Case study research or anecdotal evidence?

Definitions

Prof. Per Runeson
Lund University

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
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

"A case study examines a phenomenon in its natural setting, employing multiple methods of data collection to gather information from one or a few entities (people, groups or organization). The boundaries of the phenomenon are not clearly evident at the outset of the research and no experimental control or manipulation is used.”

Benbasat, The Case Research Strategy in Studies of Information Systems
Case study in software engineering

"Case study in software engineering is an empirical inquiry that draws on multiple sources of evidence to investigate one instance (or a small number of instances) of a contemporary software engineering phenomenon within its real-life context, especially when the boundary between phenomenon and context cannot be clearly specified”

Runeson et al, Case Study Research in SE

Case studies 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.
Case studies in SE cont’d

• Software engineering is different from social science and information systems
  – Software development rather than use
  – Project rather than function oriented
  – Advanced engineers rather than routine work

Case studies for industry

<table>
<thead>
<tr>
<th>Source of knowledge</th>
<th>Type of knowledge</th>
<th>Opinion</th>
<th>Empirical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>1 (most)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Remote</td>
<td>3</td>
<td>4 (least)</td>
<td></td>
</tr>
</tbody>
</table>
Critique against case studies

• Lack of rigor
• Generalization from single case?
• Take too long, results in tedious reports
• Results in the eye of the beholder

Countermeasures against critique [Robson p166]

1. Rigorous data collection
2. Framed with assumptions
3. Understanding of many traditions
4. Procedures from many traditions
5. Idea leads to understanding
6. Detailed methods for collection, analysis and writing
7. Analysis on multiple levels
8. Clear writing
How can I tell it is a Case Study?

- Has research questions set out from the beginning of the study
- Data is collected in a planned and consistent manner
- Inferences are made from the data to answer the research question
- Explores a phenomenon, or produces an explanation, description, or causal analysis of it
- Threats to validity are addressed in a systematic way

Perry et al ICSE06

Quality criteria for case studies

1. theoretical basis and case-study protocol
2. triangulation in methods and procedure
3. documentation of a case-study research project and case-study report
4. designing a chain of evidence
5. the logic of generalization

[Kyburz-Graber04]
Related empirical methods

• Case study
• Action research
• Survey
• Experiment

Action research

"...purpose...to influence or change some aspect of whatever is the focus of research...
Collaboration between researchers and those who are the focus of the research ... are typically seen as central"

Colin Robson, Real World Research
Action Research – origin

- Lewin (1947) systematic study of planned change - unfreezing, movement, refreezing
- Shewart (1939) Plan, Do, Check, Act (PDCA) popularized by Deming (1982)

Technical action research

“Technical action research is a case-based mechanism experiment. It is a real-world consultancy project …[which] …uses an artifact in a real-world project to help a client, or gives the artifact to others to use them in a real-world project, and uses this experience to learn about the robustness of the intended effects and the mechanisms that bring them about, in uncontrolled conditions of practice.”

Wieringa, 2014
Case study vs. Action research

Survey

"Collection of standardized information form a specific population, or some sample from one, usually, but not necessarily by means of a questionnaire or interview”

Colin Robson, Real World Research
Concepts of a Survey

Experiment

"Measuring the effects of manipulating one variable on another variable"

*Colin Robson, Real World Research*

"Subjects are assigned to treatments by random."

*Wohlin, Runeson… Experimentation*
Guidelines

- Scoping
- Planning
- Operation
- Analysis & interpretation
- Presentation & package

Level of control

- Factors to manipulate
- Factors that should be stable
- Confounding factors

<table>
<thead>
<tr>
<th>Low</th>
<th>Case study</th>
<th>Action research</th>
<th>Survey</th>
<th>Experiment</th>
<th>High</th>
</tr>
</thead>
</table>

Victor R. Basili, University of Maryland, MD, USA

"This book is a landmark in allowing us to train both the researcher and practitioner in software engineering experimentation."

Anneliese A. Andrews, University of Denver, CO, USA

"The additions and modifications in this revised version very nicely reflect the maturation of the field of empirical software engineering."
**Level of realism**

- Isolated artifact
- Artificial project
- Project with short-term commitment
- Project with long-term commitment

**Research approach**

**Fix design**
- All factors decided before launch
- Data collection first, then analysis
- Mostly quantitative

**Flexible design**
- Factors changing during study
- Data collection and analysis intertwined
- Mostly qualitative

Experiment
Survey

**Höst et al 2005**

**Robson**
### Types of data

<table>
<thead>
<tr>
<th>Quantitative</th>
<th>Qualitative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numbers and values</td>
<td>Existence (and frequency) of words</td>
</tr>
<tr>
<td>Statistical analyses</td>
<td>Structuring of information</td>
</tr>
<tr>
<td>Descriptive and confirmative</td>
<td>Citations and reasoning</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Action research</th>
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<tr>
<td>Survey</td>
<td>Case study</td>
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### Research perspectives

- **Positivist** (evidence for propositions)
  - Controlled experiments
  - Student experiments
  - Surveys, multiple case studies
  - Case studies, actions research, ethnography
  - Anectodes, story telling, diaries

- **Interpretivist** (understand phenomena)

Dawson et al 2004
The Hen and the Egg Problem

Triangulation

Multiple perspectives provide more valid view of the phenomenon

- Data (source)
- Observer
- Method
- Theory
Replication

Quantitative studies
- Sampling logic

Qualitative studies
- Comparison logic

Purpose

Survey
- Describe
  • Form

Case study
- Explore
  • Scope
  • Frequency

Experiment
- Explain
  • Relationship

Rosengren/Arvidsson 2002
Overview of main characteristics
[Höst06 p43, Runeson12 p15]

<table>
<thead>
<tr>
<th>Method</th>
<th>Primary purpose</th>
<th>Primary data</th>
<th>Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survey</td>
<td>Descriptive</td>
<td>Quantitative</td>
<td>Fix</td>
</tr>
<tr>
<td>Case study</td>
<td>Exploratory</td>
<td>Qualitative</td>
<td>Flexible</td>
</tr>
<tr>
<td>Experiment</td>
<td>Explanatory</td>
<td>Quantitative</td>
<td>Fix</td>
</tr>
<tr>
<td>Action research</td>
<td>Problem solving</td>
<td>Qualitative</td>
<td>Flexible</td>
</tr>
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Case study process

Design ➔ Preparation ➔ Collection ➔ Analysis ➔ Reporting

Runeson & Höst 2009
Task on one of your selected case study papers

- Characterize
  - Method
  - Primary purpose
  - Primary data
  - Design
- Is the terminology of the paper coherent to these definitions?
- Would another research method be (more) feasible? Which? Why?