

Case Study Research

Overview

- What is a case study?
 - What is not a case study
- Design Issues
- Case Studies in Software Engineering
 - A good example
 - A bad example

What is a case study?

- A case study is an empirical inquiry that
 - investigates a contemporary phenomenon within its real-life context, especially when
 - the boundaries between phenomenon and context are not clearly evident.
- The case study inquiry
 - copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result
 - relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result
 - benefits from the prior development of theoretical propositions to guide data collection and analysis.

When to use case studies

Strategy	Form of Research Question	Requires Control of Behavioral Events?	Focuses on contemporary events?
Experiment	How, why?	Yes	Yes
Survey	Who, what, where, how many, how much?	No	Yes
Archival Analysis	Who, what where, how many, how much?	No	Yes/No
History	How, why?	No	No
Case Study	How, why?	No	Yes

Components of Research Design

- A research design is a “blueprint” for a study
 - Deals more with the logic of the study than the logistics
- Five parts of a case study research design
 1. A study’s questions
 2. Its propositions (if any)
 3. Its unit(s) of analysis
 4. The logic linking the data to the propositions
 5. The criteria for interpreting the findings

Step 1: Study Questions

- Usually “how” and “why” Questions
 - Example: “Why do two organizations have a collaborative relationship?”
- The initial task is to clarify precisely the nature of the study questions

Types of Case Studies

- Explanatory
 - Example: Study of Cuban Missile Crisis by Allison
 - Adjudicates between competing explanations
- Descriptive
 - Example: *Street Corner Society* by Whyte
 - Describes sequence of events and underlying mechanisms
- Causal
- Exploratory
 - Example: Christopher Columbus’ voyage to the new world
 - Criteria or parameters instead of purpose

Step 2: Study Propositions

- Propositions are statements that help direct attention to something that should be examined in the case study, i.e. point to what should be studied
 - Example: “Organizations collaborate because they derive mutual benefits”
- Propositions will tell you where to look for relevant evidence
 - Example: from above example, you might decide to define and ascertain the specific benefits to each organization

Step 3: Unit of Analysis

- The unit of analysis is the primary interest of the study
 - Example: an individual, an organization, an event
 - More examples: decisions, programs, processes, changes
 - May be difficult to delineate, e.g. the beginning and end points of a process
- What unit of analysis to use generally depends on the primary research questions
- Once defined, the unit of analysis can still be changed if desired, e.g. as a result of discoveries based on data
- In order to compare results with previous studies (or allow others to compare results with yours), try to select a unit of analysis that is or can be used by others

Step 4: Linking Data to Propositions

- One of the least well developed components in case studies
 - Many ways to perform this, but none as precisely defined as the treatment/subject approach used in experiments
- Options
 - Pattern matching: Describe several potential patterns, then compare the case study data to the patterns and see which one is closer
 - Qualitative data analysis techniques, e.g. Miles and Huberman
 - NUD*IST software
 - Nonnumerical unstructure data indexing, searching, and theorizing

Step 5: Criteria for Interpreting Findings

- Also a relatively undeveloped component in case studies
- Statistical tests not possible when only single data points are captured (as is the case with single-case studies)
 - Currently there is no precise way of setting the criteria for interpreting these types of findings

Levels of Inferences

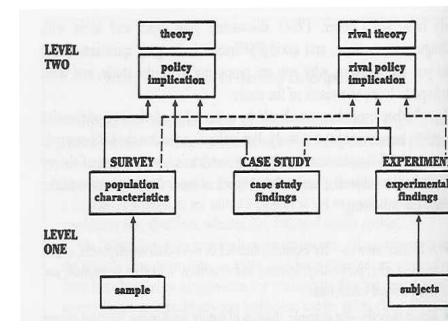
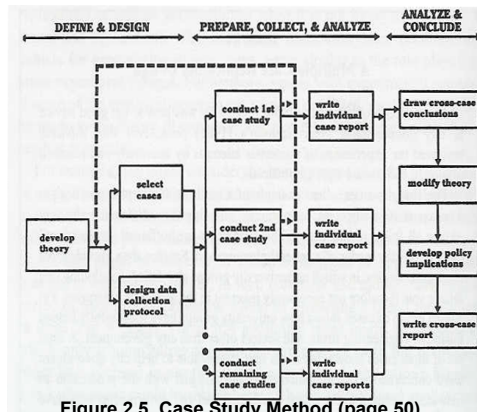


Figure 2.2 Making Inferences: Two Levels (page 32)

Replication Approach for Multiple-Case Studies



Criteria for Judging Research Quality

- **Construct Validity**
 - Correctness of operational measures
- **Internal Validity**
 - Causal relationships are distinguished from spurious relationships
 - Does the internal logic of study hold up?
 - For explanatory or causal studies only
- **External Validity**
 - Establishing the domain to which a study's findings can be generalized
- **Reliability**
 - Whether the operations of a study can be repeated and obtain the same results

Tactics to Address Quality

Tests	Case Study Tactic	Phase of research in which tactic occurs
Construct validity	• Use multiple sources of evidence	data collection
	• Establish chain of evidence	data collection
	• Have key informants review draft case study report	composition
Internal validity	• Do pattern-matching	data analysis
	• Do explanation-building	data analysis
	• Address rival explanations	data analysis
	• Use logic models	data analysis
External validity	• Use theory in single-case studies	research design
	• Use replication logic in multiple-case studies	research design
Reliability	• Use case study protocol	data collection
	• Develop case study database	data collection

Figure 2.2 Case Study Tactics for the Four Design Tests (page 34)

Case Study Designs

- 4 types of designs based on a 2x2 matrix
 - Type 1 – single-case (holistic) designs
 - Type 2 – single-case (embedded) designs
 - Type 3 – multiple-case (holistic) designs
 - Type 4 – multiple-case (embedded) designs

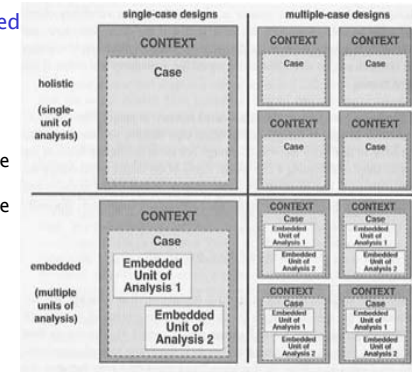


Figure 2.4 Basic Types of Designs for Case Studies (page 40)

Three Principles of Data Collection

1. Use multiple sources of evidence

- Triangulation
 - Data
 - Investigator (different evaluators)
 - Theory (different perspectives on same data)
 - Methodological

2. Create a case study database

- Notes, documents, matrices,

3. Maintain a chain of evidence

- A reliability issue, need to be able to trace inferences backwards

Case Studies in Software Engineering

• Popular, widely used

- Flexible and applicable to applied empirical studies
- Suitable because context is important and difficult to extricate from field trials

• Problematic

- Many “case studies” are not
- Some case studies make poor choices in unit of analysis, validity of results, data observation and collection

A case study is not...

• An exemplar or illustrative example

- Teaching case study vs. research case study
- Medical and legal cases

• An experience report

- A retrospective account of events or interventions that were attempted accompanied by lessons learned

• A quasi-experimental design with $n=1$

- Quasi-experimental designs still require some degree of control
- A case study has the same scope as an experiment
 - A single case is not a single subject

• An ethnography or grounded theory method

- Needs a theoretical orientation from the outset

Case Studies in Software

• Good example

- Matthias M. Müller and Walter F. Tichy, “Case Study: Extreme Programming in a University Environment,” presented at Twenty-third International Conference on Software Engineering, Toronto, Canada, pp. 537–544, 12–19 May 2001.

• Bad example

- William G. Griswold, Jimmy J. Yuan, and Yoshikiyo Kato, “Exploiting the Map Metaphor in a Tool for Software Evolution,” presented at Twenty-third International Conference on Software Engineering, Toronto, Canada, pp. 265–274, 12–19 May 2001.

Müller and Tichy

- Established research questions at the outset
- Systematic data collection
- Data analysis compared results against initial questions
- Discusses generalizability and implications

Griswold, Yuan, and Kato

- An experiment with N=1
- Study Questions
 - Would subject use Aspect Browser as a map?
 - Does map metaphor assist a programmer?
 - Improvements to AB