Testing in the Lifecycle

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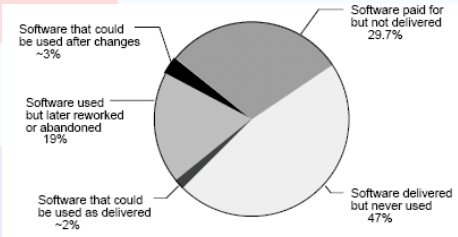
Slides thanks to Stuart Anderson

informatics

Software was difficult to get right in 1982



Year 1982: Nine Contracts Totalling $6.8 Million

It was still difficult in 1995

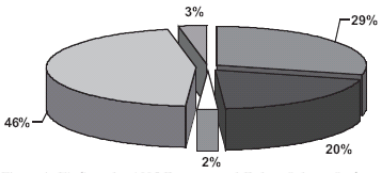


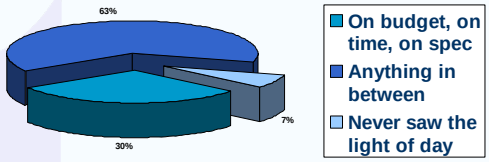
Figure 1: *Findings of a 1995 Department of Defense Software Study*

- Software paid for, but not delivered - 29%
- Software used, but extensively reworked or abandoned - 20%
- Software used as delivered - 2%
- Software delivered, but not successfully used - 46%
- Software used after changes - 3%

Total Software Costs - $35.7 billion

… and in 2007

Success rate of government IT projects and programmes



Source: The Guardian, 18 May 2007
Figures from Department for Work and Pensions spokesman (63%)
And Joe Harley, Chief Information Officer, DWP (30%)

And testing costs are significant

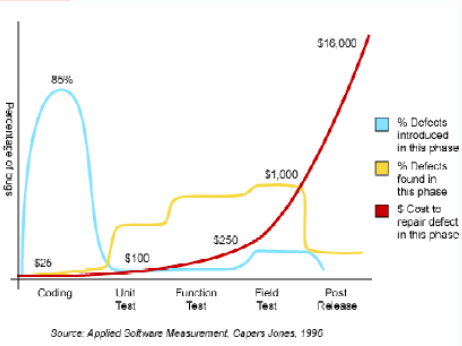
	METRIC	Proj. A	Proj. A1	Proj. B	Proj. C
1.	Testing as a part of the overall project effort	= 15.3%	= 11%	= 16.6%	=8.57%
2.	Integration effort per line of code (man months /kloc)	= 0.4			
3.	Cost of Requirement Change [man hours / change]	23.3	16.7	13	8.75
4.	Functional Coverage	Coverage =80%		Not available	Not available
5.	Code Coverage	Coverage =55% According to literature			

[Gallant, 1999] (and Winokur, 1998?)

Cost of Testing vs Cost of Defects

- NIST report (2002): "The Economic Impacts of Inadequate Infrastructure for Software Testing"
- Notes that "developers already spend approximately 80% of software development costs on identifying and correcting defects".
- "Identifying and correcting defects" not necessarily the same thing as the cost of testing, but still…

Costs of fixing defects found at different stages



Source: Applied Software Measurement, Capers Jones, 1996

Costs of Defects

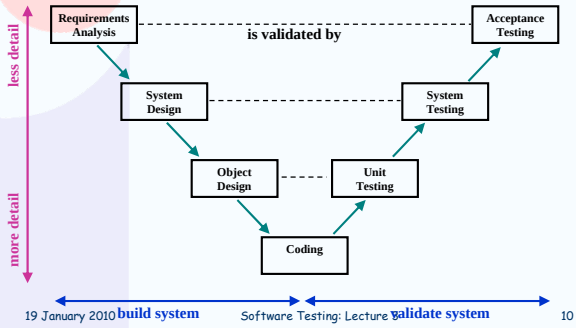
- Defects in the specification are even more costly to remove if we don't eliminate them early.
- Different software lifecycles distribute testing (verification – "building the thing right" and validation – "building the right thing") differently.
- The different distributions of test activity can have an impact on where bugs are discovered.
- We consider three representative lifecycles and consider where testing is located in each:
  - The V-model
  - Boehm's spiral model
  - eXtreme Programming ("XP")

Recap: "waterfall" model of software development

1. Requirements
2. Design
3. Implementation
4. Testing
5. Release and maintenance

- Sequential, no feedback
- Ironically its "author", Royce, presented it as an example of a broken model

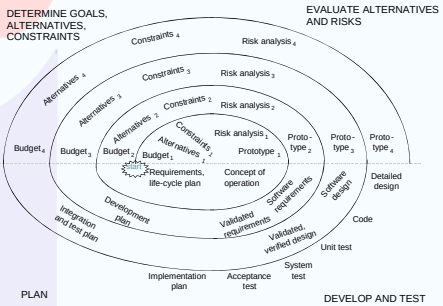
V-model



V-model Rationale

- This is a modified version of the waterfall model.
- Tests are created at the point the activity they validate is being carried out.
- So, for example, the acceptance test is created when the systems analysis is carried out.
- Failure to meet the test requires a further iteration beginning with the activity that has failed the validation.
- V model is focused on creating tests in a structured manner.
- It is popular with developers of systems that are highly regulated because it is well suited to creating evidence that can be used to justify a system to a regulator.

Boehm's Spiral Model



Spiral Model Rationale

- The spiral model is focused on controlling project risk and attempting formally to address project risk throughout the lifecycle.
- V & V activity is spread through the lifecycle with more explicit validation of the preliminary specification and the early stages of design. The goal here is to subject the early stages of design to V&V activity.
- At the early stages there may be no code available so we are working with models of the system and environment and verifying that the model exhibits the required behaviours.

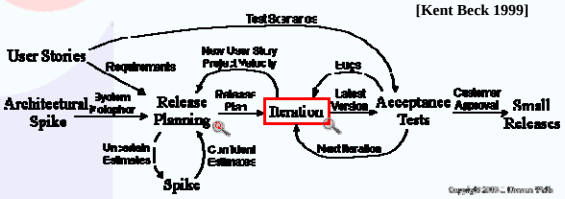
XP principles

- eXtreme Programming advocates working directly with code almost all the time.
- The 12 principles of XP summarise the approach.
- Development is test-driven .
- Tests play a central role in refactoring activity.
- "Agile" development mantra: Embrace Change.

1. Test-driven development
2. The planning game
3. On-site customer
4. Pair programming
5. Continuous integration
6. Refactoring
7. Small releases
8. Simple design
9. System metaphor
10. Collective code ownership
11. Coding standards
12. 40-hour work week

Extreme programming (XP)

[Kent Beck 1999]



http://www.extremeprogramming.org/map/project.html

Summary

- We have considered three different approaches to the lifecycle and have seen how testing fits in the lifecycles.
- Each approach will have a different testing cost and cost-profile through the lifecycle.
- Lifecycles are often dependent on the type of product and how well we understand project risk.