

Lecture

Empirical Model Building and Methods (Empirische Modellbildung und Methoden)

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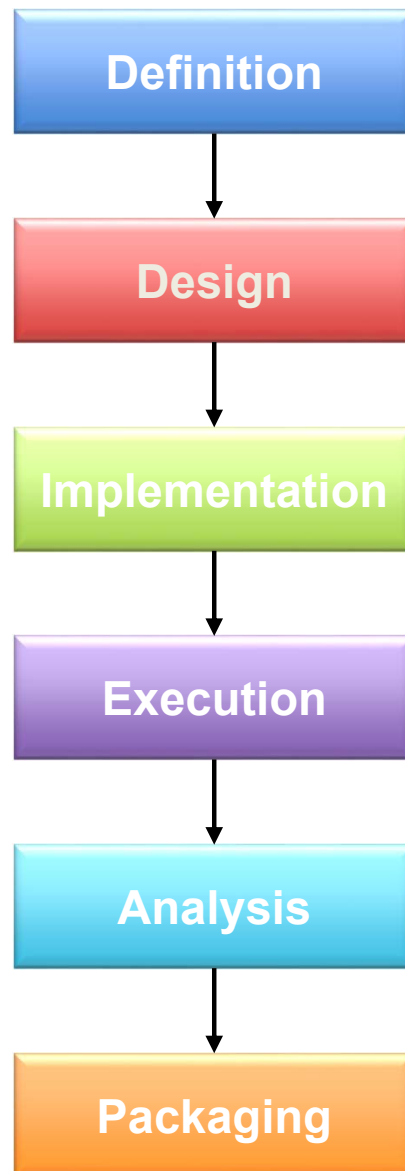
SS 2016

Chapter 3.7 – Packaging

Chapter objectives

- **At the end of this chapter, you should**
 - know how to document an empirical study design and its findings.

Empirical process - Packaging



- Report your study so that external parties are able to understand results and context of the study

Packaging

3.7.1 Motivation

3.7.2 Type of publications

3.7.3 Report outline

- 3.1 Introduction
- 3.2 Definition
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- 3.5 Execution
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Presenting, sharing and spreading results.

- Building a body of knowledge.
- Enabling review, discussion and challenge of results.

Motivating and enabling replication.

- Enabling independent “confirmation” of results.
- Making study design available for further investigation in different contexts.

Documenting results within the organization.

- Aiming at improving and understanding, e.g., organizational structure, decision, information flows and processes.

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Technical report

- Detailed account that allows replication.
- Study data base including all original data and field notes.
 - Measures, questionnaires, surveys, interview protocols, observational protocols, transcriptions, tape records, video record, pictures, ...

Papers (Scientific publications)

- Concise description of study design and results.
- Conference and journals.

Experience packages

- New knowledge to be included in the experience base.

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Relevant journals and conferences

- Journals
 - Journal of Empirical Software Engineering
 - Information Technology and Software
 - IEEE Software
 - IEEE Transactions on Software Engineering
 - ...

- Conferences
 - International Symposium on Empirical Software Engineering and Measurement (ESEM)
 - International Conference on Evaluation and Assessment in Software Engineering (EASE)
 - International Conference on Product Focused Software Development and Process Improvement (PROFES)
 - International Conference on Software Engineering (ICSE)

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Structured abstract

- 1. Introduction**
 - 2. Related work**
 - 3. Research design**
 - 4. Execution**
 - 5. Data analysis**
 - 6. Discussion**
 - 7. Conclusion**
 - 8. References**
- Appendix**

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Structured abstract

- **Background**
 - Brief introduction to the motivation for performing the empirical study.
- **Objectives**
 - Describe the aim of the study, including the object under examination, the focus, the perspective and the context.
- **Methods**
 - Describe which research method will used to examine the study object.
- **Results**
 - Summary of main results.
- **Conclusions**
 - Summary of implications.

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1. Introduction

- Scope and motivation of the empirical study.
- Summary of the problem statement, research goals and study setting and design.
- Introduction to the structure of the report.

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|---------------------------|---|
| Problem Statement | What is the problem? Where does it occur? Who has observed it? Why is it important to be solved? |
| Research Objective | Analyze <Object(s) of study> for the purpose of <purpose> with respect to their <Quality Focus> from the point of view of the <Perspective> in the context of <context> |
| Context | What information is necessary to understand whether the research relates to a specific situation (environment)? |

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2. Related work

- Description of the object of study, e.g. software technology.
- Description of the previous research (State of the art), e.g. alternatives technologies, previous empirical studies and theories/definitions regarding the quality focus.
- (If applicable) Relevance to practice.

| | |
|---------------------------------------|---|
| Technology under Investigation | What is necessary for a reader to know about the technology to reproduce its application? |
| Alternative Technologies | How this research relates to alternative technologies? |
| Related Studies | How this research relates to existing research (studies)? |
| Relevance to Practice | How does it relate to state of the practice? |

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3. Research design

- 3.1 Research goal and operationalization
 - Definition of research question (GQM goal template) and hypotheses.
 - Operationalization or conceptualization of variables.

- 3.2 Design
 - Selection and justification of a study type and sampling strategy.
 - Detailed (experimental) treatment, i.e. procedure.

- 3.3 Material
 - Guidelines, document templates, specifications, codes and tools.

- 3.4 Data collection methods
 - Description of instruments for data collection, e.g. questionnaires, interview protocols and observational protocols.

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| Goals | Formalization of goals, define the important constructs (e.g., the quality focus) of the experiment's goal |
| Experimental Units | From which population will the sample be drawn? How will the groups be formed (assignment to treatments)? Any kind of randomization and blinding has to be described. |
| Experimental Material | Which objects are selected and why? |
| Tasks | Which tasks have to be performed by the subjects? |
| Hypotheses, Parameters, and Variables | What are the constructs and their operationalization? |
| Design | What type of experimental design has been chosen? Why? |
| Procedure | How will the experiment (i.e. data collection) be performed? What instruments, materials, tools will be used and how? |
| Analysis Procedure | How will the data be analyzed? |

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4. Execution

- 4.1 Preparation
 - Peer reviews
 - Pre-evaluation

- 4.2 Schedule

- 4.3 Deviations
 - Discussion of any deviations occurred during the execution of the study, e.g. referring to
 - Data collection process and how they were applied
 - Subjects who left the study

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5. Data analysis

- **PURPOSE:** summarizes the data collected and the treatment of the data.
 - (1) It is not allowed to interpret the results
 - (2) data should be analyzed in accordance with the design.
- Sample size and description
- Descriptive statistic (e.g., box plots, tables, ...)
- Data set preparation
- Results per research questions and/or hypotheses
 - In case of statistical analysis, provide all parameters and statistics for allowing the correct interpretation and future synthesis of results.

Don't lie with your statistics!

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5. Data analysis Details

- inferential statistics are reported with
 - Correct name of test including the test of requirements (normality, ...)
 - the value of the test (p-value),
 - the probability level (alpha-level),
 - the degrees of freedom (confidence interval),
 - the direction of effect
 - the power of the test.
 - Statistics of effect size shall also be reported to facilitate meta-analysis or comparison of results across experiments.

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6. Discussion

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|---|--|
| Evaluation of Results and Implications | Explain the results and the relation of the results to earlier research, especially those mentioned in the Related Work section |
| Threats to Validity | How is validity of the experimental results assured? How was the data actually validated? threats that might have an impact on the validity of the results as such (threats to internal validity, e.g., confounding variables, bias), and, furthermore, on the extent to which the hypothesis captures the objectives and the generalizability of the findings (threats to external validity, e.g., participants, materials) have to be discussed |
| Inferences | inferences drawn from the data to more general conditions |
| Lessons Learned | Which experience was collected during the course of the experiment |

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7. Conclusions

| | |
|--------------------|--|
| Summary | The purpose of this section is to provide a concise summary of the research and its results as presented in the former sections. |
| Impact | Description of impacts with regard to cost, schedule, and quality, circumstances under which the approach presumably will not yield the expected benefit |
| Future Work | What other experiments could be run to further investigate the results yielded or evolve the Body of Knowledge |

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8. Acknowledgements

- Sponsors, participants, and contributors who do not fulfill the requirements for authorship should be mentioned

9. References

- All used literature has to be presented in the format requested by the publisher

10. Appendix

- Experimental materials, raw data, and detailed analyses, which might be helpful for others to build upon the reported work should be provided

Where to find further information? References

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