Software Engineering

Empirical Results

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Seven Years War
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Actually nine years long
(1754-63)
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Britain lost 1,512 sailors to enemy action
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Britain lost 1,512 sailors to enemy action
And almost 100,000 to scurvy
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And almost 100,000 to scurvy
Unnecessarily
James Lind (1716-94)

1747: first controlled medical experiment in history
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- cider
- sea water
- vitriol
- oranges
- vinegar
- barley water
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Allowed British ships to be effective on long patrols during the Napoleonic Wars
1950: Hill & Doll study comparing smokers and non-smokers
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1. Smoking causes lung cancer
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1. Smoking causes lung cancer
2. Many people would rather fail than change
1950: Hill & Doll study comparing smokers and non-smokers
1. Smoking causes lung cancer
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1950: Hill & Doll study comparing smokers and non-smokers

1. Smoking causes lung cancer
2. Many people would rather fail than change
A rarity in software engineering until the mid 1990s
But today, papers describing new tools or working practices routinely include results from empirical studies. A rarity in software engineering until the mid 1990s.
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Many are flawed or incomplete, but standards are constantly improving.
Windows Vista

Software Engineering

Empirical Results
Unsurprising in retrospect
Unsurprising in retrospect
Actionable
What goes wrong in developers' first job?

Microsoft
What goes wrong in developers' first job?
What goes wrong in developers' first job?
What goes wrong in developers' first job?

Also unsurprising in retrospect, and actionable.
Statistics is just one path
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Controlled experiments are expensive...
Statistics is just one path

Controlled experiments are expensive...
...and often eliminate exactly what we want to study
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Biggest hurdle is re-education
Test-Driven Development
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An article of faith among many programmers
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Meta-analysis of over 30 studies
No consistent effect
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No consistent effect
• Some positive
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The better the study, the weaker the signal
Boehm et al (1975): "Some Experience with Automated Aids to the Design of Large-Scale Reliable Software"
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...and many more since
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Most errors introduced during requirements analysis and design

![Graph showing the number of errors and cost over time]
Boehm et al (1975): "Some Experience with Automated Aids to the Design of Large-Scale Reliable Software"

...and many more since

Most errors introduced during requirements analysis and design
The later they are removed, the more expensive they are
Pessimists

Optimists
If we tackle the hump in the error injection curve, fewer bugs will get to the expensive part of the fixing curve.

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If we do shorter iterations, the total cost of fixing bugs will go down.

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Optimists
Fagan 1975: "Design and Code Inspections to Reduce Errors in Program Development"
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Reading code carefully is the most cost effective way to find bugs
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Cohen 2006: most of the value comes from the first hour and the first pair of eyes
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Reading code carefully is the most cost effective way to find bugs

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Code review now normal in open source
Facts and Fallacies of Software Engineering

Robert L. Glass
Foreword by Alan M. Davis
Do programming languages affect productivity?
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Does using design patterns make for better code?
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Can we predict software faults statistically?
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Is up-front design cost-effective?
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Why is it hard to learn how to program?
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Is up-front architecture cost-effective?

Why is it hard to learn how to program?

Is open source software actually better?
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Are some programmers 10X better?