Evaluation in Software Engineering

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What is Software Engineering?

Software Engineering means application of a systematic, disciplined, quantifiable approach to development, operation and maintenance of software.

IEEE Standard Glossary

- Evaluation and measurement play a pivotal role in Software Engineering
Software Engineering is Hard

- Software Engineering was born in 1968, but it is still maturing

- Software development is by no means easy
  - It runs over a long period of time
  - It involves many people
The complexity of software process means that it is hard to optimize it.

- Companies need to continuously try to improve their software processes.
The Value of Evaluation

- Software engineers need to know methods, process and techniques
  - But, they also should know how to evaluate them
- A practitioner wants to evaluate methods and techniques before introducing them into the organization
- A researcher wants to evaluate new results against something existing
Evaluation is Control

“You can't control what you can't measure”

Tom DeMarco

Control comes from being able to evaluate new methods, techniques, languages and tools
Process Evaluation

- Evaluation of a process requires people using it
  - Empirical studies are crucial to evaluate process and human-based activities

- Empirical studies are common in social and behavioral sciences
To perform scientific research in software engineering, we have to:
- Understand the methods available
- Understand their limitations
- Understand when they can be applied

There are four main research methods in software engineering:
- Analytical, Scientific, Engineering, and Empirical
Analytical and Scientific

- **Analytical Method**
  - A formal theory is proposed and then compared with empirical observations
  - It is often used in more formal areas of computer science, such as algorithms

- **Scientific Method**
  - The world is observed and a model is built based on observations
  - It is usually used in applied areas, such as network (to evaluate performance)
Engineering and Empirical

- Engineering Method
  - The current solutions are studied and changes are proposed
  - It is dominating in industry

- Empirical Method
  - A model is proposed and evaluated through empirical studies
  - Empirical studies have traditionally been used in social sciences and psychology
We Need Scientific Approach

- The engineering and empirical methods are variations of the scientific method.
- A more scientific approach to software engineering is needed:
  - Engineering method involves higher costs due to actual changes.
  - The nature of software engineering is similar to social sciences (it depends on human behavior).
Let’s Use Empirical Methods

- Empirical methods need to be further studied and used in software engineering.
- The need for systematic experimentation has been emphasized since middle 80s.
  - Basili raised this concern followed by Fenton, Kitchenham, Pfleeger and others.
- The number of experiments in software engineering has increased.

- Chapter 1 - Introduction