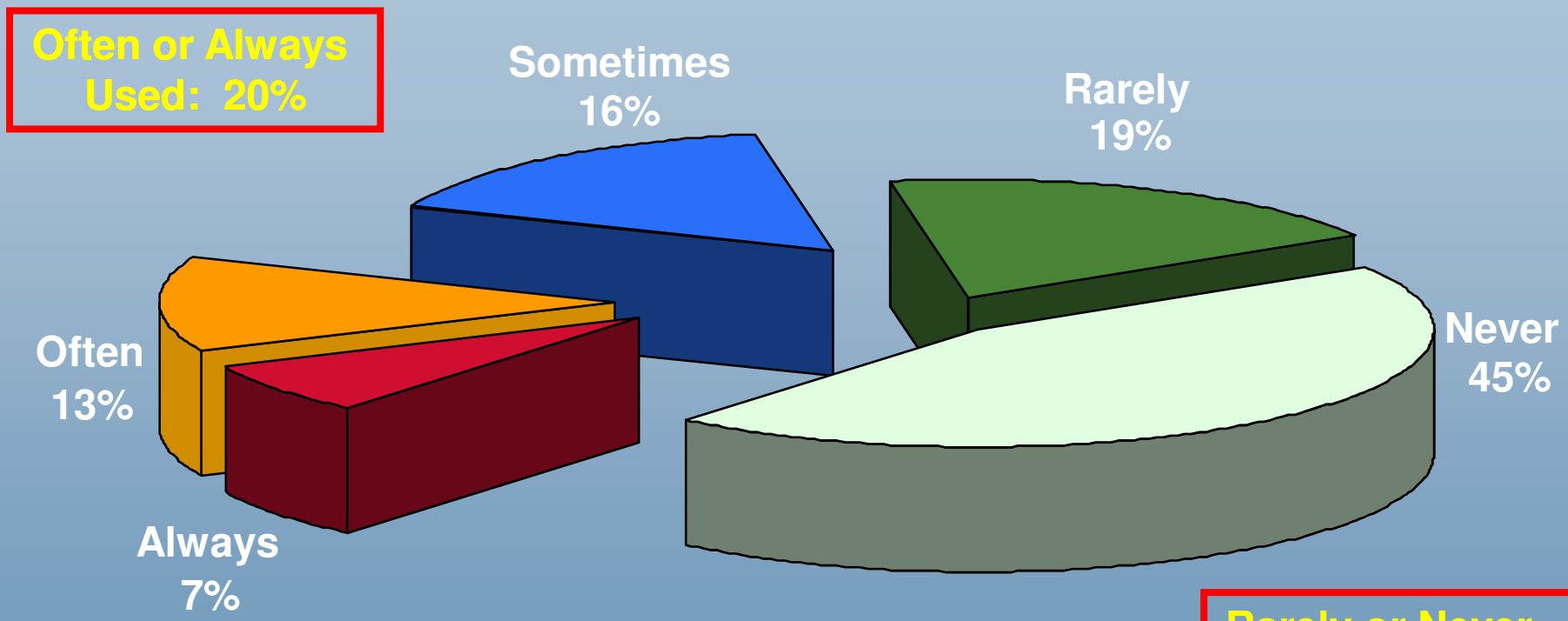
does not add

VALUE

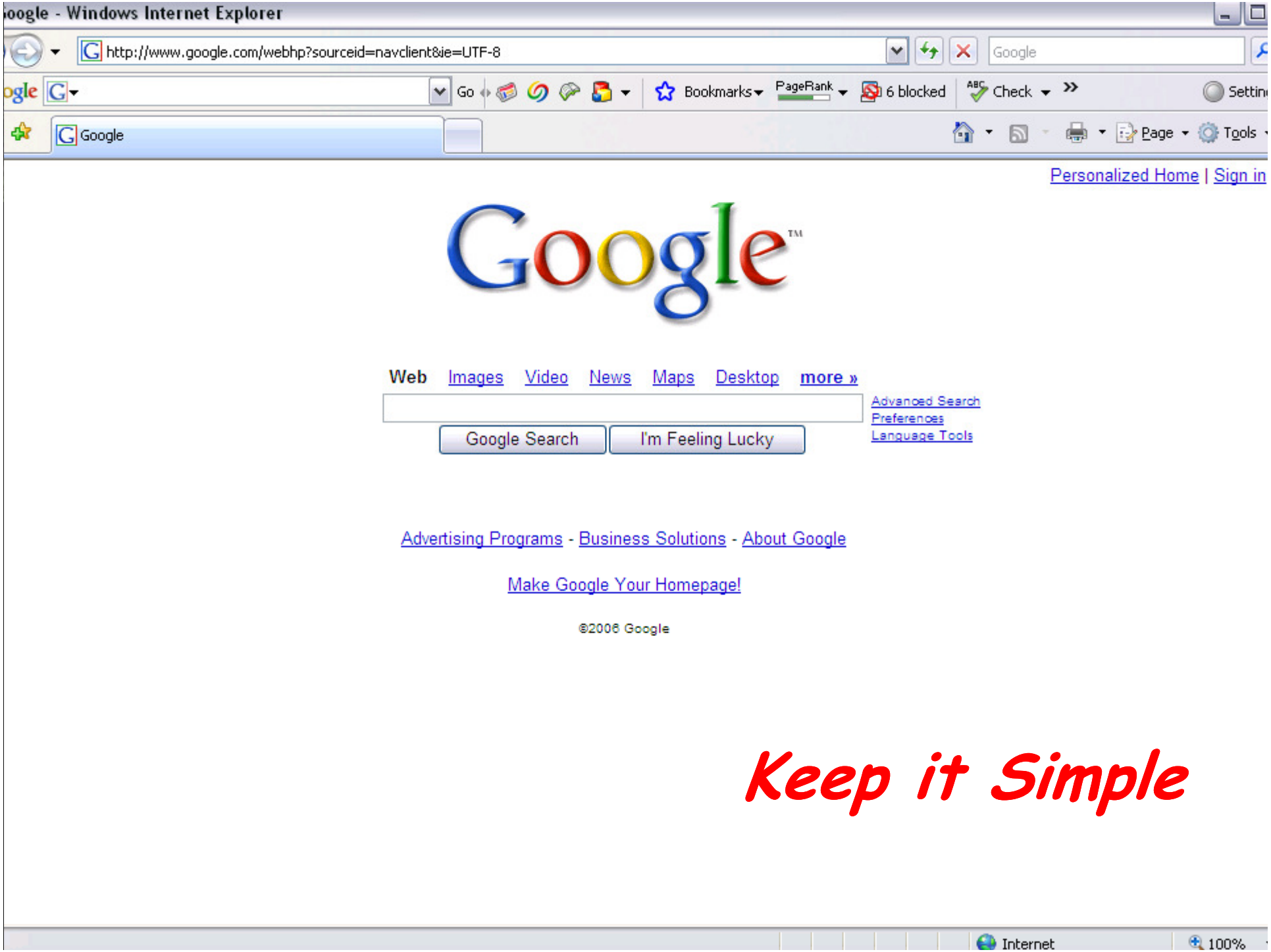
lean

Myth: Early Specification Reduces Waste

Features and Functions Used in a Typical System



Standish Group Study Reported at XP2002 by Jim Johnson, Chairman



Keep it Simple

Reduce Risk

The Biggest Risk is Work-in-Process

- ✓The ***Big Bang*** is Obsolete

Sources of Risk

- ✓Un-coded specifications
- ✓Un-tested code
- ✓Un-integrated code
- ✓Code that has not been used in production

The Best Risk Mitigation is Low Work-in-Process

- ✓Test early, integrate often, fail fast.

Lesson 2: Don't Tolerate Defects

*There are Two Kinds of Inspection**

1. Inspection to Find Defects – WASTE
2. Inspection to Prevent Defects – Essential

* Shigeo Shingo

The Role of QA

The job of QA is not to swat misquotes,

The job of QA is to put up screens.

A quality process builds quality into the code

- ✓ If you routinely find defects during verification – your process is defective.

Where do defects come from?

90% of all defects caused by the system*

1. They are not caused by individuals.
2. System problems are management problems.

* Dr. W. Edwards Deming

Change The System

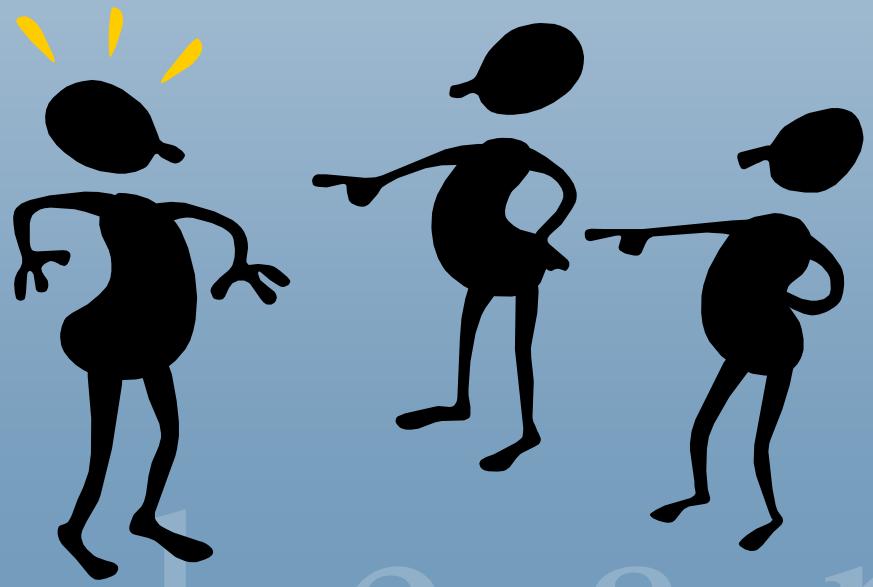
Mistake-Proof Every Step

- ✓ Detect defects the moment they occur

Don't track defects on a list

- ✓ Find them and fix them

Test FIRST



Case Study

Mobile Spectrometer to Analyze Grain

Techniques:

- ✓ Trouble log with different behaviors depending on development or field platform and severity of error.
- ✓ Dual-targeting: Bracket HW-dependent code and run only with target HW, mock-out otherwise.
- ✓ Isolate HW driver code, use scripts to test it with HW
  - × Became the HW acceptance tests
- ✓ Isolate and test domain-level code (eg communications)
- ✓ Special tests for unique domains (eg math algorithms)

Result:

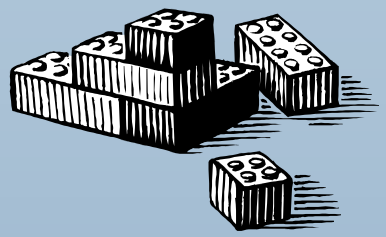
- ✓ In 3 years, only 51 defects (18 critical, 23 moderate, 10 cosmetic), with a maximum of 2 open at once!
- ✓ Productivity 3X similar embedded software teams.
- ✓ HW engineers trusted SW and used it to debug HW.

Taken from: **Taming the Embedded Tiger – Agile Test Techniques for Embedded Software,** Nancy Van Schooenderwoert & Ron Morsicato, ADC 2004 & **Embedded Agile Project by the Numbers with Nubies,** Nancy Van Schooenderwoert, Agile 2006

Building Block Disciplines

Development

- ✓ Coding Standards
- ✓ Configuration Management
  - × Tool
  - × Team Practices
- ✓ One Click Build
- ✓ Continuous Integration
- ✓ Automated Testing
  - × Unit Tests
  - × Acceptance Tests
  - × ***STOP*** if the tests don't pass
- ✓ Nested Synchronization

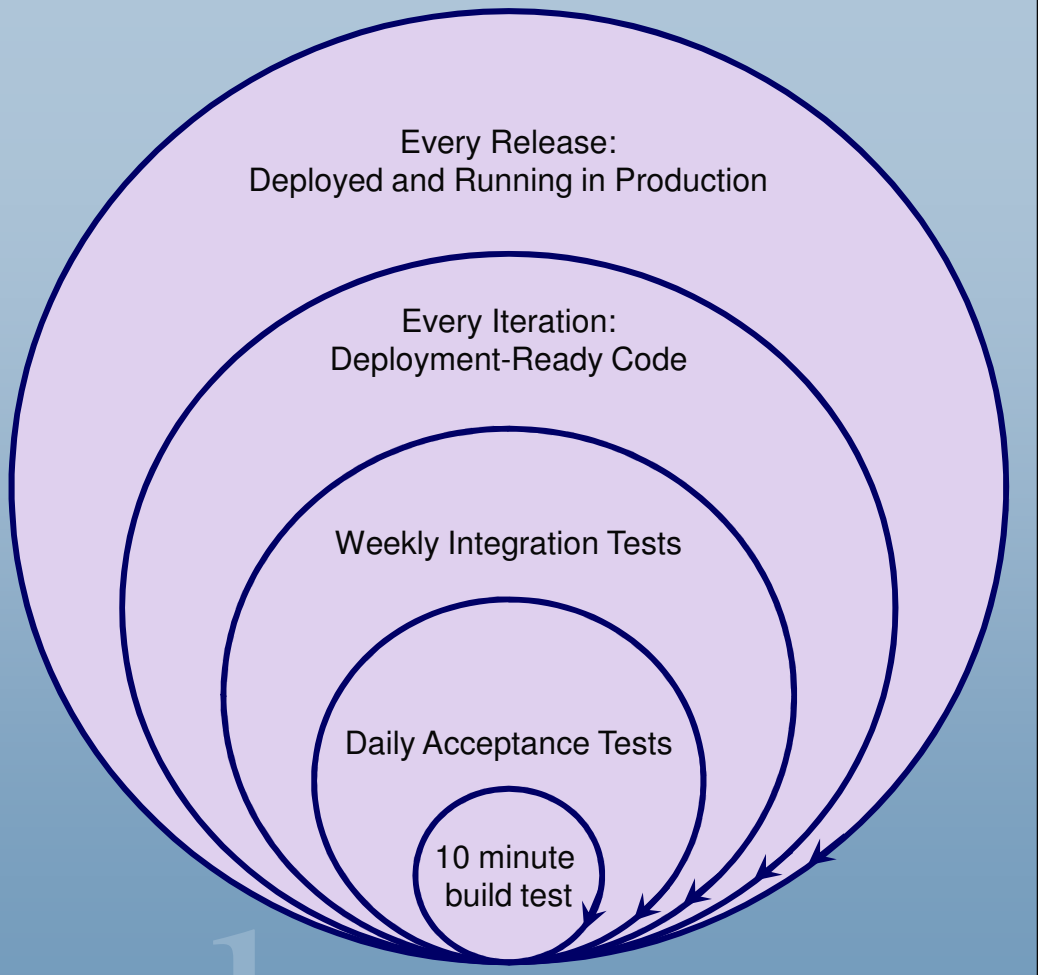


Deployment

- ✓ Production-Hardy Code
- ✓ Automated Release Packages
- ✓ Automated Installation
- ✓ "Done" means the code is running live in production.

Nested Synchronization

- ✓Every few minutes
  - Build & run unit tests
  - ***STOP*** if the tests don't pass
- ✓Every day
  - Run acceptance tests
  - ***STOP*** if the tests don't pass
- ✓Every week
  - Run production testes
  - ***STOP*** if the tests don't pass
- ✓Every iteration
  - Deployment-ready code
- ✓Every Release
  - Deploy and run in production



Make it Flawless

Types of Testing

Automated:
Every Day

Manual:
As Early as
Practical

Business Facing

Support Programming

Critique Product

From Brian Marick

Acceptance Tests Business Intent (Design of the Product)	**Usability Testing** **Exploratory Testing**
Unit Tests Developer Intent (Design of the Code)	**Property Testing** Response, Security, Scaling, Resilience

Automated:
Every Build

Tool-Based:
As Early as
Possible

Technology Facing

Myth: Automated Testing takes too much time/costs too much money

Team struggling with legacy java code

10 defects / 1000 NCSS*

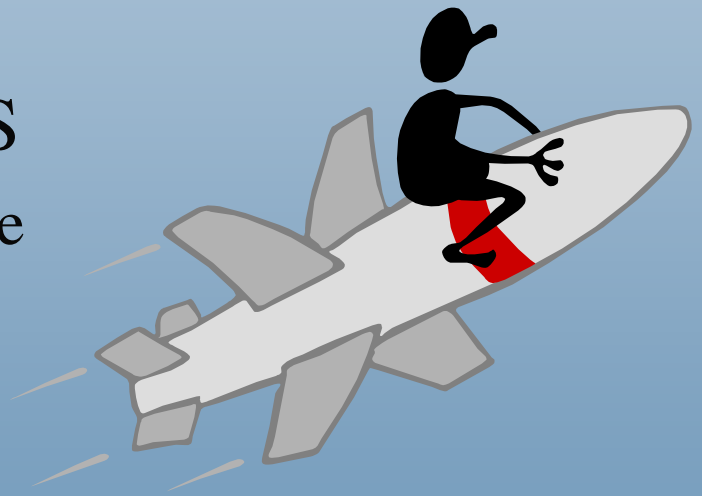
Affected company's reputation and threatened survival

Adopted Test Driven Development

Defects dropped to <3 / 1000 NCSS

- ✓ Including all untouched legacy code
- ✓ 80-90% improvement in quality

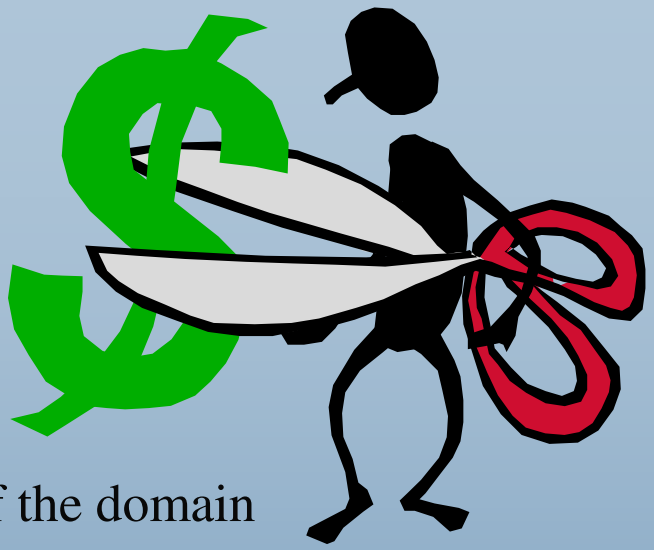
Productivity more than tripled



* Non-comment Source Statements-

--- From Mike Cohn

Test Driven Development



Doesn't cost, it pays!

Is a design technique

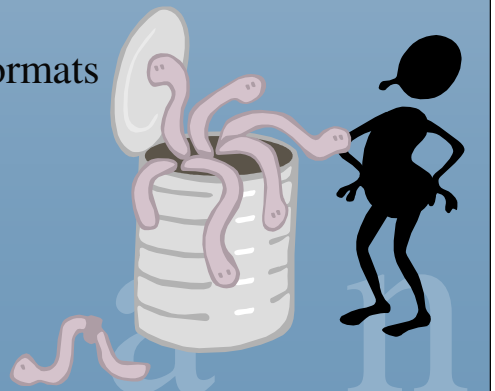
- ✓ Cleaner Design
  - × Acceptance Test Driven Design
    - ❖ Matches the design to the structure of the domain
  - × Unit Test Driven Design
    - ❖ Simpler, More Understandable Code
- ✓ Self-verifying
- ✓ Protects from unintended consequences
  - × For the life of the code

A Test Harness to Simulate Integration Testing

- ✓ Create a harness to simulate the remote system at each integration point in the system under test.
- ✓ Design a devious harness with nasty, malicious behavior that will beat up the system.
- ✓ Try to provoke all possible failure modes in any remote system at all seven OSI layers.
- ✓ A single harness can work for many networked applications, simulating similar bad behavior.
- ✓ See "**Release It! Design and Deploy Production-Ready Software"** Michael Nygard, Pragmatic Press, 2007

A harness for a Web Services call

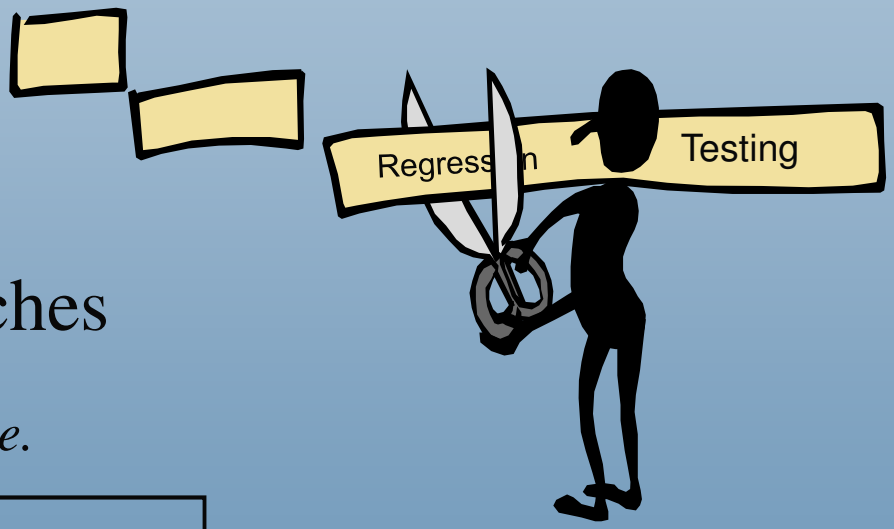
- × Refuse all connections
- × Refuse all credentials
- × Listen but time out
- × Connect very slowly
- × Send nothing but RESET's
- × Accept connection but don't send data (or don't acknowledge data)
- × Accept a request and send response headers but no body
- × Report data received but never empty the buffer
- × Send 1 byte of data every 30 sec.
- × Send megabytes of data when kilobytes are expected
- × Send unexpected formats
- × Etc.



Avoid Technical Debt

Anything that makes code difficult to change
(The usual excuse for batches & queues)

- ✓Complexity
  The cost of complexity is exponential.
- ✓Regression Deficit
  Every time you add new features the regression test grows longer!
- ✓Unsynchronized Code Branches
  The longer two code branches remain apart, the more difficult merging will be.



Perfection is ***One-Piece-Flow:***

Any useful feature set – at any time – in any order

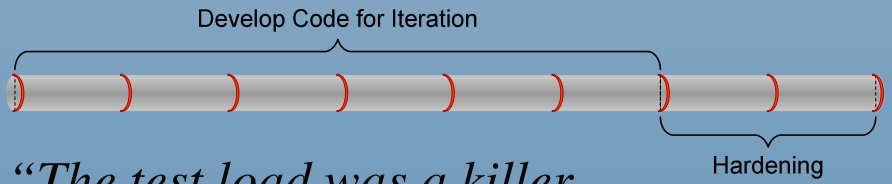
Let it Flow

Case Study: Rally Software Development

"We found ourselves doing waterfall in time-boxed increments. During the first year we had a lot of technical debt."

Testing:

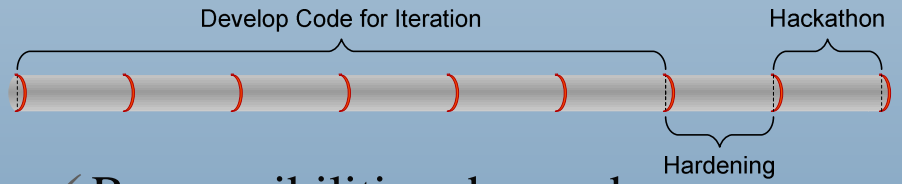
- ✓ JUnit for unit tests
- ✓ HTTPUnit for testing the GUI
  - × Not capable of testing page flows
  - × Most GUI testing manual
  - × All acceptance testing manual
- ✓ 6 weeks to develop, 2 weeks to test, and not all testing was done.



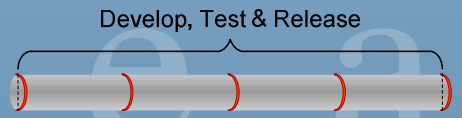
"The test load was a killer, and it just kept going up."

Ryan Martens, CTO

- ✓ Gradually moved page flow platform to Spring and AJAX
  - × Tested Spring with FIT & Fitnesse
  - × Tested AJAX by using JIFFIE to bind Java to IE. Wrote tests in Java to test AJAX through the browser.
- ✓ Hardening was reduced to 1 week.



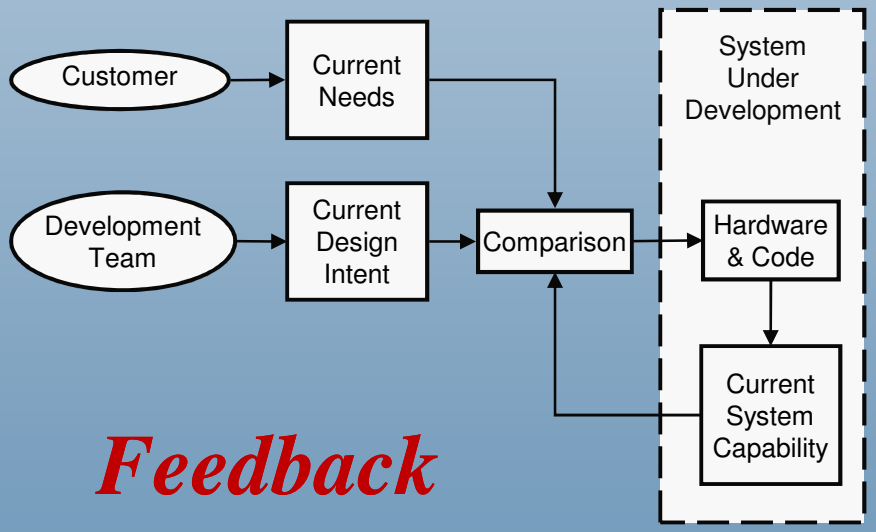
- ✓ Responsibilities changed:
  - × Testers: FIT tables & JIFFIE tests
  - × Developers: FIT fixtures, JUnit tests, and GUI test harness
- ✓ Now release monthly, pre-hardened!



Lesson 3: Focus on Learning

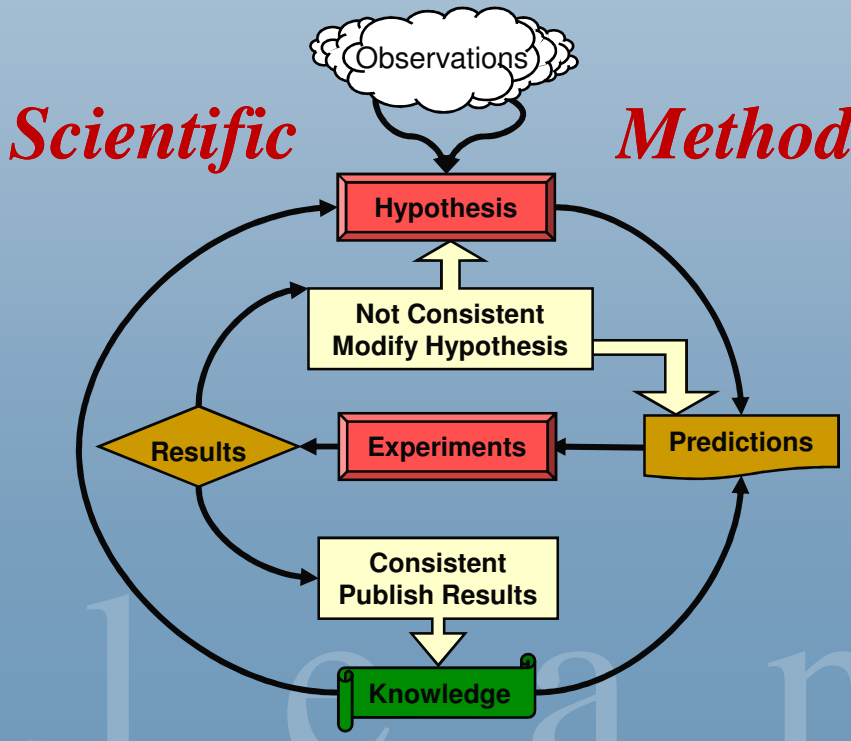
Cycles of Discovery

Products emerge through iterations of learning.

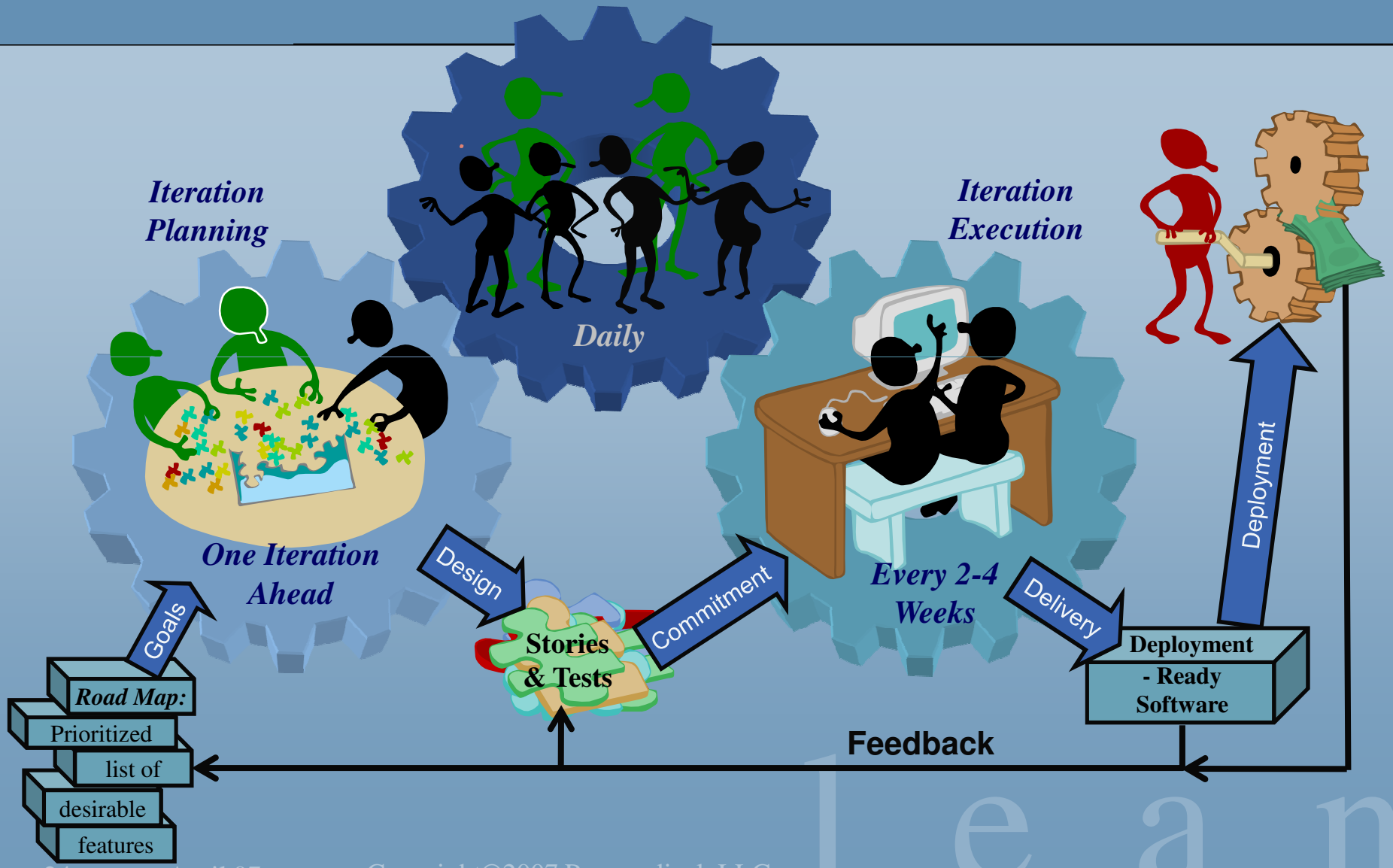


Relentless Improvement

Engaded people design and improve their own processes.



Iterative Development



Relentless Improvement

KAIZEN

Kai

改

Change

Zen

善

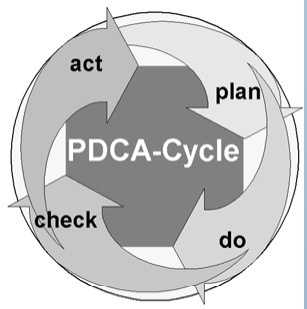
Good

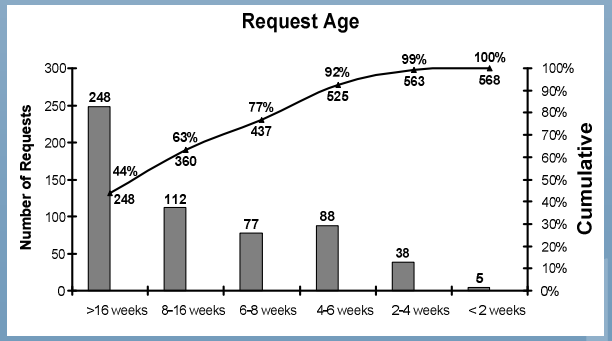
Regular Work Team Meetings

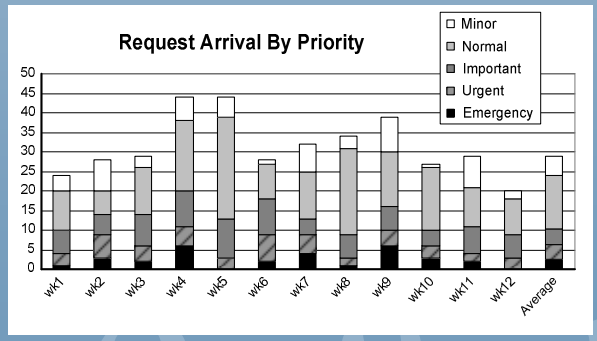
- ✓ Every week or
- ✓ Every iteration

Data-Based Problem Analysis

- ✓ Don't guess
- ✓ Find and analyze the data
- ✓ Experiment!







Refactoring: Relentless Improvement of the Code Base

Just-in-time NOT Just-in-Case

- ✓ Start with what you know is needed now
- ✓ Add features only when you know you need them
- ✓ Refactor: Simplify the code based on what you know now

Maintain a Simple, Clean Design

- ✓ No features ahead of their time
- ✓ No features after their time
- ✓ No Repetition

Safety First!

- ✓ You can't refactor without test harnesses.

Time to Refactor

Lesson 4
Change the Measurements

Fujitsu took over help desk of BMI (airline) in 2001

- ✓ Fujitsu analyzed all calls
  - × Found that 26% of calls were for printers
    - ❖ Could not print boarding passes / luggage tags
  - × Quantified the cost of the calls
    - ❖ Tracked the time to fix the problems
    - ❖ Measured impact on business of the problem
  - × Convinced BMI management to get better printers
    - ❖ Printer calls were down 80% in 18 months
    - ❖ Total calls were down 40% in 18 months
    - ❖ Major savings in flight operations
- ✓ What's Wrong With This Picture?

From "Lean Consumption"
By James P. Womack & Daniel T. Jones
Harvard Business Review, March 2005

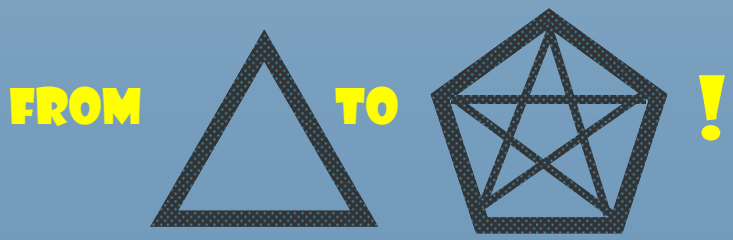
Measure UP

Decomposition

- ✓ You get what you measure
- ✓ You can't measure everything
- ✓ Stuff falls between the cracks
- ✓ You add more measurements
- ✓ You get local sub-optimization

Example

- ✓ Measure Cost, Schedule, & Scope
  - × Quality & Customer Satisfaction fall between the cracks
  - × Measure these too!



Aggregation

- ✓ You get what you measure
- ✓ You can't measure everything
- ✓ Stuff falls between the cracks
- ✓ You measure UP one level
- ✓ You get global optimization

Example

- ✓ Measure Cost, Schedule, & Scope
  - × Quality & Customer Satisfaction fall between the cracks
  - × Measure Business Case Realization instead!

Three System Measurements

Average Cycle Time

- ✓ From Product Concept
- ✓ To First Release

or

- ✓ From Feature Request
- ✓ To Feature Deployment

or

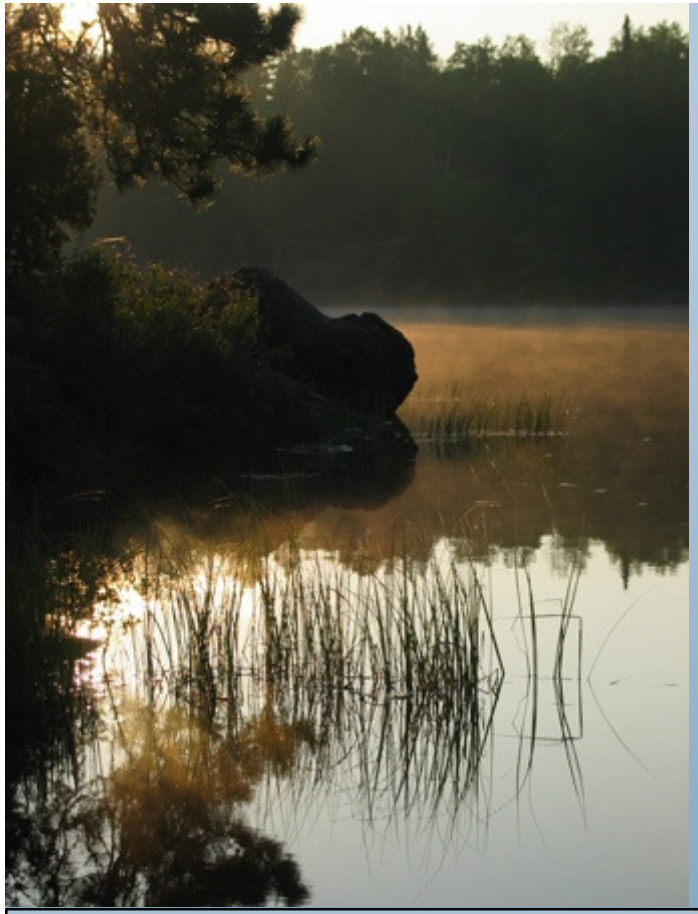
- ✓ From Defect
- ✓ To Patch

The Business Case

- ✓ P&L or
- ✓ ROI or
- ✓ Goal of the Investment

Customer Satisfaction

- ✓ A measure of sustainability



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Thank You!

mary@poppendieck.com Mary Poppendieck www.poppendieck.com