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 form one or a few entities (people, groups or organization). The boundaries of the phenomenon are nor 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 isan 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

Credibility of knowledge in Software Engineering
[Rainer03]

Source of knowledge	Type of knowledge	
	Opinion	Empirical
Local	1 (most)	2
Remote	3	4 (least)

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**
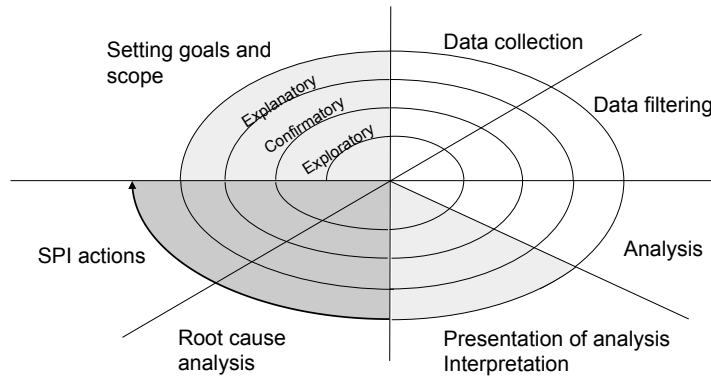- **Shewart (1939) Plan, Do, Check, Act (PDCA) popularized by Deming (1982)**

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

Setting goals and scope

Data collection

Data filtering

Explanatory

Confirmatory

Exploratory

SPI actions

Analysis

Root cause analysis

Presentation of analysis
Interpretation

Areas of responsibility:
- Researchers
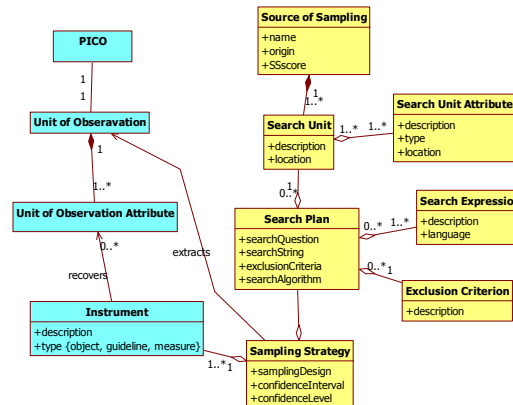- Researchers and company
- Company

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

de Mello, R. M., P. Silva, P. Runeson, and G. H. Travassos (2014). Towards a Framework to Support Large Scale Sampling in Software Engineering Surveys. In: *Proceedings ESEM*. Torino, Italy. doi: 10.1145/2652524.2652567.

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**

Claes Wohlin · Per Runeson
Martin Höst · Magnus C. Ohlsson
Björn Regnell · Anders Wesslén

Experimentation in Software Engineering

Springer

Level of control

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

Case study   Action research   Survey   Experiment

low   **high**
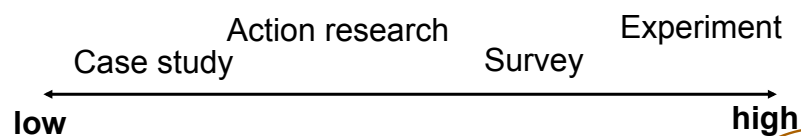
Level of realism

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

Experiment

Case study

Höst et al 2005

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

Case study
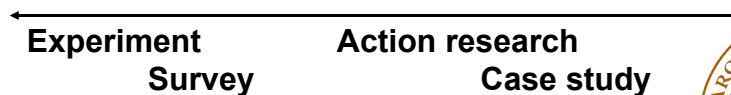**Action research**

Robson

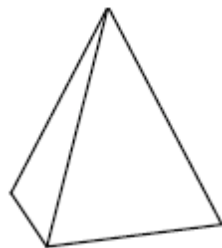## Types of data

Quantitative

- Numbers and values

- Statistical analyses

- Descriptive and confirmative

Qualitative

- Existence (and frequency) of words

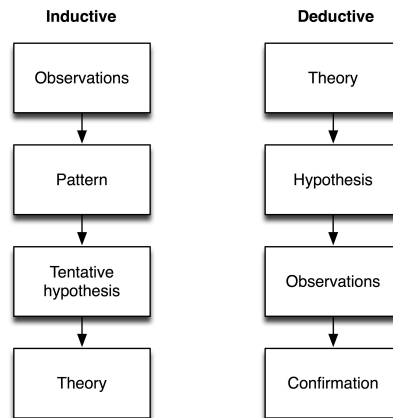- Structuring of information

- Citations and reasoning

| Experiment | Action research |
| Survey | Case study |

Research perspectives

- **Positivist** (evidence for propositions)

  - **Controlled experiments**

  - **Student experiments**

  - **Surveys, multiple case studies**

  - **Case studies, actions research, ethnography**

  - **Anectodes, story telling, diaries**

Dawson et al 2004 • **Interpretivist** (understand phenomena)

The Hen and the Egg Problem

Inductive

Observations

↓

Pattern

↓

Tentative hypothesis

↓

Theory

Deductive

Theory

↓

Hypothesis

↓

Observations

↓

Confirmation

Triangulation

Multiple perspectives provide more valid view of the phenomenon

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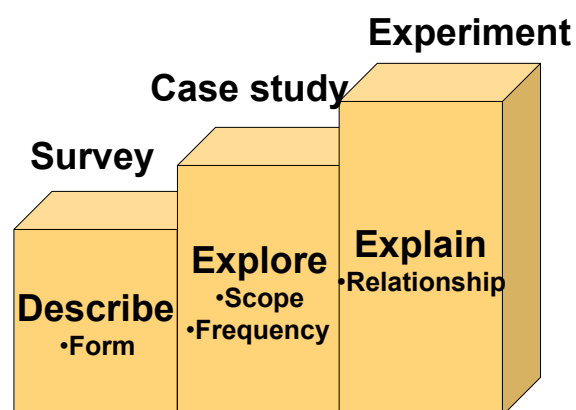- **Theory**

Replication

Quantitative studies
- **Sampling logic**

Qualitative studies
- **Comparison logic**

Purpose

Experiment

Case study

Survey

Explore
- **Scope**
- **Frequency**

Describe
- **Form**

Explain
- **Relationship**

Rosengren/Arvidsson 2002

Overview of main characteristics
[Höst06 p43, Runeson12 p15]

Method	Primary purpose	Primary data	Design
Survey	Descriptive	Quantitative	Fix
Case study	Exploratory	Qualitative	Flexible
Experiment	Explanatory	Quantitative	Fix
Action research	Problem solving	Qualitative	Flexible

Case study process

Design

Preparation

Collection

Analysis

Reporting
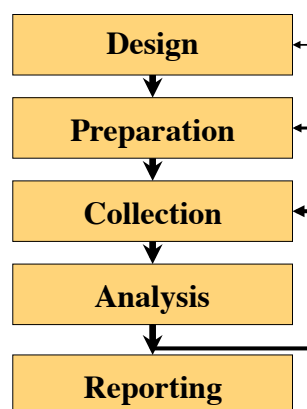
Runeson&Höst09

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?**