

ELLIIT impact case

Impact of BTH's and LU's work on research methods in empirical software engineering on the education of researchers and on the conduct of research in (empirical) software engineering.

Software engineering was established as a research discipline in 1968, and the area has evolved rapidly over the last few decades. As a relatively new discipline built on empirical research rather than mathematics, there has been a strong need for support in conducting empirical studies.

This need has been addressed by the research groups in software engineering at BTH and LU. The work by these SE groups has had, and continues to have, a strong influence on research and education in empirical software engineering worldwide. It is hard to find a course syllabus in software engineering research methods that does not include one or more of the groups' works. Likewise, publications in empirical software engineering research most often include one or more of the two groups' method papers.

- Claes Wohlin published a book on “Experimentation in Software Engineering” with his early PhD students from LU. Three of them are now full professors, and one, Per Runeson (LU), is active in ELLIIT.
 - Original edition (Kluwer) in 2000. First and second editions (Springer), 2012 and 2024. The latest edition includes essential updates to ensure that the book covers contemporary research methods in software engineering. There is also a Chinese version of the book (China Machine Press), published in 2015.
 - This book has 12000+ citations in Google Scholar and is considered THE standard book in the field that every PhD student and researcher needs to know.
- Claes Wohlin also received the Most Influential Paper award at the International Conference on Evaluation and Assessment in Software Engineering (EASE) in 2024 for his paper “Guidelines for Snowballing in Systematic Literature Studies and a Replication in Software Engineering,” published at EASE 2014. This paper has attracted 6000+ citations in Google Scholar, averaging 3 citations per day in 2024, illustrating its current impact.
- His early PhD students from LU (with Per Runeson as the first author) published another landmark book in empirical software engineering, “Case Study Research in Software Engineering” (Wiley & Sons) in 2012.
 - This book is also considered a standard text for students in empirical software engineering.
 - It has 2000+ citations in Google Scholar, plus another 6000+ for a precursor published in the journal Empirical Software Engineering (Vol. 16, 2009).
- Several of Claes Wohlin's PhD students have continued working on research methods for empirical software engineering, e.g., Kai Petersen (who left the ELLIIT core for a

position in Germany in 2021), with his works on “Guidelines for Conducting Systematic Mapping Studies in Software Engineering” (two publications with 9000+ citations in Google Scholar).

- There are numerous further well-cited articles on research methods in empirical software engineering by members (and former members) of the two groups.

This work continues in the SE groups at BTH and LU, and members of these SE groups, including Nauman Bin Ali (ELLIIT core), are also engaged in ACM SIGSOFT’s work on empirical standards in software engineering research.

In the book, titled “Contemporary Empirical Methods in Software Engineering” (Springer 2020), ELLIIT researchers from BTH (Nauman Bin Ali and Kai Petersen) and LU (Per Runeson and Emelie Engstrom) have contributed chapters on case surveys, design science, and simulation-based studies. The first author of the book (M. Felderer) was employed at BTH while writing and editing it.

The latest addition to these works is the “Handbook on Teaching Empirical Software Engineering” (Springer, 2024), in which Nauman bin Ali (ELLIIT core) is a co-editor. The book has 21 chapters written by 53 authors from 39 institutions across 16 countries; several of them are part of the ELLIIT environment or are ELLIIT alumni. The book offers comprehensive guidelines and strategies for teaching software engineering research methods (e.g., controlled experiments, case studies, surveys, action research, design science, ethnography, mining software repositories, simulation-based studies, and literature reviews).

In a recent paper titled “Towards measurement-based Software Engineering” by Victor Basili, David Weiss, and Dieter Rombach, who are among the pioneers of the field of empirical software engineering, they reflect on the progress in the field over the last 40 years. Among the notable book contributions to the field, two of the four books highlighted are contributions from the ELLIIT researchers listed above¹:

“There are several books on the area of empirical software engineering. A comprehensive book is “Foundations of Empirical Software Engineering: The Legacy of Victor R. Basili” by Barry Boehm, Hans Dieter Rombach, and Marvin V. Zelkowitz Springer, 2005 [21]. The books “Basics on Software Engineering Education”, by Natalia Juristo and A M Moreno, published by Springer in 2010 [22], and *“Experimentation in Software Engineering” (second edition), by Claes Wohlin, Per Runeson, Martin Hoest, Magnus Ohlsson, and Anders Wesslen, published by Springer, 2024 [23]* provide a comprehensive overview on performing controlled experiments and empirical studies. *And most recently, the book by Daniel Mendez, Paris Avgeriou, Marcos Kalinowski, and Nauman bin Ali, published this year [24], covers many relevant topics for teaching empirical software engineering from instrumentation and measurement, e.g., action research, survey research, qualitative data analysis, experimental design, case study research,*

¹ V. R. Basili, D. M. Weiss and H. D. Rombach, "Toward Measurement-Based Software Engineering," in IEEE Transactions on Software Engineering, vol. 51, no. 3, pp. 717-719, March 2025, doi: 10.1109/TSE.2025.3541922.

systematic literature reviews and mining software repositories. It provides a collection of techniques and approaches that concentrate and organize support for empirical software engineering education.”