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EXPERIMENTELLE VERBESSERUNG
DES LERNENS VON SOFTWARE ENGINEERING

HOCHSCHULE COBURG
university of applied sciences

ANALYZING CHALLENGES IN SOFTWARE ENGINEERING CAPSTONE PROJECTS

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Presenters‘ resume

- **Yvonne Sedelmaier** holds a diploma and a PhD in pedagogy with a major focus on adult learning and continuing education at the University of Bamberg, Germany. Her research interests are teaching and learning software engineering at universities and software engineering didactics.

- **Dieter Landes** is a full professor of software engineering and database systems at the University of Applied Sciences, Coburg, Germany. His research interests are in requirements engineering, software engineering education, and data mining.

Outline

- Context
- Intended Learning Outcomes
- Educational Context
- Research Questions & Design
- Results
- Discussion
- Summary & Outlook

Software Engineering …

… is concerned with

- building complex systems
- in a team of developers
- over an extended period of time
- for a more or less precisely known group of users.

Teaching Software Engineering – A Challenge

- Various social and personal competencies needed, e.g. communication within a team and across disciplinary boundaries
- Various technical roles within the software development process
- No two identical software development projects
- Methodological and problem-solving skills required
- Rapid change of factual knowledge requires lifelong learning

Educational Context
Software Engineering Capstone Project (1)

- **Goal:**
  - tie together what has been learned in terms of methodology and technologies
  - exercise soft skills in a typical professional setting, in conjunction with technical skills
- **Realistic Project Setting:**
  - run through all phases of the development cycle
  - real customer with genuine interest in using results
  - pre-defined team roles

Educational Context
Software Engineering Capstone Project (2)

- **Approach:**
  - Mix of students from a bachelor and a master program in informatics
  - per Team:
    - five bachelor students (on average) in their final year
      - technical / development focus
    - one Master student
      - focus on process and management issues

Intended Learning Outcomes (1)

for **Bachelor Students**:

- understanding and combining chunks of technical knowledge, which up to then have been isolated, into one big picture
- integrating in a team, which includes fostering communication skills

for **Master Students**:

- organizing and leading a team (training of communicating with team members, structuring tasks, and motivating team members for effective teamwork)

Intended Learning Outcomes (2)

for **both groups** of students:

- Intended learning outcomes are mainly competences and, consequently, assessment is competence-oriented as well.
- Self-reflection as a key competence addressed
  - Anonymous self-reflection reports, structured according to several guiding questions
  - Post-mortem session

Research Data: Students' post-mortem self-reports

- Over nine years
- 79 reports from 81 students in
- 13 teams
  - Each team guided by a master student, in one case two master students (Scrum master plus product owner), i.e. 14 self-reports written by master students.
- average length of reports: two pages of prose text

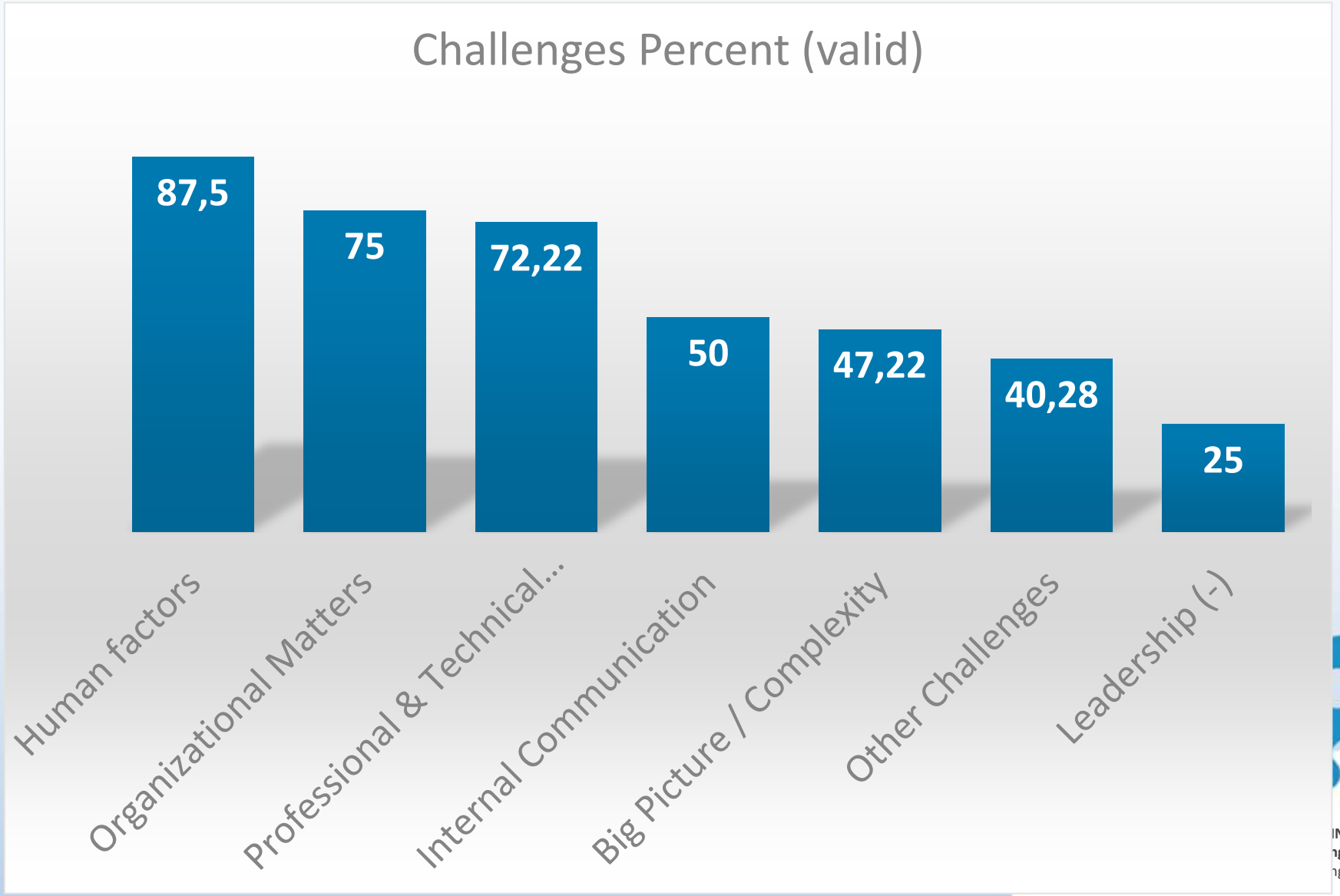
Research Design

- mixed methods approach with focus on qualitative analyses
- applying the basic strategy of Grounded Theory
- in combination with Mayring's content analysis
- generating codes in a multi-stage procedure while reading, abstracting and interpreting the texts

Initial Results – Overview (1)

	Students' Challenges in SE Capstone Projects		
	Percent (valid)	*Percent*	*Documents*
Human factors	87,5	79,75	63
Organizational Matters	75	68,35	54
Professional & Technical Issues	72,22	65,82	52
Internal Communication	50	45,57	36
Big Picture / Complexity	47,22	43,04	34
Other Challenges	40,28	36,71	29
Leadership (-)	25	22,78	18
DOCUMENTS with Code(s)	100	91,14	72
DOCUMENTS without Code(s)	-	8,86	7
ANALYSED DOCUMENTS	-	100	79

Initial Results – Overview (2)



Initial Results – Top Issues in Human Factors

Top 4 Issues in Category "Human factors"		
Category	***Number of codes***	***Percent***
Collaboration Bachelor and Master students	32	10.49
Motivation	31	10.16
Collaboration	25	8.2
Communication with Third / Other Disciplines	20	6.56

Initial Results – Top Issues in Organizational Matters

Top 5 Issues in Category "Organizational Matters"		
Category	***Number of codes***	***Percent***
Time aspects / Timeliness	34	26.15
Management in general	33	25.38
Software Process Modell	16	12.31
Distribution of Tasks and Responsibilities	16	12.31
Communication	13	10.00

Initial Results – Top Issues in Professional & Technical Issues

Top 5 Issues in Category "Professional & Technical Issues"		
Category	***Number of codes***	***Percent***
Documentation	27	21.77
Software Requirements	25	20.16
Technical Knowledge	17	13.71
Effort Estimation	12	9.68
Tools	10	8.06

Initial Results – Top Issues in Professional & Technical Issues

Top 3 Issues in Category "Other Challenges"		
Category	***Number of codes***	***Percent***
General Organisation	12	29.27
Shared Vision	9	21.95
Individual Situation	5	12.20

Discussion (1)

- technical issues play only a minor role with respect to the “success” of a student project
- other aspects tend to become crucial, e.g. collaboration within the team and beyond, project management and organisation, or methodological issues related to requirements engineering and effort estimation
- issues related to project planning are some challenge

Discussion (2)

- more fine-grained insights compared to related work
- allowing for more sophisticated hypotheses to be tested subsequently
  - E.g., project organisation (and not just planning), individual motivation and individual deficiencies in setting or adhering to deadlines not mentioned as important issues in related research

Summary and Outlook

- well-founded qualitative approach to analysing educational data, in this case in the context of software engineering capstone projects.
- 19 main categories of challenges that students face in capstone projects.
- 19 main categories correspond to semantic clusters of issues raised in more than 70 textual post-mortem self-reports.
- self-reports may be analysed from various additional perspectives

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Questions?

Thank you for your attention!

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