

Software Engineering

Empirical Methods in Software Engineering (01QTFIU)



SoftEng
<http://softeng.polito.it>

<http://softeng.polito.it/EMSE/>

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1






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2



3

Software Engineering

- The origin of the discipline
 - ♦ Garmish 1968
 - ♦ NATO organized conference
 - Motivation was that the computer industry at large was having a great deal of trouble in producing large and complex software systems

4

Software Engineering

Multi person construction of
multi version software

- ♦ Parnas

SE

A discipline that deals with the
building of software systems
which are so large that they
are built by a team or teams of
engineers

- ♦ Ghezzi, Jazayeri, Mandrioli

SE

- Sub-discipline of computer science
 - ♦ defining models, techniques, methods and tools to **support** the development of large software systems based on sound engineering principles
 - ♦ defining models, techniques, methods and tools to **manage** software development projects and organizations
 - ♦ empirically **evaluating** the effectiveness of models, techniques, methods and tools in specific contexts
 - Rombach

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7

Concerned with Software...

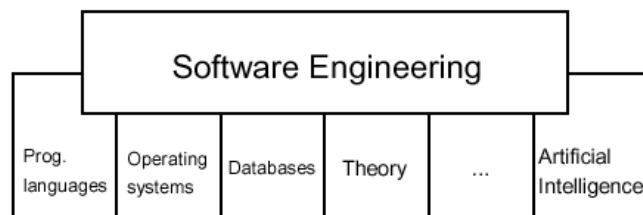


8



9

SE and CS



- Software engineering builds on the foundations of other computer science disciplines
- Also influenced their development
 - ♦ strong links in both directions

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10

Software Discipline Premises

- Evolutionary and experimental
- Development as opposed to production
- Makes use of technologies that are ultimately human based

Software is Software is Software?

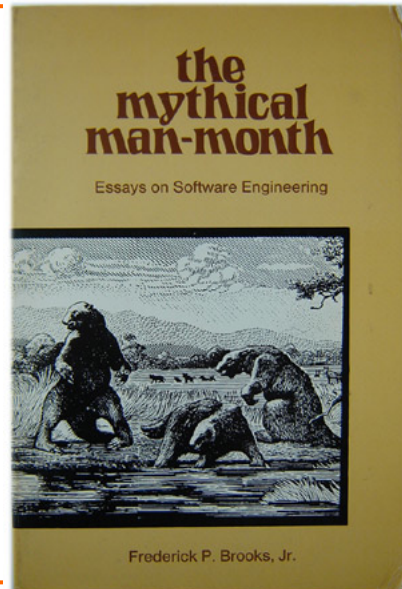
- No!
- All software is not the same
 - ♦ Process is a variable
 - ♦ Goals are variable
 - ♦ Content varies
 - ♦ ...

The mythical man-month

- Fred Brooks, 1975

*Adding manpower to
a late software project
makes it later.*

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13

13

SE Research Revisited

- Most software engineering research has followed a research-then-transfer methodology, with mixed results.
- We must do more than create new techniques, we must understand the old ones
- What is seen as major research problem is often trivial in practice

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Potts, 1993

14

14

SE Research Revisited

- We should pay more attention to human factors and not leave all the work to social psychologists
- Most of the research-then-transfer work that seeks to develop completely general tools is naïve.
- Changes that cannot be predicted can tell us a lot about what's really going on.
- Unless you know what to ask and what to measure, emphasis on quantitative data may be misguided

Is SE a science?

- No foundations in physics, chemistry, biology, ..
- Huge impact of human factors (individual and organizational level)
- Regular hypes and fashions ..
 - ♦ CASE Tools, OO, agile, services, cloud, ..

What is a science?

- Application of scientific method
 - ♦ Define hypothesis
 - ♦ Perform experiment to test hypothesis
 - If experiment contradict hypothesis, reject
 - Otherwise keep it
 - ♦ As more and more evidence accumulates, one or more hypotheses can form the basis for a scientific theory

What is NOT a science

- Hypothesis that cannot be falsified is not scientific [K. Popper]
 - ♦ Gold is soluble in hydrochloric acid
 - False, scientific
 - ♦ Some homeopathic medicine does work
 - May be true
 - Unscientific because cannot be rejected by one experiment / observation report

SE as a science

- Need to apply scientific method
- Need to empirically evaluate models, techniques and tools (empirical SE)
 - ♦ Is Java 'better' than C?
 - ♦ Is OO design 'better' than structured design?
 - ♦ Is agile 'better' than traditional?

Other inspiring disciplines

- Social sciences
 - ♦ Effect of education, age and sex on income
 - ♦ Effect of immigration on crime
- Medicine
 - ♦ Effect of smoke on lung cancer
 - ♦ Effect of cholesterol on heart illnesses

Myths and Facts of ESE

Myth	Fact
Scientific method is inapplicable	All we need is to observe a phenomenon, formulate hypotheses and test them
Current empirical level is enough	False when comparing to other disciplines
Experiments are expensive	Some experiments require a limited budget and often the return on investment pays off
Math demonstrations are enough	Demonstration are limited and can at most show the potentials
There is too much noise	Generally the noise can be separated from the subject
Experimentation hampers progress	Actually sound research favour progress
Technology changes too quickly	Research questions that lose interest rapidly are not worth while investigating
It is hard to publish	Small steps well validated can be easily published

21

21

Publication venues

- Primarily focused on ESE
 - ♦ Empirical Software Engineering Journal
 - <http://www.springer.com/computer/swe/journal/10664>
 - ♦ ESEM – Empirical Software Engineering and Measurement Conferences
 - <http://www.esem-conferences.org/>
 - ♦ EASE – Evaluation and Assessment in Software Engineering Conference
 - <http://www.scm.keele.ac.uk/ease/>

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22

22

Publication venues

- Journals
 - ♦ TSE:
 - <http://www.computer.org/portal/web/tse>
 - ♦ IEEE Software:
 - <http://www.computer.org/portal/web/software/home>
 - ♦ IST
 - <http://www.journals.elsevier.com/information-and-software-technology/>
 - ♦ JSS
 - <http://www.journals.elsevier.com/journal-of-systems-and-software/>
- Conferences
 - ♦ ICSE: <http://www.icse-conferences.org/>
 - ♦ ICSM: <http://conferences.computer.org/icsm/>
 - ♦ ICPC: <http://www.program-comprehension.org/>