

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



SWELL - Swedish V&V Excellence

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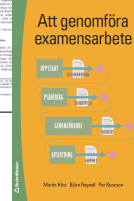
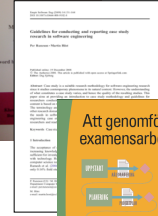
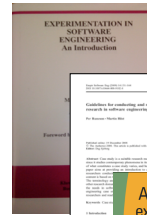
Research interests

1995

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

2011

Empirical research
– surveys, case studies, experiments



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Advertizing

- **ICST** – 5th Int. Conference on Software Testing, Verification and Validation, Montreal, 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)



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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

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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

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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

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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)

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Guidelines for case studies

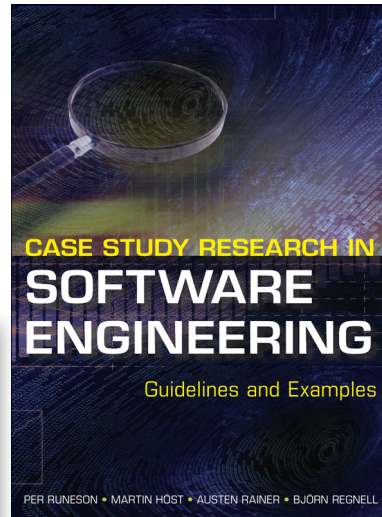
- Empirically derived and evaluated
- EMSE (2009) open access
- Wiley (2011)

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

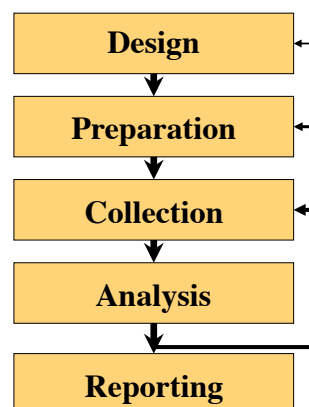
Per Runeson • Martin Höst

Published online: 19 December 2008
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Case study process



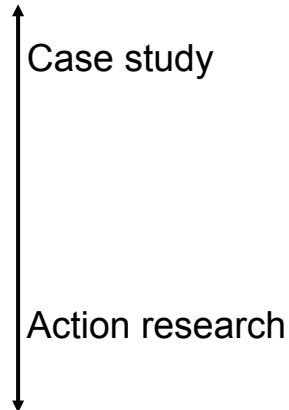
(Höst, 2007, Runeson 2009, 2011)

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Design

Purpose of a case study

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

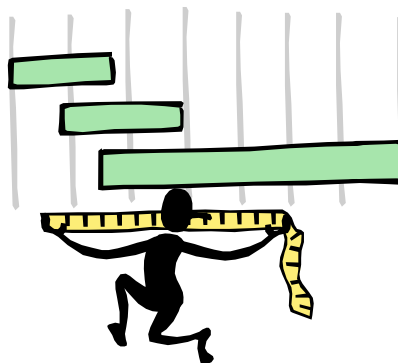


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Design

Unit(s) of analysis

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



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Design

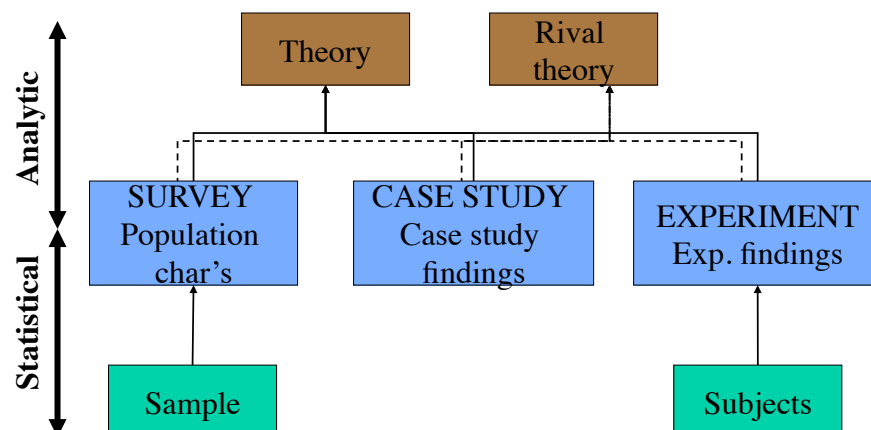
Case selection

- Typical
 - Critical
 - Revelatory
 - Unique
- (Benbasat 1987)
- Extreme/deviant
 - Maximum variation
 - Critical
 - Paradigmatic
- (Flyvbjerg 2007)

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Design

Generalization



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Design

Ethics

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

(Singer and Vinson, 2002)

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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?

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Preparation Collection

Case study protocol



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

(Pervan and Maimbo, 2005)

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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)

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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)

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

Internal validity

How can I trust an analysis?

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

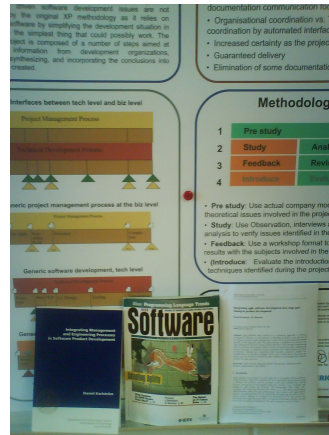
External validity

- 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

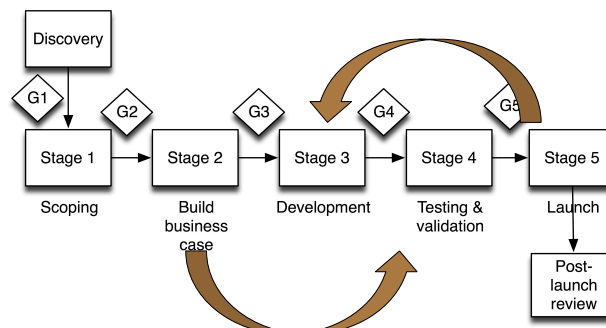
Researcher's checklist	Reader's checklist
Case study design (1-10)	39-50 with pointers to 1-38
Preparation for data collection (11-15)	
Collecting evidence (16-21)	
Analysis of collected data (22-27)	
Reporting (28-38)	

(Höst 2007, Runeson 2009, 2011)

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Case Study Example

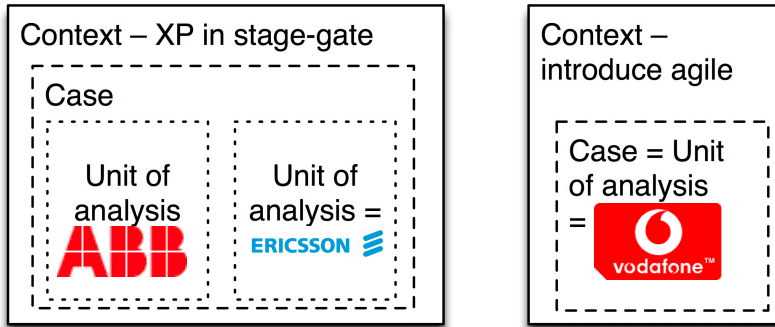
How do Agile Methods coexist with Stage-Gate Project Management?



(Karlström and Runeson 2005, 2006)

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Cases and units of analysis



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

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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"

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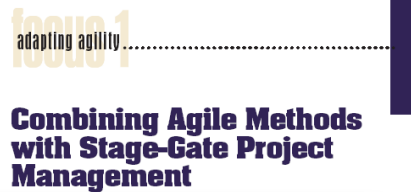
Management reactions

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...”

Report audiences

- Academic colleagues
- Policymakers, practitioners, ...
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Empir Software Eng (2006) 11: 203–225
DOI 10.1007/s10664-006-6402-8

Integrating agile software development into stage-gate managed product development

Daniel Karlström · Per Runeson

© Springer Science + Business Media, Inc. 2006
Editor: Marvin Zelkowitz

Abstract Agile methods have evolved as a bottom-up approach to software development. However, as the software in embedded products is only one part of development projects, agile methods must coexist with project management models typically of the stage-gate type. This paper presents a qualitative case study of two large independent software system projects that have used eXtreme Programming (XP) for software development within contexts of stage-gate project management models. The study is comprised of open ended interviews with managers as well as practitioners, followed by a structured, fully traceable, qualitative analysis. We conclude that it is possible to integrate XP in a gate model context. Key issues for success are the interfaces towards the agile subproject and management attitudes towards the agile approach.

Keywords: Agile methods, Stage-gate project management, Qualitative study

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.

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