

# THE SOFTWARE ECONOMICS OF LATE BUG FIXES:

## Effort Multiples to Find/Fix Errors caught in Systems Test that should have been caught in earlier Software Development Phases

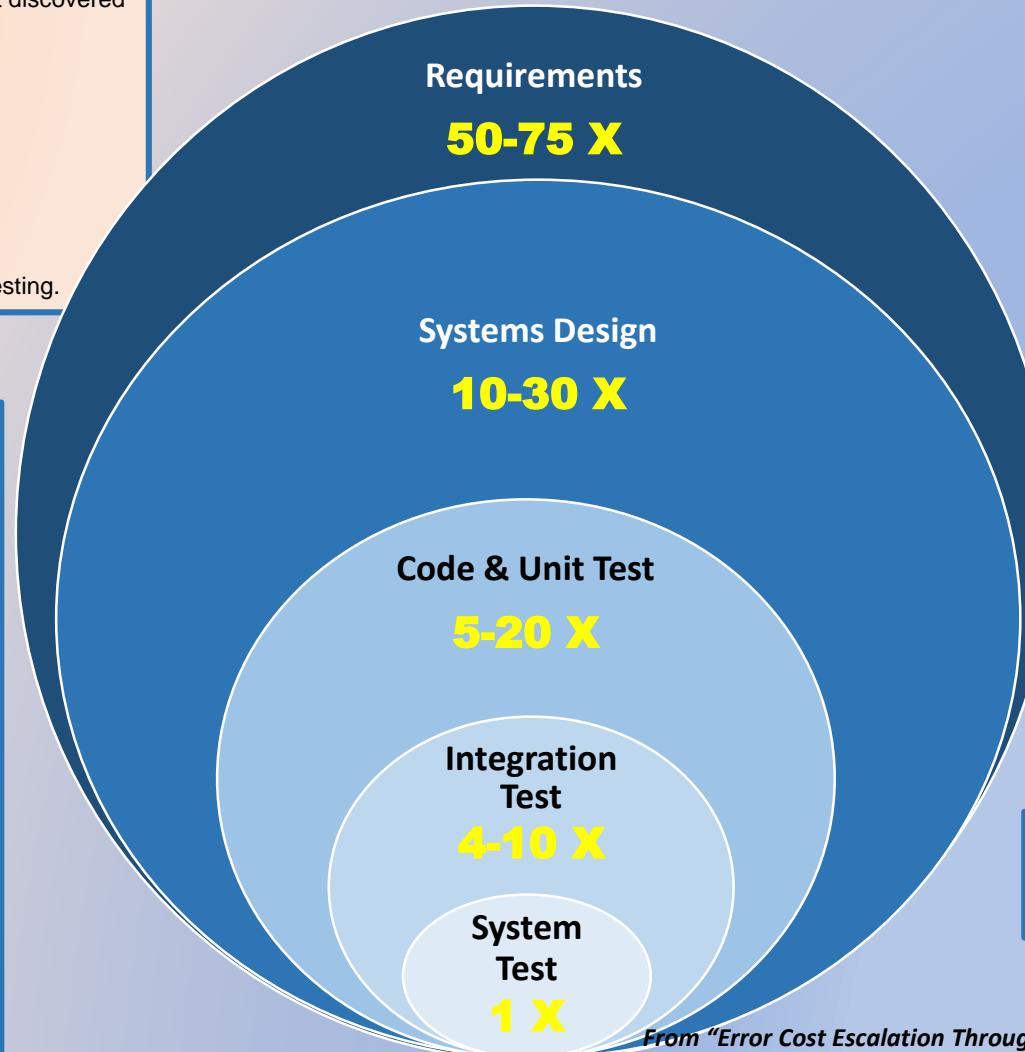
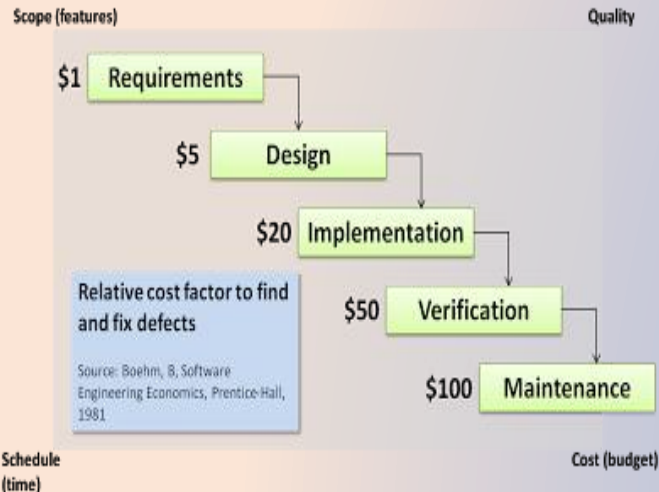
**Additional multiples** of Developer/Integrator effort are needed to isolate and fix errors found in System Testing that were not discovered earlier because of:

- Shortcuts taken
- Abandoning industry “best practice testing methods”
- Under-budgeted test resources & schedule
- unskilled/ untrained testers
- Poor test management
- Failure to use automated tools as appropriate, and
- Of course, poor requirements, design and, lower level testing.

**Testing tasks and processes often shortcut include:**

- Complete, unambiguous, consistent requirements elicitation, documentation, prioritizing & management
- Poor system/software architecture design that doesn't really fit the requirements, goals, business case, etc.
- Static analyses (walkthrus, inspections, reviews, prototypes)
- Sufficient Dynamic Testing (#/types, breadth/scope)
- Negative test cases
- Documenting Unit Test Cases
- Regression Tests
- Visual checking of the Database
- Full end-to-end “Customer Business Processes” tests
- Conversion testing; interface testing (i.e., typically underestimated and performed at the last minute)
- Quality Testing (incl.: test code coverage; code complexity levels; conformance to coding standards)
- Performing certain performance tests (incl.: stress, reliability, scalability, ‘race’, usability, auditability, and maintainability testing; recovery/restart testing; hot backup testing)
- Creating/using/updating an automated regression test suite that can be turned over to Maintenance

From opposite perspective. (i.e., what costs 1 unit of effort to do right in Requirements, costs 5 units to find/fix in design, \$20 in implementation (code/unit test), \$50 in Testing/ acceptance, etc.



From “Error Cost Escalation Through the project Life Cycle” NASA Johnson Space Center and multiple peer-review publications.

**Note: The cost of finding/fixing errors after Go-Live/In-production can cost as much as 100 to 1000x more that if done right in requirements. (i.e., think Apple Maps release in 2012)**