Case Study Research
in Software Engineering

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Who am I?

- Professor in Software Engineering, Lund University
- Leader for the Software Engineering Research Group at LU and the EASE industrial excellence center
- Sabbatical at North Carolina State University, 2011-12
- Sony Ericsson, part time 2010
- LU since 1998
- Q-Labs 1991-1998

EASE
Embedded Applications Software Engineering

SWELL - Swedish V&V Excellence

Lund University / Faculty of Engineering / Department of Computer Science / Software Engineering Research Group

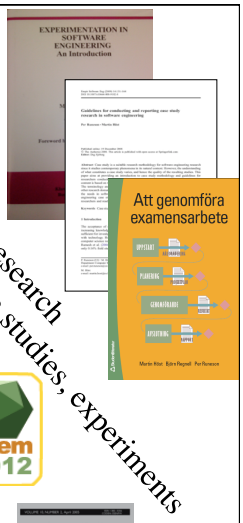
Research interests

1995

2011

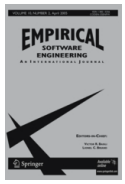
- Reliability testing
- Inspection methods
- System validation
- Agile management
- Test management
- Unit testing
- Regression testing
- Product line testing

Empirical research – surveys, case studies, experiments



ICST

esem 2012



Advertizing

- **ICST** – 5th Int. Conference on Software Testing, Verification and Validation, Montreol, Canada, April 17-21, 2012
  CFP: October 28, 2011 (abstract)
- **ESEM** – 6th Int. Symposium on Empirical Software Engineering and Measurement, Lund, Sweden, September 19-20, 2012
  CFP: March 4, 2012 (abstract)

ICST

esem 2012

Case study

”Case study is an empirical inquiry that investigates a **contemporary phenomenon** within **its real-life context**, especially when the **boundaries** between the phenomenon and context are **not clearly evident**”

Robert K. Yin, Case Study Research

Case study

”Case study is a strategy for doing research which involves an empirical investigation of a particular **contemporary** phenomenon **within its context** using **multiple sources of evidence**”

Colin Robson, Real World Research

Characteristics

	Case study	Experiment
Control	Low	High
Realism	High	Low
Design	Flexible	Fixed
Primary data	Qualitative	Quantitative
Case/subject selection	Intentional	Random
Primary objective	Exploratory	Explanatory

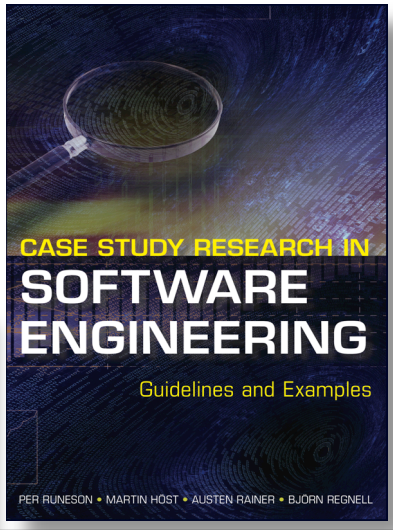
What makes Case Studies science?

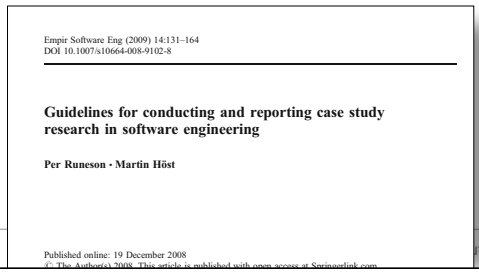
1. Theoretical basis
2. Triangulation (data, observer, method, theory)
3. Chain of evidence
4. Full documentation
5. Iterative reporting

(Kyburz-Graber, 2004)

Guidelines for case studies

- Empirically derived and evaluated
- EMSE (2009) open access
- Wiley (2011)



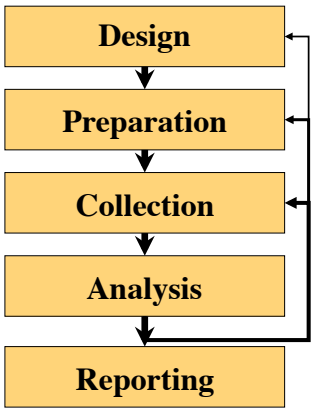

Empir Software Eng (2009) 14:131–164
DOI 10.1007/s10664-008-9102-8

Guidelines for conducting and reporting case study research in software engineering

Per Runeson · Martin Höst

Published online: 19 December 2008

Case study process



(Höst, 2007, Runeson 2009, 2011)

Design

Purpose of a case study

- Understand
- Illustrate
- Evaluate
- Compare
- Improve
- Disseminate

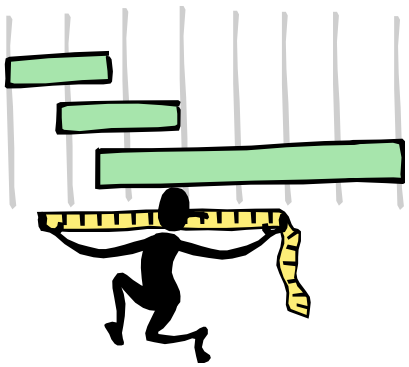
Case study

Action research

Design

Unit(s) of analysis

- event
- individual
- group
- process
- project
- product
- policy
- role
- technology



Design

Case selection

- Typical
- Critical
- Revelatory
- Unique

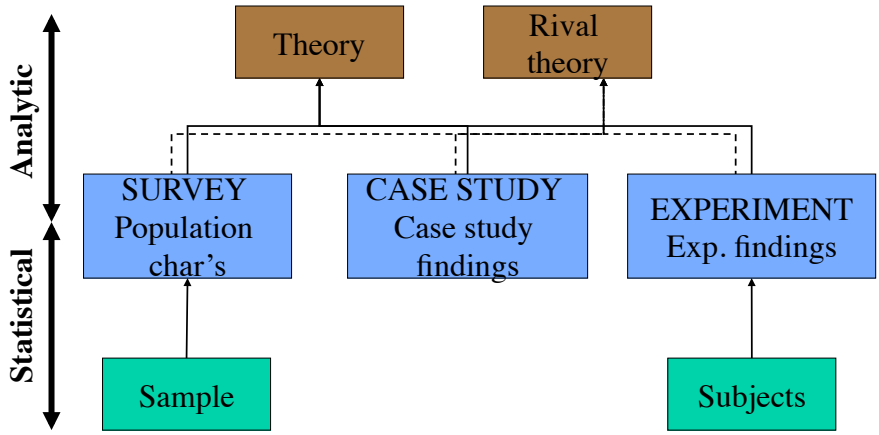
(Benbasat 1987)

- Extreme/deviant
- Maximum variation
- Critical
- Paradigmatic

(Flyvbjerg 2007)

Design

Generalization



Design

Ethics

- Informed consent
- Confidentiality
- Handling of sensitive results (anonymity?)
- Decide on inducements
- Feedback results, in particular quotations

(Singer and Vinson, 2002)

Preparation

Planning data collection

- What type of documents and databases do you need access to?
- Which activities do you want to observe or participate in?
- Who should be interviewed?
- When should data be collected?

Preparation | Collection

Case study protocol

Preamble	Purpose, data storage, publication
General	Overview of research project
Procedures	Detailed description
Research instruments	Interview guide, Questionairre
Data analysis	Detailed description
Appendix	Invitation letter etc

(Pervan and Maimbo, 2005)

Analysis

Qualitative analysis

Bring structure to the data

- Start by transcribing speech
- Find key words, either from the material or from theory
- Group and contrast statements
- Draw conclusions

- Coding
- Data reduction
- Data display
- Conclusion drawing

(Robson 2002, p.476)

Analysis

Qualitative analysis – level of formalism

- **Quasi-statistical** – count occurrence and frequency of terms
- **Template based** – group statements to key words from theory
- **Editing** – create categories from the data itself
- (**Immersion** – play with the data and draw conclusions)

(Robson 2002 p.457)

Analysis

A Word of Warning

- Quasi-statistical methods do *not* imply *anything* beyond the population

"57% of the interviewees agreed/disagreed"
- Indicates that it might be worth understanding
- Says nothing about the general situation

Analysis

Internal validity

How can I trust an analysis?

- **Quantitative** – appropriate methods, fulfilled assumptions, significance
- **Qualitative** – reported methods, clear viewpoints, traceable conclusions

Analysis

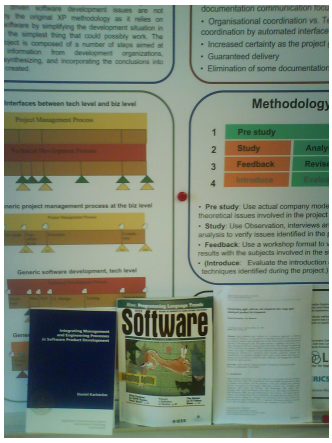
External validity

- Generalization: Drawing conclusions about phenomena outside the studied setting
  - **Statistical generalization** – "inference… about a population on the basis of empirical data collected about a sample"
  - **Analytic generalization** – "a previously developed theory is used as a template…to compare the empirical results of a case study"

(Yin 2003 p. 32-33)

Report audiences

- Academic colleagues
- Policymakers, practitioners, …
- Dissertation committees
- Funders of research



Convince reviewers and editors

”The paper is based mostly on interviews with little quantitative project data to back any observation or conclusion. Such papers are not suitable for a journal like TSE.” Editor of IEEE TSE

”The study was very well designed. The design approach is backed up by literature and a description of subjects, research strategy, research methods, how the analysis was done, the threats to validity and how they were addressed are all presented.” Reviewer of EMSE

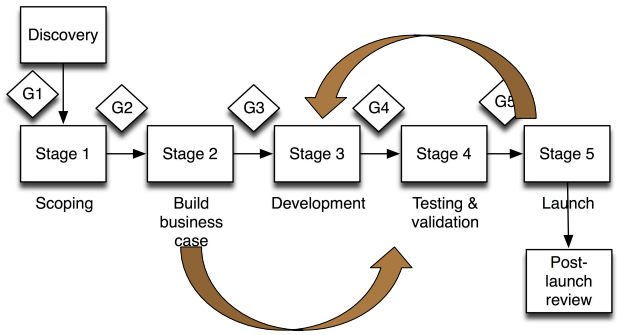
Checklists

Researcher's checklist	Reader's checklist
Case study design (1-10)	39-50 with pointers to 1-38
Preparation for data collection (11-15)	
Collecting evidence (16-21)	
Analysis of collected data (22-27)	
Reporting (28-38)	

(Höst 2007, Runeson 2009, 2011)

Case Study Example

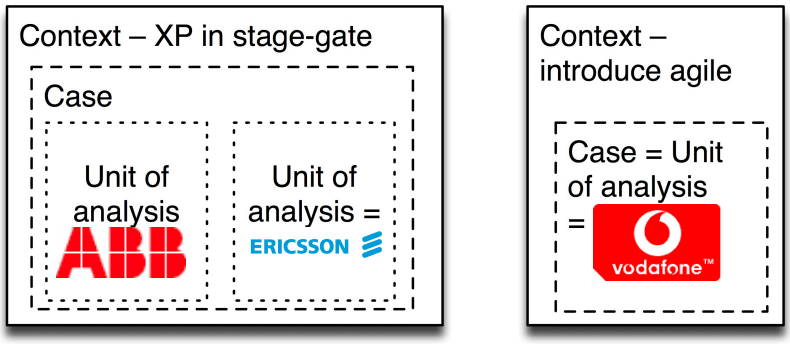
How do Agile Methods coexist with Stage-Gate Project Management?



(Karlström and Runeson 2005, 2006)

Design

Cases and units of analysis



Preparation | Collection

Data collection and analysis

- Semistructured interviews
  - 18 persons
    - Engineers
    - Managers
    - Product Mgmt
    - Project Mgmt
- Transcription + Coding
- Qualitative analysis

Analysis

Selected key findings

Area	Agile feature	Effect
Planning and prioritisation	Most important feature first Micro planning	+ Early feedback on features + Avoid req's cramming ! Little long term planning
Communication and follow-up	Small manageable tasks Automatic testing	+ Feeling of being under control + Communication of change
Process model and roles	Customer involvement Documentation tasks	+ Continuous feedback +/! Prioritization
Project management	Engineering level empowerment Focus	+ Engineers feel motivated ! Managers afraid initially + Engineering/mgmt + /! Early technical issues

Analysis

"In control"

Citation: "…you have everybody's work under control…The short cycle time is the biggest advantage and that we always – and now I exaggerate slightly – but we have always something executable."

Conclusion: "All people involved in the projects have a strong feeling of being in control, with the exception of management"

Analysis

Management reactions

Citation: “The worked in a manner that was not described in any process description. That implied that our line managers, SQA and others had no reference to measure against.”

Conclusion: “Management perceived that they lost some control, as they did not recognize their usual planning models…”

Reporting

Report audiences

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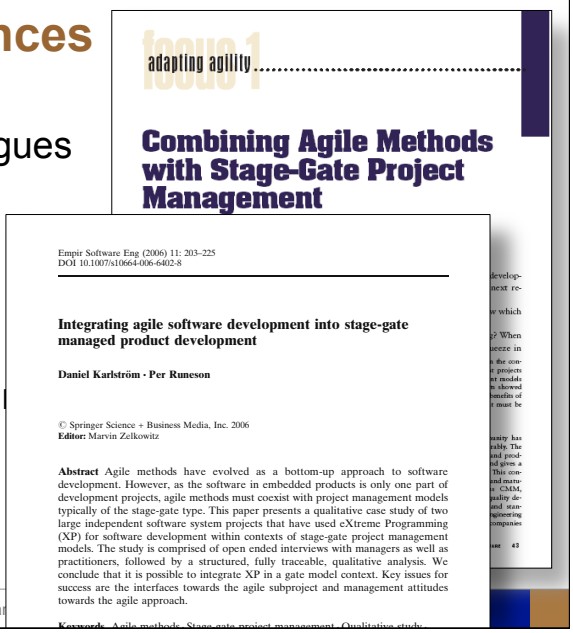

Summary: Case study research in SE

- Software engineering and software process improvement
  - are complex activities
  - success or failure depends on many interrelated factors
  - cannot be fully studied in isolation
  - needs empirical studies in real world settings.

Literature

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