40 Years of Software Engineering

A Look Back

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Representing Views of F. L Bauer

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The initiative ...

In the second half of the 60s:

- US research organisations were dissatisfied by the state of programming
  - ◊ compilers worked quite well, but
  - ◊ operating system proved to be much harder than expected
- US Nobel price winner (in physics 1944) Isidor Isaac Rabi, a delegate in the NATO Science Committee, chairman of the Committee of scientific advisors to the US president, expressed his concern that research suffers under the bottleneck of software development
- NATO Science Committee decided to form a study group
- Professor Prestel from Hannover, the German delegate in the NATO Science Committee, approached Fritz Bauer and asked him to join this study group

Background of the Conference

- NATO Science Committee in 1967 decided
  - ◊ to organize a conference
  - ◊ perhaps (later) the setting up of an International Institute of Computer Science
  - ◊ to establish a study group
- the phrase “software engineering” was deliberately chosen as being provocative
- the conference was prepared by three working groups on design, production, and service
- 50 participants were invited
- the conference was to shed further light on the many problems of software engineering

F.L.Bauer served as a Chairman of the Conference

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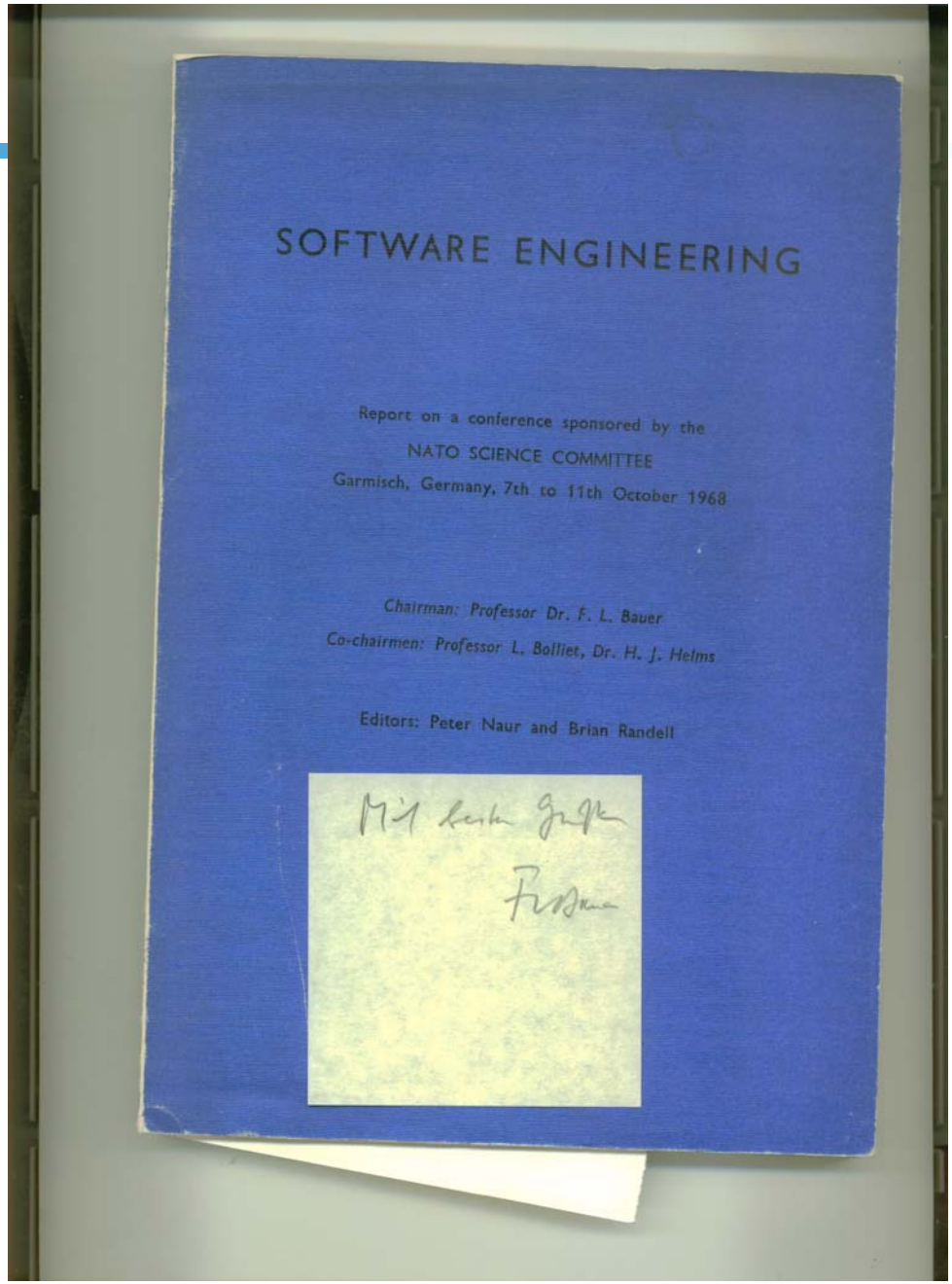
The report


SOFTWARE ENGINEERING
Report on a conference sponsored by the
NATO SCIENCE COMMITTEE
Garmisch, Germany, 7th to 11th October 1968
Chairman: Professor Dr. F. L. Bauer
Co-chairmen: Professor L. Bolliet, Dr. H. J. Helms
Editors: Peter Naur and Brian Randell

The term “Software Engineering”

“When the term was coined in 1968 by F.L. Bauer of the Technological University of Munich, I welcomed it.”

E. W. Dijkstra

E. W. Dijkstra Archive. The University of Texas at Austin, Department of Computer Sciences. Retrieved on 2007-02-17.

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Highlights: Covered Aspects

- Relation of software to the hardware of computers
- Design of software
- Production, or implementation of software
- Distribution of software
- Service on software

Key problems

- reliability of data systems integrated ... in modern society
- difficulties meeting schedules
- education of software engineers
- software priced separately from hardware

What constitutes an engineering discipline ...

- Engineering is the discipline and profession of
  - ◊ applying scientific knowledge and
  - ◊ utilizing natural laws and physical resources
  - ◊ in order to design and implement materials, structures, machines, devices, systems, and processes that
  - ◊ realize a desired objective and meet specified criteria.
- The American Engineers' Council for Professional Development, defines Engineering as:
  - ◊ “the creative application of scientific principles to design or develop structures, machines, apparatus, or manufacturing processes, or works utilizing them singly or in combination; or to construct or operate the same with full cognizance of their design; or to forecast their behaviour under specific operating conditions; all as respects an intended function, economics of operation and safety to life and property.”

Developing software as an engineering discipline

- Software Engineering is the discipline and profession of
  - ◊ applying scientific knowledge and
  - ◊ utilizing laws of informatics and application domains and computational and human resources
  - ◊ in order to design and implement structures, machines, devices, systems, and processes that
  - ◊ realize a desired objective and meet specified criteria.

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Significance of Garmisch

- An exciting mixture of participants ...
  - From industry, research organisations, and universities ...
  - Leading experts and key figures in the field ...
- A relevant range of topics
  - Many experience reports
  - Careful analysis of
  - Lots of ideas how to improve
- A common sense of an emerging discipline

Science of software engineering

- Foundation:
  - ◊ Mathematics
    - Logics
    - Discrete mathematics
  - ◊ Modelling
  - ◊ Empirical knowledge
- Key Development Issues
  - ◊ Software engineering principles
  - ◊ Process
  - ◊ Quality
  - ◊ Economy
  - ◊ Tooling
- Key
  - ◊ Application domain specifics
  - ◊ Software infrastructure: operating systems and middleware
  - ◊ Hardware
- Education

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F.L. Bauer's conclusions ...

"What is needed is mathematics"

- Education
  - ◊ Informatics as a discipline ...
  - ◊ Marktoberdorf Summer Schools ...
  - ◊ Special programmes to build up academic staff and faculties
- Research: Foundation of Abstraction
  - ◊ Wide spectrum language
    - Specification
  - ◊ Program transformation
  - ◊ Tool support
  - ◊ A mathematical and logical basis
    - Data structures
    - Operations
    - Functional programming

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40 years later ... what we have achieved - and still have to achieve ...

- Foundation
  - ◊ Comprehensive system modelling theories ... that have to be reflected in powerful and tractable modelling languages
- Process
  - ◊ Adequate process models such as the V-Modell XT with tailoring ... that have to broad to a professional use
- Specification
  - ◊ A rich set of specification formalisms ... that have to made practically applicable
- Structuring
  - ◊ Understanding architectures ... but their broad exploitation in practical projects still a challenge.
- Verification
  - ◊ Verification of industrial systems proven feasible ... but economical feasibility to be shown.
- Quality
  - ◊ Structured quality models ... that have to be made state of practice
  - ◊ Reliability of safety critical systems very impressive ... but still areas to be improved
- Tooling
  - ◊ A rich set of tools ... that have to be integrated

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Setting a theme ...

“Systems should be built in levels, from modules which form a mathematical structure”

F.L. Bauer 1968

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