

The Software Problem

"In 2000, total sales of software reached approximately \$180 billion, supported by a large workforce encompassing 697,000 software engineers and 585,000 computer programmers."

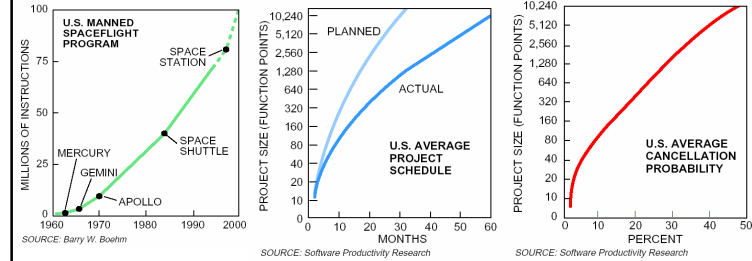
NIST News Release
Software Errors Cost U.S. Economy \$59.5 Billion Annually
 NIST Assesses Technical Needs of Industry to Improve Software-Testing

FOR IMMEDIATE RELEASE: June 28, 2002
 Contacts: Michael Newman (301) 975-3025
 NIST 2002-10

Software bugs, or errors, are so prevalent and so detrimental that they cost the U.S. economy an estimated \$59.5 billion annually, or about 0.6 percent of the gross domestic product, according to a newly released study commissioned by the Department of Commerce's National Institute of Standards and Technology (NIST). At the national level, over half of the costs are borne by software users and the remainder by software developers/vendors. The study also found that, although all errors cannot be removed, more than a third of these costs, or an estimated \$22.2 billion, could be eliminated by an improved testing infrastructure that enables earlier and more effective

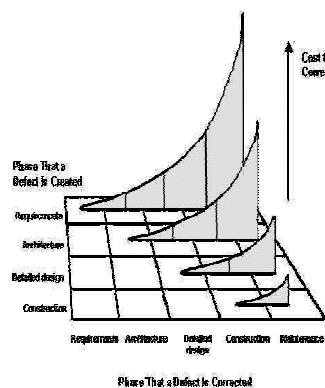
- Scale
- Users as bugs
- Users as evolution
- Evolution yields complexity and bugs
- Software engineering matters

Scale



Gibbs, Software's Chronic Crisis, Sci. Am., Sept. 1994

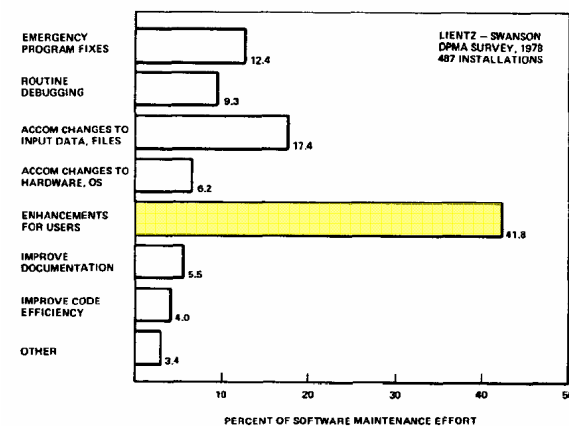
Users as Bugs



"Studies have found that **reworking** defective requirements, design, and code typically consumes **40 to 50 percent of the total cost of software development** (Jones 1986). As a rule of thumb, every hour you spend on defect prevention will reduce your repair time from three to ten hours. In the worst case, **reworking** a software requirements problem **once the software is in operation typically costs 50 to 200 times what it would take to rework the problem in the requirements stage** (Boehm and Papaccio 1988). It's easy to understand why. **A 1-sentence requirement can expand into 5 pages of design diagrams, then into 500 lines of code, 15 pages of user documentation, and a few dozen test cases.** It's cheaper to correct an error in that 1-sentence requirement at requirements time than it is after design, code, user documentation, and test cases have been written to it."

Steve McConnell, Software Quality at Top Speed, Software Development, August 1996

Users as Evolution



Boehm, SE as it is, ICSE'79

Evolution yields Complexity/Bugs

Figure 4 Serial and average growth trends of a particular attribute

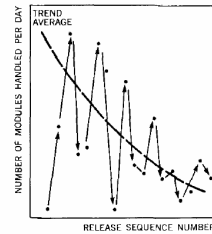
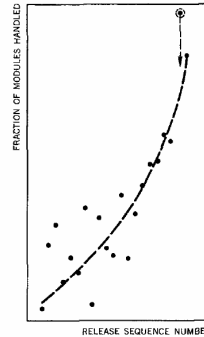
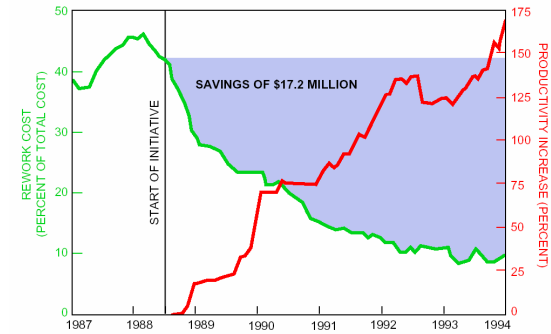


Figure 7 Complexity growth during the interval prior to each release



Belady & Lehman, A Model of Large Program Development, *IBM Systems Journal*, (15)3, 1976

Software Engineering Matters



SOURCE: Raytheon

RAYTHEON HAS SAVED \$17.2 million in software costs since 1988, when its equipment division began using rigorous development processes that doubled its programmers' productivity and helped them to avoid making expensive mistakes.

SCIENTIFIC AMERICAN September 1994 91

The Changing Face of Software

- Applications
 - Web 2.0
 - Developing world
 - Ubiquitous computing
- Methodologies
 - Open Source
 - Agile
- Technologies
 - Web services, javascript, AJAX
 - Programming environments (Eclipse), AOP
 - Model-driven software development

Do we rewrite the rules, or just reinterpret them?