Quality Management

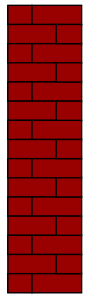
Ellen George

PS&J Software Six Sigma

The Problem

The code is delivered to the "Great Black Hole" of Integration & Test

Code is developed



Integration & Test uses up its budget and schedule, but … *defects continue to be found* !!!

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When will testing be complete?
What will the product quality be?

Schedule Management

- In order to manage schedule, you need to be able to accurately estimate the time required to
  - Develop the product
  - Remove all of the defects
- But how will you know if all the defects have been removed?

In order to meet your schedule commitments, you must explicitly plan for product quality

Quality Management

- The first step in planning for quality is to collect and understand your own historical data
  - How many defects have been found in integration?
  - During what other phases are defects found?
  - What is the relative cost of finding defects in different phases of the life cycle?
  - What types of defects have been found in the past?
  - What is the most practical and economical way to find similar defects in the future?
- The second step is to ***use that data*** to generate a "defect removal strategy" and a "defect removal plan"
- The third step is to manage to the defect removal plan

Defects and Data Collection

Accidents and Defects

- As humans, we are all fallible
- We all carry insurance because the probability is that someday we will have an accident
- In software, accidents are known as "defects"
- We all inject them. It's a fact of life. We are fallible.
- The big question is …

  What are we going to do about it?

Companies who learn to manage their defects will have a significant cost, schedule and quality advantage over their competitors

"What Gets Measured Gets Managed"

- Only three basic measurements

  EFFORT: the effort spent by phase

  SIZE: the size of the work product

  DEFECTS: the number of defects by phase, injection phase and removal phase, effort required to fix, description

- All other metrics are derived from these
- With this data, we can plan for and manage quality

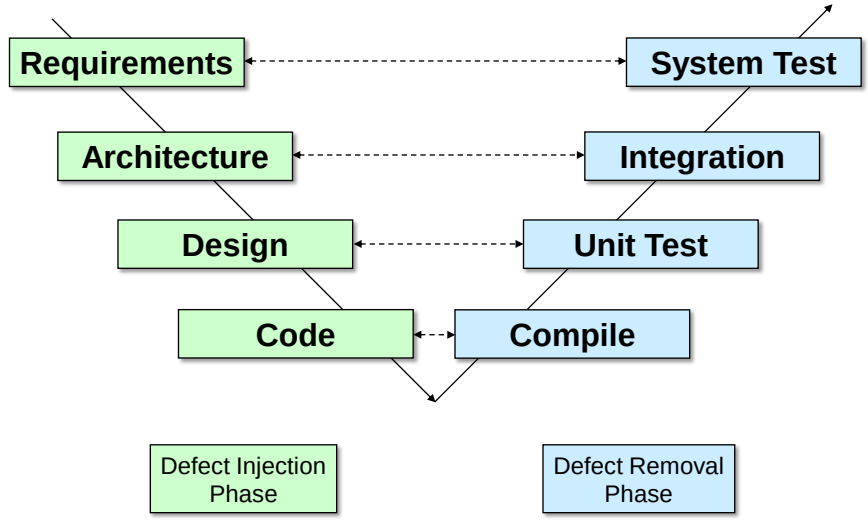
The focus of this presentation is on measurement and management of defects

Measurement Driven Improvement

- With data you can:
  - Manage your product
    - Create project plans
    - Measure progress relative to a plan
    - Forecast quality and schedule outcome of the project
    - Take appropriate corrective action when there is a deviation from plan
  - Manage your process
    - Understand current process capability
    - Improve the product development processes

Defect Removal Strategy

The Develop and Test Cycle



Defect Removal Strategy – Test Phases

Test Phase \ Defect Type	Requirement Defects	Interface Defects	Logic Defects	Syntax Defects
Compile	Unlikely	Unlikely	Unlikely	YES
Unit Test	Maybe	Maybe	YES	Why wasn't it caught during Compile ?
Integration Test	Maybe	YES	Why wasn't it caught during Unit Test ?	Why wasn't it caught during Compile ?
System Test	YES	Why wasn't it caught during Integration ?	Why wasn't it caught during Unit Test ?	Why wasn't it caught during Compile ?

Defect Removal Strategy – Summary

- Each defect removal phase should have a specified purpose or objective
- Each defect removal phase should be expected to remove ALL of the defects that exist up to that point
- When a defect removal phase finds defects that could have been caught earlier, then you should question why they weren't

Defect Removal Plan

Estimating Test Effort

Effort to run test cases in order to find/fix defects

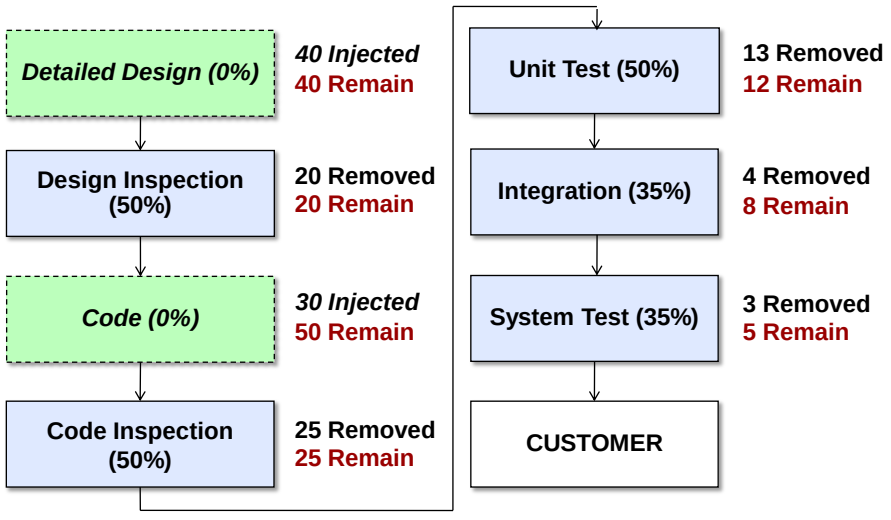
(# predicted defects) x (avg time to find/fix a defect)

PLUS

Effort to run test cases for a final, clean run

(# test cases) x (avg time to run a test case)

Predicting Defects



Referenced to 1KLOC New and Changed LOC

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The Quality Matrix

Phase	Remaining	Injected	Present	Yield	Removed
Design	0.0	40	40.0	0%	0.0
Design Inspection	40.0	0	40.0	50%	20.0
Code	20.0	30	50.0	0%	0.0
Code Inspection	50.0	0	50.0	50%	25.0
Unit Test	25.0	0	25.0	50%	12.5
Integration Test	12.5	0	12.5	35%	4.4
System Test	8.1	0	8.13	35%	2.8
Customer	5.3				

- **Referenced to 1KLOC New and Changed LOC**
- **Numbers are for illustration only, yours may differ**
- **If you have any data at all, then use your data to modify the assumptions in this quality matrix**

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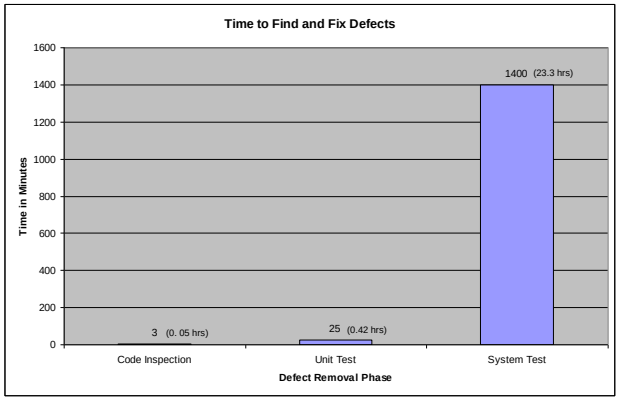
Cost of Quality

Phase	Defects Remaining	Defects Injected	Defects Present	Defect Removal Yield	Defects Removed	Cost/ Defect	Defect Removal Cost
Design	0.0	40	40.0	0%	0.0		
Design Inspection	40.0	0	40.0	50%	20.0	10 min	3.3 hrs
Code	20.0	30	50.0	0%	0.0		
Code Inspection	50.0	0	50.0	50%	25.0	5 min	2.1 hrs
Unit Test	25.0	0	25.0	50%	12.5	12 min	2.5 hrs
Integration Test	12.5	0	12.5	35%	4.4	5 hrs	22.0 hrs
System Test	8.1	0	8.1	35%	2.8	10 hrs	28.0 hrs
Customer	5.3						

Relative Defect Costs - Xerox



Reference: Watts S.Humphrey, *Winning with Software*, Reading, MA: Addison-Wesley, 2002

Consider the time required to find and fix 100 defects

Inspection = 5 hrs; Unit Test = 42 hrs; System Test = 2,340 hrs

Calculating Your Average Find/Fix Time

- Determine total phase effort
  - Take the total duration spent in phase (ex. 14 weeks)
  - Multiply by the # of people working on that phase
- Determine total defects found and fixed in phase
  - Problem report data
  - Defect logs
- Avg Find/Fix Time = (Total Effort) / (Total # Defects)

Even rough estimates of your own find/fix time is better than not knowing.

Cost of Quality – Without Inspections

Phase	Defects Remaining	Defects Injected	Defects Present	Defect Removal Yield	Defects Removed	Cost/ Defect	Defect Removal Cost
Design	0.0	40	40.0	0%	0.0		
Design Inspection	40.0	0	40.0	0%	0.0	10 min	0 hrs
Code	40.0	30	70.0	0%	0.0		
Code Inspection	70.0	0	70.0	0%	0.0	5 min	0 hrs
Unit Test	70.0	0	70.0	50%	35.0	12 min	7.0 hrs
Integration Test	35.0	0	35.5	35%	13.0	5 hrs	65.0 hrs
System Test	22.0	0	22.0	35%	8.0	10 hrs	80.0 hrs
Customer	14.0						

	w/out Inspections	w/ Inspections
Cost of Quality	152 hrs	
Defects delivered to Customer	14 defects	

Cost of Quality – With Inspections

Phase	Defects Remaining	Defects Injected	Defects Present	Defect Removal Yield	Defects Removed	Cost/ Defect	Defect Removal Cost
Design	0.0	40	40.0	0%	0.0		
Design Inspection	40.0	0	40.0	50%	20.0	10 min	3.3 hrs
Code	20.0	30	50.0	0%	0.0		
Code Inspection	50.0	0	50.0	50%	25.0	5 min	2.1 hrs
Unit Test	25.0	0	25.0	50%	12.5	12 min	2.5 hrs
Integration Test	12.5	0	12.5	35%	4.4	5 hrs	22.0 hrs
System Test	8.1	0	8.1	35%	2.8	10 hrs	28.0 hrs
Customer	5.3						

	w/out Inspections	w/ Inspections
Cost of Quality	152 hrs	58 hrs
Defects delivered to Customer	14 defects	5.3 defects

Defect Removal Plan – Summary

- **You can build a simple MS Excel spreadsheet to model your defect injection and removal activity.**
- **Using this model, you can plan for quality at each step in the development life cycle.**
- **There is a considerable variability in industry data. Even rough estimates of your own find/fix time is better than using industry data.**

Managing to the Plan

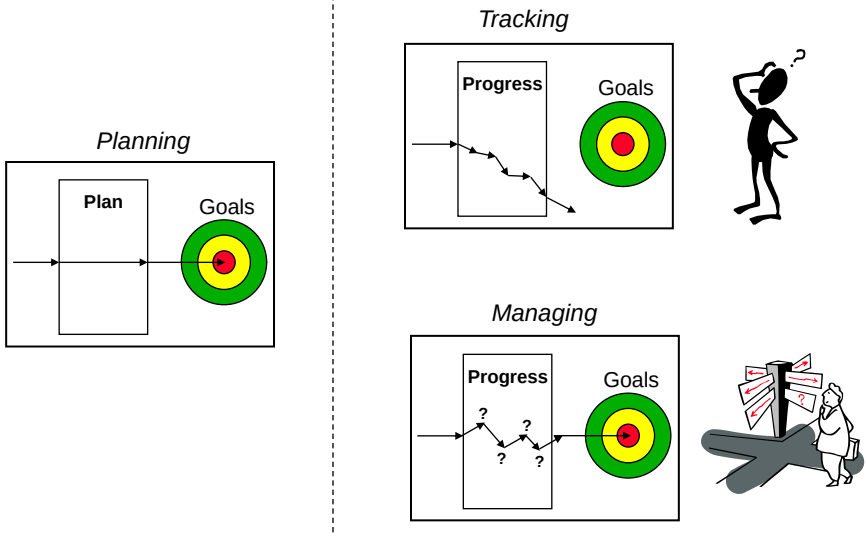
Definition: Tracking vs Managing

- **Track:**
  - **to follow by vestiges : TRACE**
  - **to observe or plot the moving path of (as a spacecraft or missile) instrumentally**
  - **to keep track of (as a trend) : FOLLOW**

- **Manage:**
  - **to work upon or try to alter for a purpose**

Source: Merriam-Webster Online Dictionary

Project Tracking vs Project Management



Tracking vs. Managing

- **Tracking**
  - **Collect data**
  - **Report status**
- **Managing**
  - **Collect data**
  - **Analyze the data**
  - **Take corrective action to keep process in control**
  - **Anticipate problems and take preventative action**

Quantitative Entry and Exit Criteria

- Entry and exit criteria gate the process, preventing product of questionable quality from automatically moving forward
- Product must meet exit criteria before it is allowed to exit current phase
- Product must meet entry criteria before it is allowed to enter the next phase
- Not meeting exit or entry criteria does not mean that product quality is poor, only that it should be examined
- Product determined to be of poor quality is not advanced
- Helps prevent surprises in downstream testing

Setting Entry / Exit Criteria

Phase	Defects Remaining	Defects Injected	Defects Present	Defect Removal Yield	Defects Removed	Defects Removed Lower Limit	Defects Removed Upper Limit
Design	0.0	40	40.0	0%	0.0		
Design Inspection	40.0	0	40.0	50%	20.0	16	24
Code	20.0	60	80.0	0%	0.0		
Code Inspection	50.0	0	50.0	50%	25.0	20	30
Unit Test	25.0	0	25.0	50%	12.5	10	15
Integration	12.5	0	12.5	35%	4.4	3.5	5.3
System Test	8.1	0	8.13	35%	2.8	2.3	3.4
Customer	5.3						

Defect removal thresholds

Managing to the Plan – Summary

- To "track" means to collect data
- To "manage" means using that data to take some action and to alter the trajectory of the project
- By "gating" the process, poor quality product can be identified and reworked early in the life cycle, helping to ensure a high quality product is delivered into system test

Summary

- In order to meet schedule commitments, you must explicitly plan for product quality
- Defects happen. The big question is …
  What are we going to do about it?
- Analyze and understand the economics of your current defect removal methods. Look for opportunities to improve.
- Build a quality plan.
- Manage to the quality plan by using the data to take appropriate corrective actions when needed.

Contact Information

For additional information visit our web site at:

www.SoftwareSixSigma.com

Or contact us at:

Ellen George +1 (201) 358-8828
EllenGeorge@SoftwareSixSigma.com

Steve Janiszewski +1 (201) 947-0150
SteveJaniszewski@SoftwareSixSigma.com