Softwaretechnik / Software-Engineering

Lecture 1: Introduction

2016-04-18

Prof. Dr. Andreas Podelski, Dr. Bernd Westphal

Albert-Ludwigs-Universität Freiburg, Germany
Content

- Software, Engineering, Software Engineering

- Successful Software Development
  - working definition: success
  - unsuccessful software development exists
  - common reasons for non-success

- Course
  - Content
    - topic areas
    - structure of topic areas
    - emphasis: formal methods
    - relation to other courses
    - literature
  - Organisation
    - lectures
    - tutorials
    - exam
IEEE Standard Glossary of Software Engineering Terminology

Sponsor
IEEE Standards Coordinating Committee of the Computer Society of the IEEE

Approved September 28, 1990
IEEE Standards Board


Keywords: Software engineering; glossary; terminology; definitions; dictionary.

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Authorized licensed use limited to: UNIVERSITY OF FRIEDBURG. Downloaded on April 03, 2015 at 13:47:32 UTC from IEEE Xplore. Restrictions apply.
**Software** – Computer programs, procedures, and possibly associated documentation and data pertaining to the operation of a computer system.

See also: application software; support software; system software.

Contrast with: hardware.

IEEE 610.12 *(1990)*

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**Software** –

1. all or part of the programs, procedures, rules, and associated documentation of an information processing system. […]

2. see 610.12

3. program or set of programs used to run a computer. […]

NOTE: includes firmware, documentation, data, and execution control statements.

IEEE 24765 *(2010)*
## Engineering vs. Non-Engineering

<table>
<thead>
<tr>
<th>Mental prerequisite</th>
<th>workshop (technical product)</th>
<th>studio (artwork)</th>
</tr>
</thead>
<tbody>
<tr>
<td>the existing and available technical know-how</td>
<td>artist’s inspiration, among others</td>
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<thead>
<tr>
<th>Deadlines</th>
<th>can usually be planned with sufficient precision</th>
<th>cannot be planned due to dependency on artist’s inspiration</th>
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| Price | oriented on cost, thus calculable | determined by market value, not by cost |
|       |                                |                                            |

| Norms and standards | exist, are known, and are usually respected | are rare and, if known, not respected |
|                     |                                             |                                            |

| Evaluation and comparison | can be conducted using objective, quantified criteria | is only possible subjectively, results are disputed |
|                           |                                               |                                            |

| Author | remains anonymous, often lacks emotional ties to the product | considers the artwork as part of him/herself |
|        |                                                               |                                            |

| Warranty and liability | are clearly regulated, cannot be excluded | are not defined and in practice hardly enforceable |
|                       |                                               |                                            |

(Ludewig and Lichter, 2013)
Software Engineering –
(1) The application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software; that is, the application of engineering to software.

(2) The study of approaches as in (1).

IEEE 610.12 (1990)

Software Engineering –
1. the systematic application of scientific and technological knowledge, methods, and experience to the design, implementation, testing, and documentation of software.
2. see IEEE 610.12 (1)


Software Engineering:
Multi-person Development of Multi-version Programs.

D. L. Parnas (2011)

Software Engineering – the establishment and use of sound engineering principles to obtain economically software that is reliable and works efficiently on real machines.

F. L. Bauer (1971)
There is no universally accepted definition of software engineering. For some, software engineering is just a glorified name for programming. If you are a programmer, you might put “software engineer” on your business card but never “programmer.” Others have higher expectations. A textbook definition of the term might read something like this: “the body of methods, tools, and techniques intended to produce quality software.”

Rather than just emphasizing quality, we could distinguish software engineering from programming by its industrial nature, leading to another definition: “the development of possibly large systems intended for use in production environments, over a possibly long period, worked on by possibly many people, and possibly undergoing many changes,” where “development” includes management, maintenance, validation, documentation, and so forth.

David Parnas, a pioneer in the field, emphasizes the “engineering” part and advocates a software engineering education firmly rooted in traditional engineering—including courses on materials and the like—and split from computer science the way electrical engineering is separate from physics.

Because this article presents a broad perspective on software education, I won’t settle on any of these definitions; rather, I’d like to accept that they are all in some way valid and retain all the views of software they encompass. In fact, I am not just focusing on the “software engineering courses” traditionally offered in many universities but more generally on how to instill software engineering concerns into an entire software curriculum.

If not everyone agrees on the definition of the discipline, few question its importance. We might have wished for less embarrassing testimonials of our work’s societal relevance than the Y2K scare, but it is still fresh enough in everyone’s mind to remind us how much the world has come to rely on software systems. The institutions that teach software—are responsible for producing software professionals who will build and maintain these systems to the satisfaction of their beneficiaries. This article presents some ideas on how best to honor this responsibility.

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Judging by the employment situation, current and future graduates can be happy with their studies. The Information Technology Association of America estimated in April 2000 that 850,000 IT jobs would go unfilled in the next 12 months. The dearth of qualified personnel is just as perceptible in Europe and Australia. Salaries are excellent. Project leaders wake up at night worrying about headhunters hiring away some of their best developers—or pondering the latest offers they received themselves.
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The course’s working definition of Software Engineering

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F. L. Bauer (1971)
“software that is reliable and works efficiently” (Bauer, 1971)


6.1 Functionality
The capability of the software product to provide functions which meet stated and implied needs when the software is used under specified conditions.

6.1.1 Suitability
The capability of the software product to provide an appropriate set of functions for specified tasks and user objectives.
“software that is reliable and works efficiently” (Bauer, 1971)

Successful Software Development
A software development project is **successful** if and only if developer, customer, and user are happy with the result at the end of the project.
Is Software Development Always Successful?

Erfolgs- und Misserfolgsfaktoren bei der Durchführung von Hard- und Softwareentwicklungsprojekten in Deutschland

2006

Autoren:
Ralf Buschermöhle
Heike Eekhoff
Bernhard Josko

Report: VSEK/55/D
Version: 1.1
Datum: 28.09.2006
Some Empirical Findings (Buschermöhle et al. (2006))

- Budget in € (378 responses):
  - 1-9,999
  - 10,000-99,999
  - 100,000-499,999
  - 500,000-999,999
  - ≥ 1,000,000
  - Not specified

- Planned duration in months (378 responses):
  - ≤ 3
  - > 3-6
  - > 6-12
  - > 12-24
  - > 24

- Criticality (378 responses, 30 'not spec.')
  - Business critical
  - Mission critical
  - Safety critical

- Project completion (378 responses):
  - Completed
  - Cancelled

- Deadline (368 responses):
  - Kept
  - Early
  - Late

- Main functionality realised (368 responses):
  - Kept
  - Below
  - Above

- Secondary functionality realised (368 responses):
  - < 25%
  - 25-49%
  - 50-74%
  - 75-89%
  - 90-94%
  - 95-99%
  - 100%
A Closer Look

• **Successful:**

  **Time** $t$: 
  ![Diagram](image1)

  ![Diagram](image2)

  **Time** $t' \geq t$: 
  ![Diagram](image3)

• **Unsuccessful:**

  **Time** $t$: 
  ![Diagram](image4)

  ![Diagram](image5)

  **Time** $t' \geq t$: 
  ![Diagram](image6)

What might've gone wrong?
Some scenarios:

<table>
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- e.g. misunderstanding of requirements
- e.g. non-scalable design
- e.g. programming mistake
- e.g. wrongly conducted test
- e.g. wrong estimates
# Course Content

## Software Project Management

- **Capturing Requirements**
- **Design**
- **Implementation**
- **Code Quality Assurance**

<table>
<thead>
<tr>
<th>Module</th>
<th>Dates</th>
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<tbody>
<tr>
<td>Introduction</td>
<td>L 1: 18.4., Mon</td>
</tr>
<tr>
<td>Scales, Metrics, Costs</td>
<td>L 2: 21.4., Thu</td>
</tr>
<tr>
<td></td>
<td>L 3: 25.4., Mon</td>
</tr>
<tr>
<td></td>
<td>T 1: 28.4., Thu</td>
</tr>
<tr>
<td>Development</td>
<td>L 4: 2.5., Mon</td>
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<td></td>
<td>- 5.5., Thu</td>
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<td>L 5: 9.5., Mon</td>
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<tr>
<td></td>
<td>- 16.5., Mon</td>
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<tr>
<td></td>
<td>- 19.5., Thu</td>
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<td></td>
<td>T 2: 23.5., Mon</td>
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<tr>
<td></td>
<td>- 26.5., Thu</td>
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<tr>
<td>Requirements Engineering</td>
<td>L 7: 30.5., Mon</td>
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<tr>
<td></td>
<td>L 8: 2.6., Thu</td>
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<td>L 9: 6.6., Mon</td>
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<td>T 3: 9.6., Thu</td>
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<tr>
<td>Architecture &amp; Design</td>
<td>L10: 13.6., Mon</td>
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<td></td>
<td>L 11: 16.6., Thu</td>
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<td>L12: 20.6., Mon</td>
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<td>T 4: 23.6., Thu</td>
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<tr>
<td>Software Modelling</td>
<td>L13: 27.6., Mon</td>
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<td>L14: 30.6., Thu</td>
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<td>L15: 4.7., Mon</td>
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<td></td>
<td>T 5: 7.7., Thu</td>
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<tr>
<td>Quality Assurance (Testing, Formal Verification)</td>
<td>L16: 11.7., Mon</td>
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<td>L 17: 14.7., Thu</td>
</tr>
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<td></td>
<td>L18: 18.7., Mon</td>
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<tr>
<td></td>
<td>L19: 21.7., Thu</td>
</tr>
</tbody>
</table>
Example: Requirements Engineering

Vocabulary
- e.g. consistent, complete, tacit, etc.

Techniques
- informal
- semi-formal
- formal
**Excursion: Informal vs. Formal Techniques**

**Example**: Requirements Engineering, Airbag Controller

**Requirement:**

Whenever a crash is detected, the airbag has to be fired within 300 ms ($\pm \varepsilon$).

### vs.

- Fix observables:  
  - `crashdetected : Time $\rightarrow \{0, 1\}$
  - `fireairbag : Time $\rightarrow \{0, 1\}`

- Formalise requirement:

  \[
  \forall t, t' \in \text{Time} \quad \text{crashdetected}(t) \land \text{fireairbag}(t') \implies t' \in [t + 300 - \varepsilon, t + 300 + \varepsilon]
  \]

$\implies$ no more misunderstandings, sometimes tools can **objectively** decide: requirement satisfied yes/no.
no more misunderstandings, sometimes **tools** can **objectively** decide: requirement satisfied yes/no.
**Structure of Topic Areas**

**Example**: Requirements Engineering

- **Vocabulary**: e.g. consistent, complete, tacit, etc.
- **In the course**:
  - **Use Cases**
  - **Pattern Language**
  - **Decision Tables**
  - **Live Sequence Charts**
- **Techniques**:
  - informal
  - semi-formal
  - formal
  - e.g. “Whenever a crash…”
  - e.g. “Always, if ⟨crash⟩ at t…”
  - e.g. “∀ t, t’ ∈ Time • …”
Content

- Software, Engineering, Software Engineering
- Successful Software Development
  - working definition: success
  - unsuccessful software development exists
  - common reasons for non-success
- Course
  - Content
    - topic areas
    - structure of topic areas
    - emphasis: formal methods
    - relation to other courses
    - literature
  - Organisation
    - lectures
    - tutorials
    - exam
Course Software-Engineering vs. Other Courses

The lecturer points out connections to other topics areas (e.g. research, praxis).

- totally agree
- strongly disagree

%agreement
- fully agree
- agree
- neutral
- disagree
- fully disagree
On popular demand, the chair for software engineering agreed on: strong(er) coupling between both courses.
more on the course homepage.
Any Questions So Far?
Course: Organisation
Organisation: Lectures

- **Homepage:** [http://swt.informatik.uni-freiburg.de/teaching/SS2016/swtvl](http://swt.informatik.uni-freiburg.de/teaching/SS2016/swtvl)
- **Course language:** *English* (since we are in an even year)
- **Script/Media:**
  - *slides without* annotations on homepage with beginning of lecture the latest
  - *slides with* annotations on homepage typically soon after the lecture
  - *recording* on ILIAS (stream and download) with max. 2 days delay (cf. link on homepage)
- **Schedule:** topic areas à three 90 min. lectures, one 90 min. tutorial (with exceptions)
- **Interaction:** absence often moaned; but *it takes two*, so please ask/comment immediately.
- **Questions/comments:**
  - *“online”:* ask immediately or in the break
  - *“offline”:* (i) try to solve yourself  
    (ii) discuss with colleagues  
    (iii) a) *Exercises:* ILIAS (group) forum, contact tutor  
             b) *Everything else:* contact lecturer (cf. homepage)  
               or just drop by: Building 52, Room 00-020
- **Break:** we’ll have a *5-10 min. break* in the middle of each lecture (from now on), unless a majority objects *now.*
Schedule/Submission:
- exercises online (homepage and ILIAS) with first lecture of a block,
- early submission 24h before tutorial (usually Wednesday, 12:00, local time),
- regular submission right before tutorial (usually Thursday, 12:00, local time).
- please submit electronically via ILIAS; paper submissions are tolerated
- should work in teams of approx. 3, clearly give names on submission

Grading system: “most complicated grading system ever”
- Admission points (good-will rating, upper bound)
  (“reasonable grading given student’s knowledge before tutorial”)
- Exam-like points (evil rating, lower bound)
  (“reasonable grading given student’s knowledge after tutorial”)

10% bonus for early submission.

Tutorial: Three groups (central assignment), hosted by tutor.
- Starting from discussion of the early submissions (anonymous), develop one good proposal together,
- tutorial notes provided via ILIAS.
Organisation: Exam

- **Exam Admission:**

  Achieving 50% of the *regular admission points* in total is sufficient for admission to exam.

  20 regular admission points on exercise sheets 1–6, and 10 regular admission points on sheets 0 and 7

  → 120 *regular* admission points for 100%.

- **Exam Form:**

  - *written* exam
  - date, time, place: tba
  - permitted exam aids: one A4 paper (max. 21 x 29.7 x 1 mm) of notes, max. two sides inscribed
  - scores from the exercises *do not* contribute to the final grade.
  - example exam available on ILIAS
One Last Word on The Exercises…

- Every exercise task is a tiny little scientific work!
- Basic rule for high quality submissions:
  - rephrase the task in your own words,
  - state your solution,
  - convince your tutor of (at best: prove) the correctness of your solution.
Tell Them What You’ve Told Them...

- Basic vocabulary:
  - software, engineering, software engineering,
  - customer, developer, user,
  - successful software development

→ note: in many cases, definitions are neither formal nor universally agreed

- (Fun) fact: software development is not always successful

- Basic activities of software engineering:
  - gather requirements,
  - design,
  - implementation,
  - quality assurance,
  - project management

→ motivates content of the course

- Formal (vs. informal) methods
  - avoid misunderstandings,
  - enable objective, tool-based assessment

→ note: humans are at the heart of software engineering.

- Course content and organisation
Any (More) Questions?
References
References


