Lecture 1
Introduction to
Empirical Software Engineering
Constantly Evolving Technology
Constantly Evolving Technology

CASE tools

structured design

abstract data types

maturity models

structured programming
Research Claims
Research Claims
by Vendors...
Research Claims
by Vendors...

Productivity increases by 250%!
Research Claims by Vendors...

Productivity increases by 250%!

Maintenance Effort decreases by 80%!
How do I decide which tool to use?
How do I decide which tool to use?

one way to find out...
How do I decide which tool to use?

one way to find out...

Experimentation
How do I decide which tool to use?

one way to find out...

Experimentation

or

Empirical Software Engineering
Empirical means...?
Empirical means...?

- “Relying on or derived from observation or experimentation.”
- “Verifiable or provable by means of observation or experimentation.”
Empirical Software Engineering

“...a branch of software engineering where the focus is to experiment on software systems including its products and processes.”
Empirical Software Engineering

“...a branch of software engineering where the focus is to experiment on software systems including its products and processes.”

...or Experimental Software Engineering?
Analytical Advocacy Research

gtrust me... it will work!
Aeronautical Engineering
Aeronautical Engineering

Empirical analysis and testing
Formal Methods

Evidence for use in fault tolerant systems?

Widespread appeal without rigorous experimentation.

Adoption requires revolutionary change in design.

IBM claimed a saving of $5.5 million, 9% and 60% fall in defects.

Fig. 2. Example 1.
What can we borrow from other mature disciplines?
... law of mechanics described how particles respond to forces.

... law of gravity described how mass of objects is involved in their attraction for one another.
“most physicists believed that the world works in a rational way, and if they tried hard enough, they could find the rules by which this behaviour happens.”
Albert Einstein

Theory of Relativity
Goal-Question-Metric

Today's definition of above average rainfall
Poor Experimental Design

Later, David Scanlan conducted experiments to suggest otherwise. He also pointed many design flaws in the above experiment.

Ben Schneiderman and colleagues showed that flowcharts do not help programmers' comprehension.
Why Experiment?

Experiments don’t prove a thing.

Experiments can only show the presence of bugs in a theory, not their absence.

Edsger Dijkstra
University of Texas, Austin
Fallacy 1

Traditional Scientific Experimentation is Inapplicable
Fallacy 2

The current level of experimentation is good enough.
Fallacy 3

Experiments cost too much
Fallacy 4

Demonstrations will suffice.
Fallacy 5

There is too much noise.
Fallacy 6

Experiments will slow progress.
Fallacy 7

Technology changes too fast.
Fallacy 8

You’ll never get it published.
Conclusions

• ...but, currently little empirical evidence to confirm improvements.
Conclusions

• ...but, currently little empirical evidence to confirm improvements.
• need to carefully assess costs and benefits.
Conclusions

- ...but, currently little empirical evidence to confirm improvements.
- need to carefully assess costs and benefits.
- Perhaps, a widespread demand for change might change things?
Sources of Material

