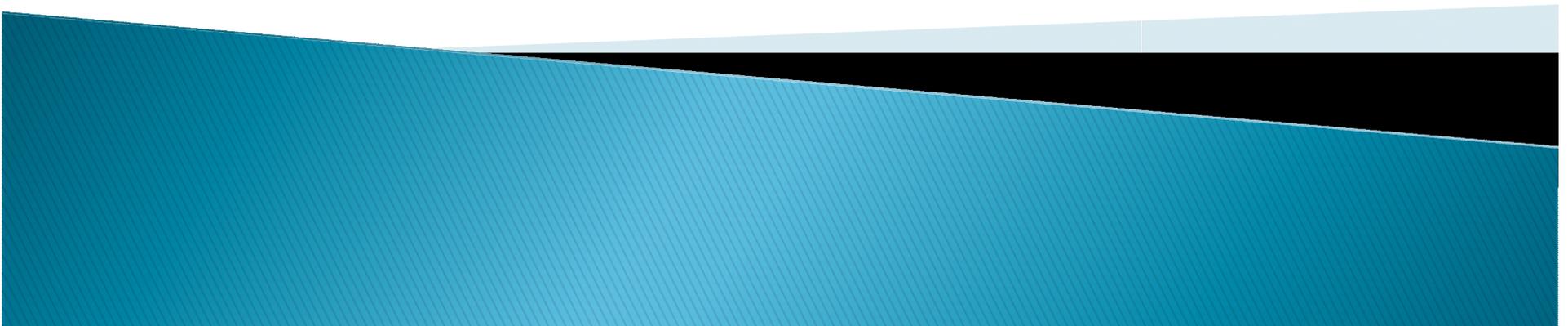


The Last 9% Uncovered Blocks of Code

A Case Study

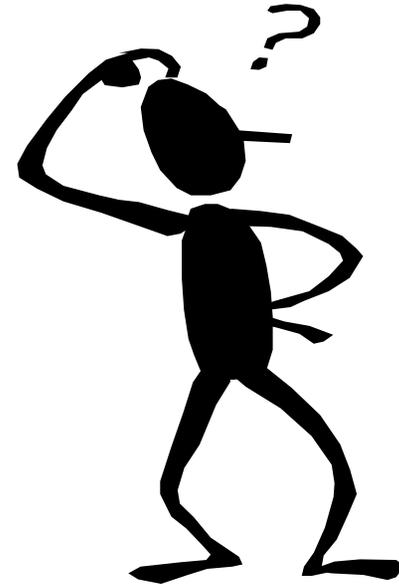
Cristina Manu
Cristina.Manu@microsoft.com



Testing Process

- ▶ Documentation
- ▶ Functional testing
- ▶ Scenario testing
- ▶ Stress testing
- ▶ Performance testing
- ▶ Security testing
- ▶ Code Reviews
- ▶ Usability
- ▶ User studies
- ▶ Customer involvement

...

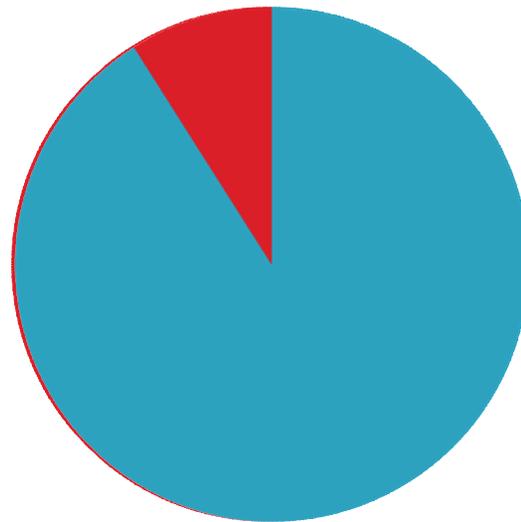


Are we done ?

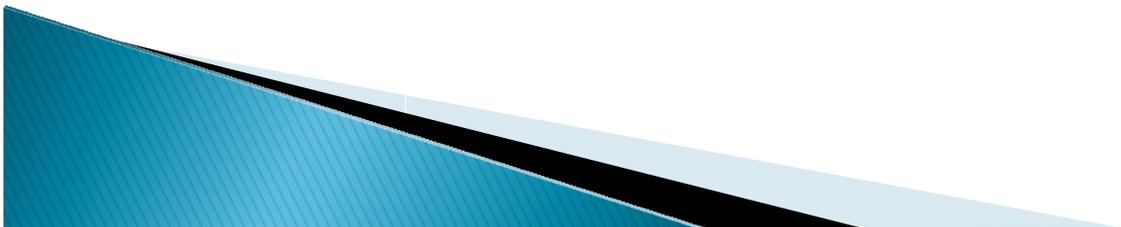


Some help...

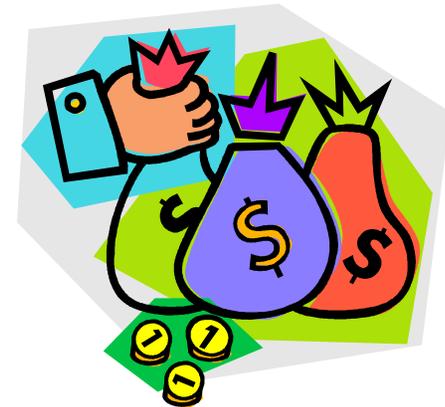
- ▶ Block Coverage analysis



■ Covered
■ Not Covered



- ▶ 100% block coverage



What we know...

- High Block Coverage \neq ship readiness
- High Block Coverage $==$ increases the confidence in the product quality
- Block Coverage analysis \rightarrow good technique for understanding what code has not been exercised by an existing test bed



... and what we don't

How much we should invest in increasing the Block Coverage Values



Block Coverage Project Goals

- ▶ Answer to the questions:
 - What is left in the uncovered areas?
 - What is the returned value of the effort done to increasing the block coverage?
 - In addition to the possible bugs found, are there any other benefits to be gained by investigating the coverage data?



Block Coverage Project Description

- ▶ Two main efforts focused on:
 1. Public API space and high cyclomatic complexity code paths
 2. Reach 100% block coverage



Measurements

Return of Test Effort (RTE)

Sum of bugs found per day weighted by severity in rapport with the time invested

$$RTE = \frac{\sum_{k=1}^{\maxSeverity} BugsOfSev(k) * 2^{(\maxSeverity+1-k)}}{TimeInvested}$$



Measurements

Return of Coverage Efforts (RCE)

Number of new blocks covered per day

$$RCE = \frac{\sum_{k=1}^{\maxSeverity} \Delta(oldCC, newCC)}{TimeInvested}$$



Measurements

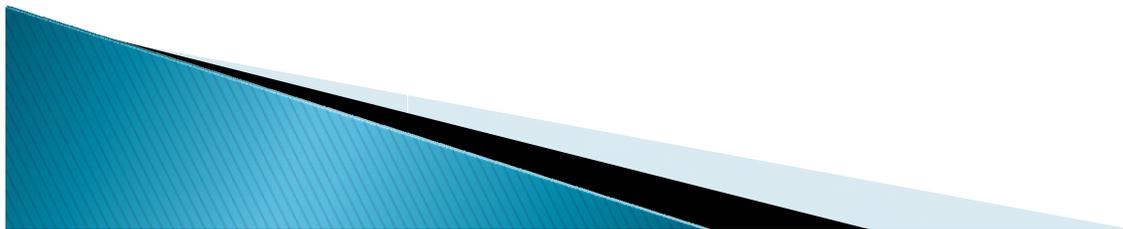
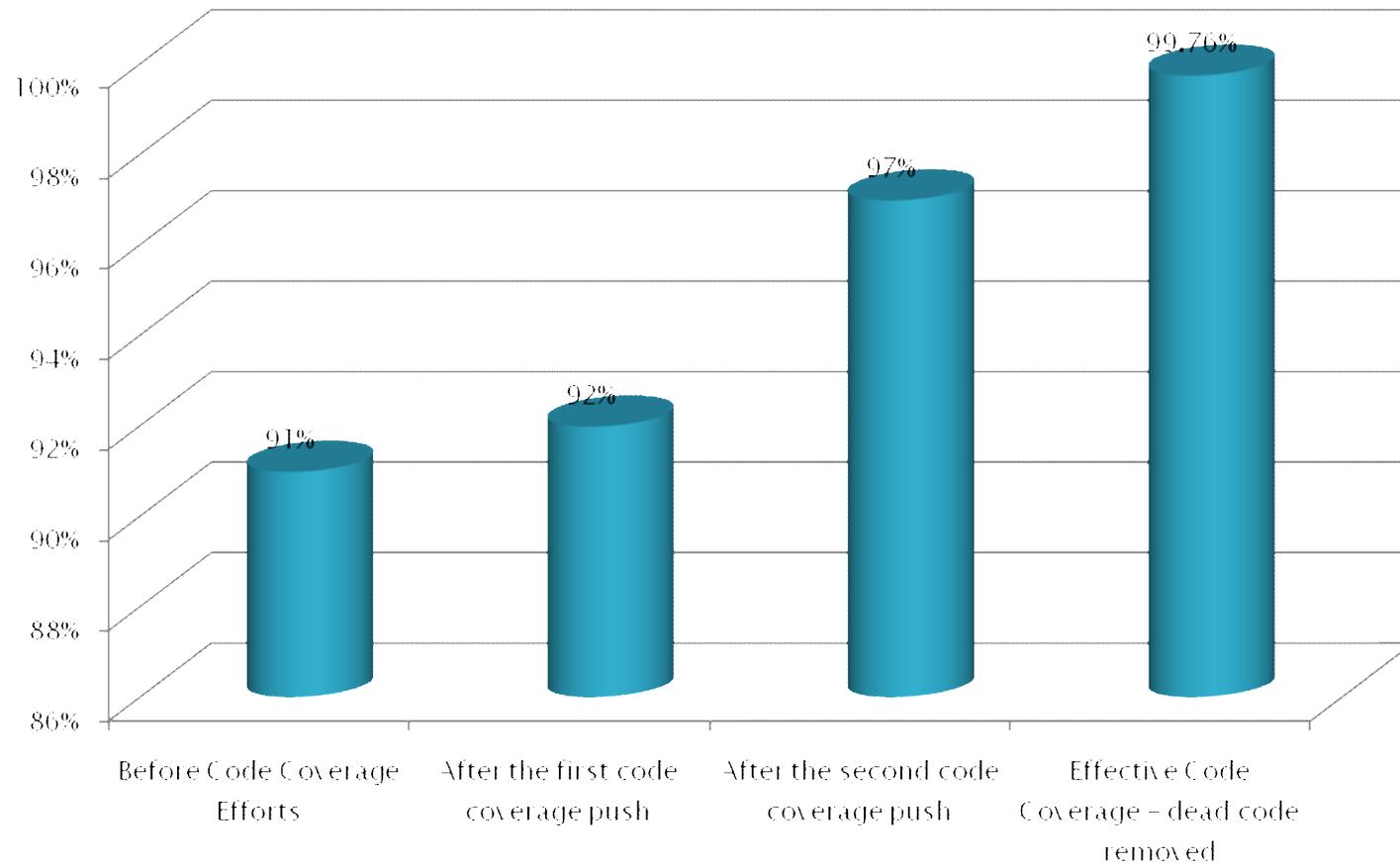
Bug Finding Efficiency (BFE)

Ratio of the number of bugs found by a specific test activity, compared to other test activities

$$BFE(\text{timeInterval}) = \frac{CCBugCount(\text{timeInterval})}{TotalBugCount(\text{timeInterval})} \%$$



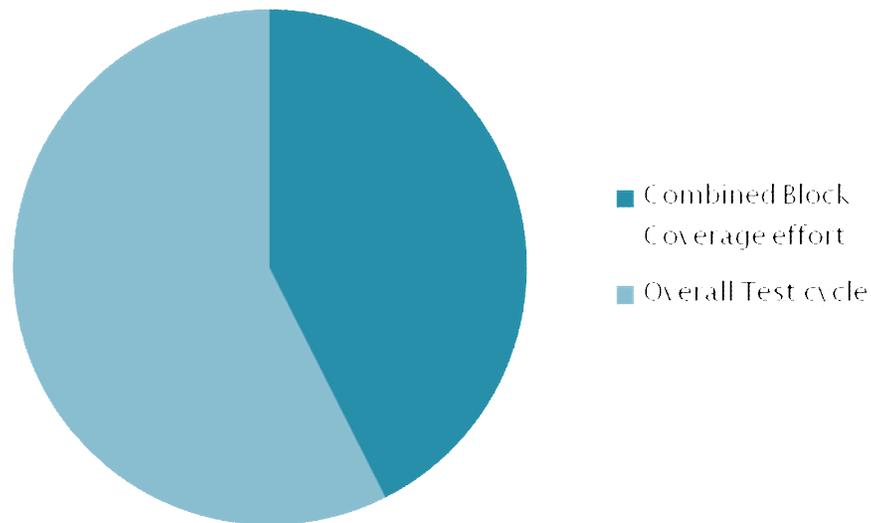
Results



Results

Return of Test Effort (RTE)

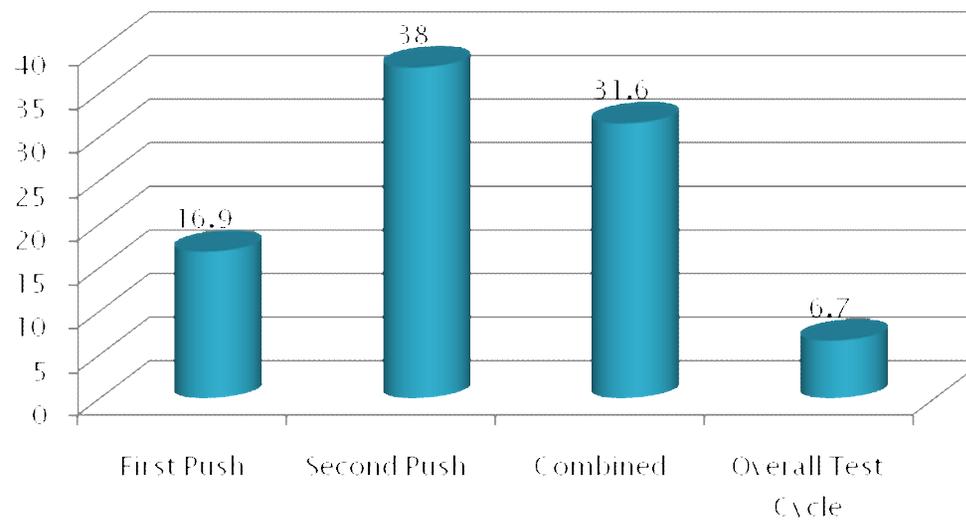
A function of numbers of bugs founded weighted by their severity and the time invested



Results

Return of Coverage Efforts (RCE)

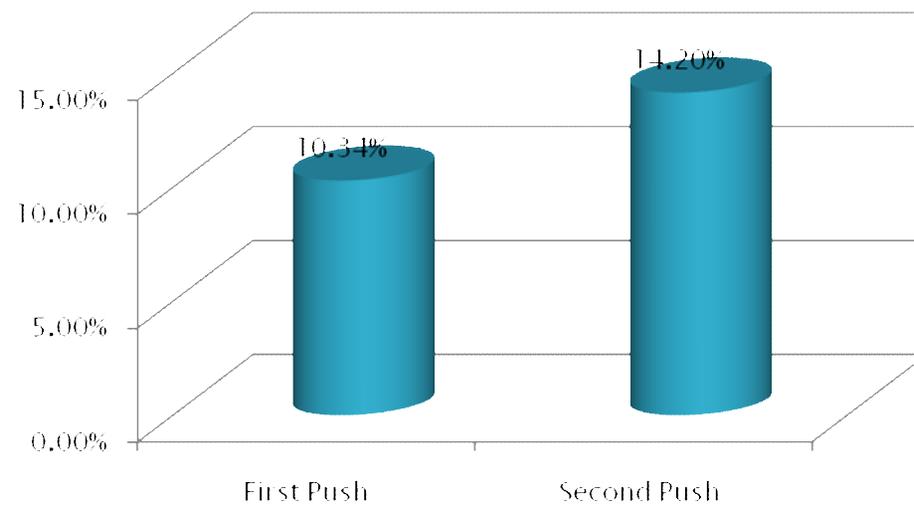
The RCE values represent an estimation of the blocks covered per day



Results

Bug Finding Efficiency (BFE)

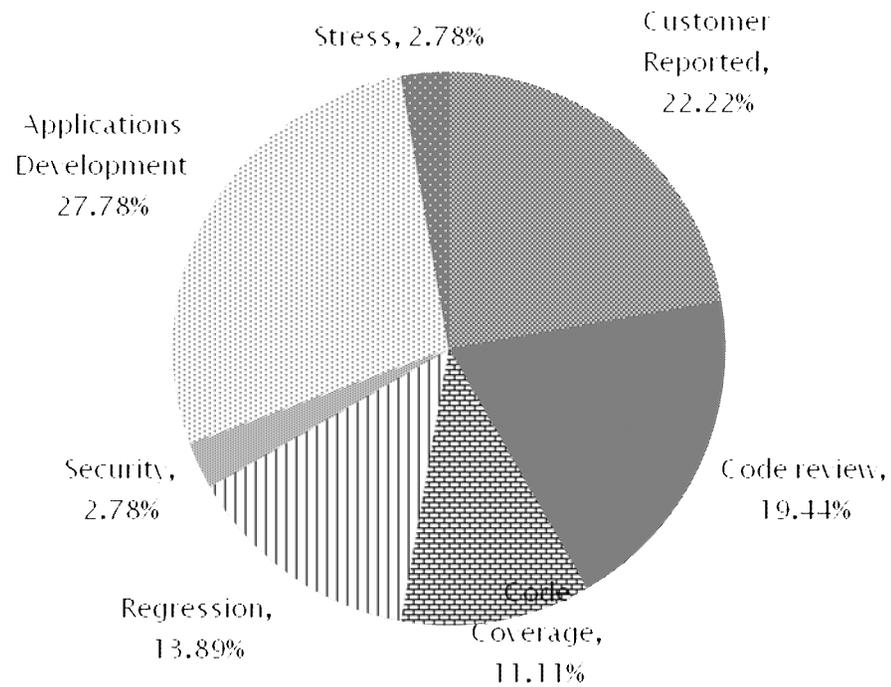
A measure to understand how effective the code coverage activity was for finding bugs when compared to other test activities



Results

Bug classification

BugDistributionOnTestingTypes



Reaching 100% block coverage ... is it hard?

- ▶ It is costly but not prohibitive
- ▶ Factors that increase the cost
 - Nature of the product
 - Special cases
 - Dead code



Key Take Aways

- ▶ Use Block Coverage investigations to find missing test patterns and increase confidence
- ▶ Block Coverage analysis encourages white box testing
- ▶ Strive for perfection, stop at the right balance



Q & A

