Research, Education, and Innovation in Software Engineering at University of Paderborn:

S-lab as transfer platform

Topics for international cooperation

Prof. Dr. Wilhelm Schäfer, wilhelm@upb.de
Stefan Henkler, shenkler@upb.de
Ahmet Mehic, amehic@upb.de

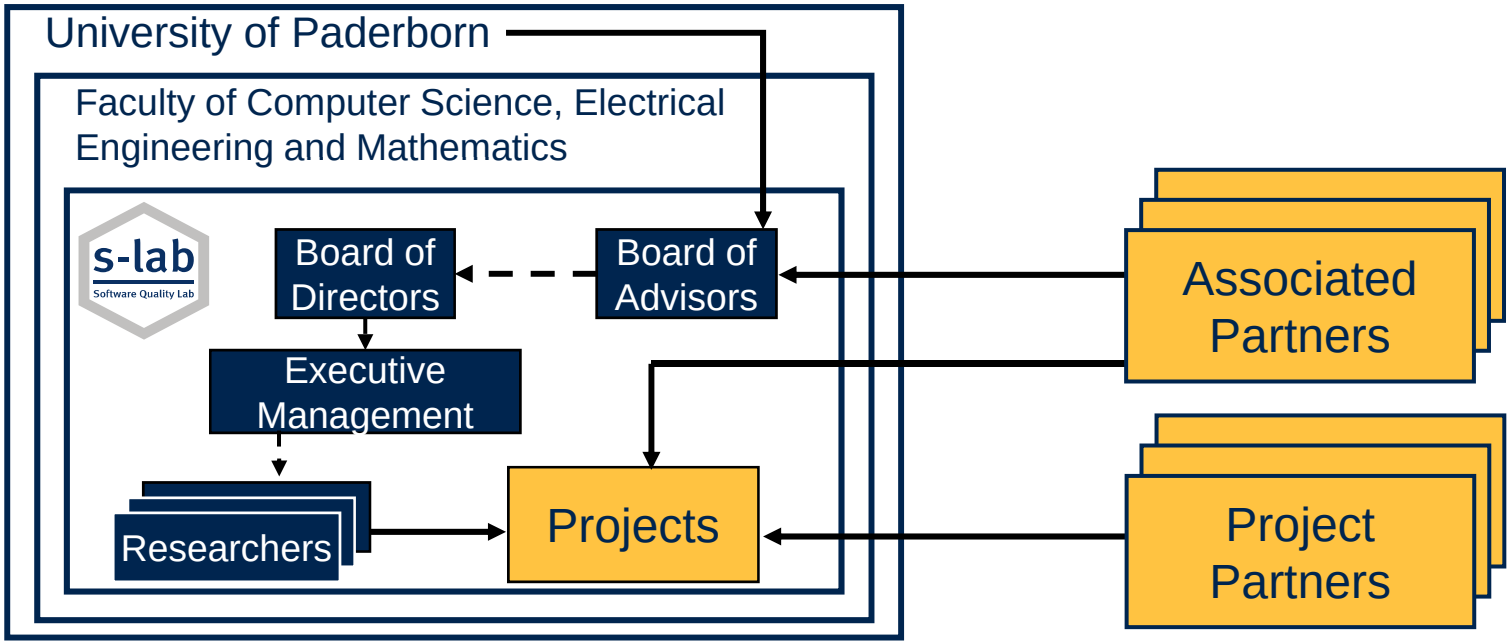
Software Quality Lab

The **Software Quality Lab** (s-lab) is an institute for **knowledge and technology transfer** and a **competence center for software engineering**. In s-lab, **partners from industrial software development** closely cooperate with **research groups** of the University of Paderborn.

Work in s-lab is centered upon development and evaluation of constructive and analytical **methods and tools of software engineering** for obtaining **high-quality software**.

High relevance for industrial software development and the need for **employing scientific methods** characterize the problems that are dealt with in s-lab.

Organisation



- Open Multi Private Public Partnership (Multi-PPP) institute
- Five research groups
- 7 associated partners from industry
- Additional project partners from research and industry
- Application-driven projects with industrial partners

Transfer Cycle

Prof. Dr. Gregor Engels
Database & Information Systems

Prof. Dr. Uwe Kastens
Programming Languages & Compilers

Prof. Dr. Hans Kleine Büning
Knowledge-based Systems

Prof. Dr. Franz J. Rammig
Design of Parallel Systems

Prof. Dr. Wilhelm Schäfer
Software Engineering

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Orga Systems.

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Transfer Cycle





Research

s-lab
Software Quality Lab

Industry

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Transfer Cycle

#	[9]	Score	Institution
1		25.29	Massachusetts Institute of Technology
2	3	23.90	Carnegie Mellon University
3	7	20.50	Georgia Institute of Technology
4		17.60	University of Maryland, College Park
5		15.89	Oregon State University
6		14.89	University of California, Irvine
7		14.19	University of British Columbia, Canada
8		13.80	Politecnico di Milano, Italy
9		13.70	University of Texas, Austin
10		13.59	IBM Thomas J. Watson Research Center
11		11.90	University of Waterloo, Canada
12		11.70	University of Massachusetts, Amherst
13		11.50	Imperial College London, UK
14		10.80	University College London, UK
15		10.70	Carleton University, Canada
16		9.60	University of Paderborn
17		9.39	Purdue University
18		9.27	Stanford University
19		9.19	Kansas State University
20		9.19	Katholieke Universiteit Leuven, Belgium
21		9.19	Michigan State University
22		9.00	University of Pittsburgh
23		8.30	University of Colorado, Boulder
24		8.19	University of Texas, Dallas
25		7.69	University of Washington, Seattle
26		7.60	University of Toronto, Canada
27		6.90	Ohio State University
28		6.80	University of Southern California
29		6.60	University of Karlsruhe, Germany
30		6.50	Osaka University, Japan
31		6.50	University of California, Davis
32	5	6.30	Fraunhofer-IESE, Germany
33		6.29	University of Virginia
34	14	6.20	Simula Research Lab, Norway
35		6.20	Washington University in St. Louis
36		6.10	Hong Kong Polytechnic University, China
37		5.90	Brown University
38		5.80	University of Illinois, Urbana-Champaign
39		5.80	University of Strathclyde, UK
40		5.50	NASA Ames Research Center
41		5.40	University of Bologna, Italy
42		5.30	University of California, San Diego
43		5.20	Avaya Labs Research
44		5.19	Northeastern University
45		5.19	West Virginia University

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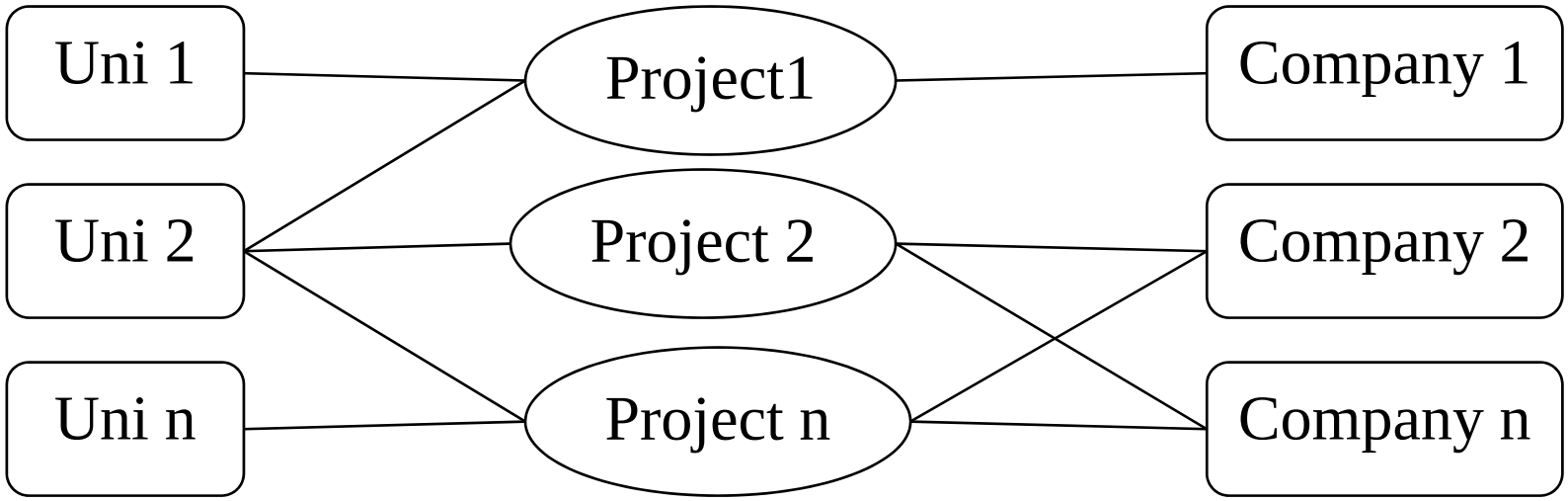
What do we require?

- National- / International projects
  - Tempus SM – knowledge triangle: competence center as platform for education – innovation – research transfer
    - Network of competence
      - Many to many associations



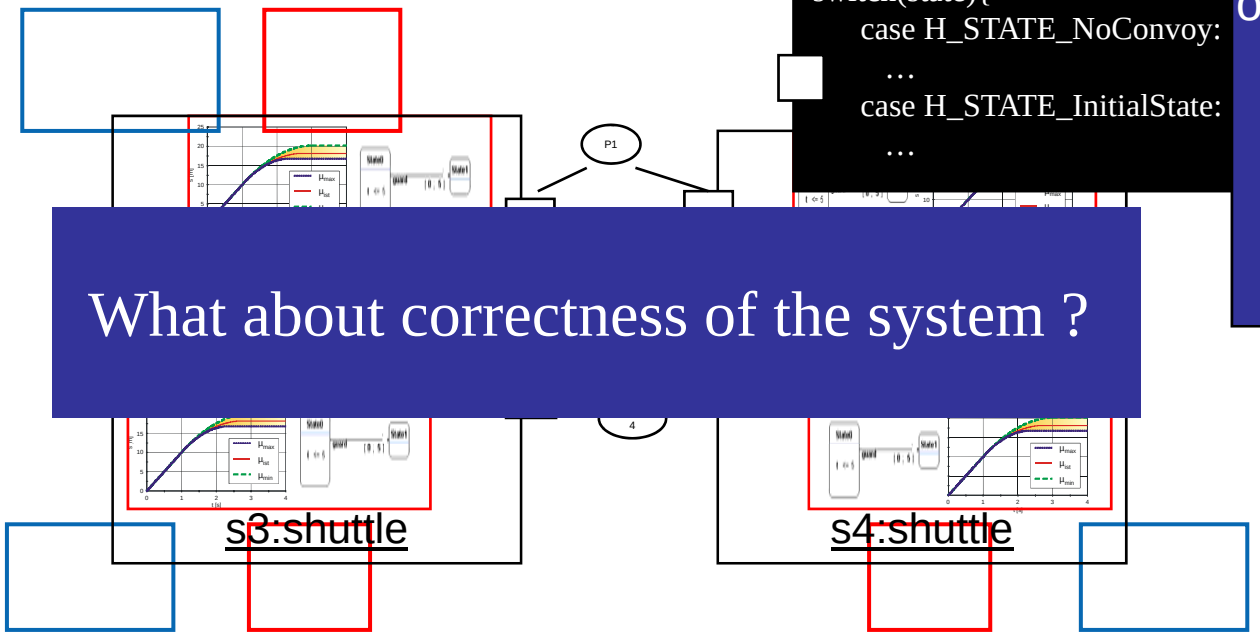
Networked mechatronic systems

Example: Convoy of shuttles
SFB 614 „Self-optimizing concepts and structures in mechanical engineering“
[Neue Bahntechnik Paderborn - railcab]

- Shuttle convoy
  - Autonomous vehicle
  - Build convoy to reduce energy consumption
- Complex coordination is required to build convoy/drive in convoy mode
  - Need software engineers
    - Beside the common engineers disciplines
- Hard real-time requirements and distributed
- How can we achieve that these systems are safe w.r.t given properties
  - Adequate modeling approach
  - Analysis

- Decompose
  - Structure
    - Component
  - Behavior
    - Real-time Coordination Pattern
- Correctness of system
  - Formal verification of pattern
  - Formal verification of Component

[MechatronicUML]



What about correctness of the system ?

- Model of component not known
  - Matlab s-function
  - …

Integrating Legacy Components

- Manual integration
  - Error prone
  - Time intensive
- Automatic integration – reverse engineering
  - Use known context
  - Use techniques
    - Model checking
    - Model testing
    - Automata learning

Research Topics

I. Model-based development
- Which models are required to represent the required information?

II. Reengineering

I. Reverse Engineering
- Learning the behavior of a legacy component
  - Automatic behavior synthesis
  - Probe effect free information gathering
    - » How to monitor the legacy component
  - Extracting platform specific information?
- Static analysis of legacy system
  - Existing work only for documentation purpose [NSW+02]
- Do we have a component like legacy system?

II. Restructuring

III. Correctness by construction
- Use learned behavior of collaborations
- Generate internal behavior of component

Forms of cooperation

- Short-term projects (surveys, consulting, development)
- Long-term projects (research & development, PhD projects)
- Joint projects with public funding (European, national, etc.)
- Bachelor and Master theses
- Project groups
- Guest presentations (in lectures)
- Training courses and workshops
- Joint marketing events (exhibitions, etc.)
- Joint publications

- Bilateral and multilateral projects
  - Between Universities and Industry (SMEs)