

# Guidelines for industrially-based multiple case studies in software engineering

## **Six part of this presentation:**

1. Prepare the case study
2. Case study focus or planning
3. Design the case study
4. Data collection
5. Data analyze
6. Reporting

# 1. Prepare the case study

- 5 main activities or steps in this phase

*Review the need for legal agreements*

*Organize requirements for ethics*

*Find out what the publishing criteria is*

*Ensure familiarity with partner schedules*

*Oversee working conditions*

- There are four main categories of elements in BPMN: flow objects, connectors, artifacts, and swim lanes.

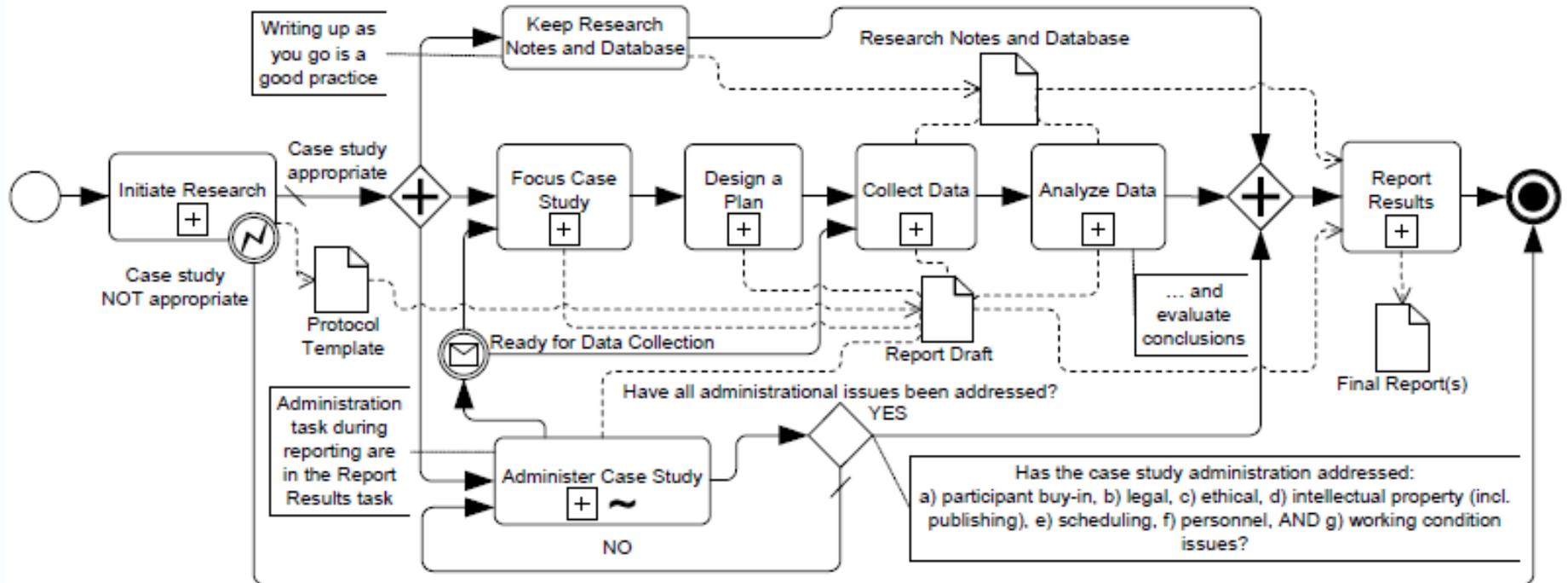


Figure 1. General organization of phases in case study research (BPMN 1.0 diagram)

## 2. Case study focus or planning

- In this section we describe in detail the 16 steps that comprise the phase that determines basic characteristics of the case study. This phase is sometimes called planning but we find the term “**case study focus**” more appropriate, because a detailed plan will be developed fully in the subsequent phase. The order of the 16 steps need not be sequential in all circumstances.

- 16 steps are as follows

*Step 1: Refine research objectives and formalize research questions*

*Step 2: Define clear research proposition(s)*

*Step 3: Identify unit of analysis*

*Step 4: Define conceptual framework*

*Step 5: Define concepts and measures*

*Step 6: Define how you will analyze results*

*Step 7: Identify characteristics of cases to study*

*Step 8: Identify & justify sites and/or individuals that are the focus*

*Step 9: Define boundary of case study*

*Step 10: Identify baseline for evaluation if appropriate*

- 16 steps are as follows

*Step 11: Establish benefits for organization or group (includes buy-in for appropriate groups)*

*Step 12: Identify feasible cases*

*Step 13: Select cases to study*

*Step 14: Select pilot case(s)*

*Step 15: Ensure case study researchers have appropriate skills and understand their purpose and role*

*Step 16: Decide if you will get appropriate level of confidence*

# 3.Design the case study

- Multiple case studies
- Embedded case studies
- Theoretical replications
- Data (source) triangulation  
*using more than one data source(six source)(下面会提到)*
- Observer triangulation  
*using more than one observer in the study*
- Methodological triangulation  
*both qualitative and quantitative methods*

- “The design is the logical sequence that connects the empirical data to a study’s initial research questions and, ultimately to its conclusions”. The following nine phases comprise case study design in our guidelines.

*Step 1: Convert propositions to hypotheses*

*Step 2: Identify method of comparison if appropriate*

*Step 3: Minimize the effect of confounding factors*

*Step 4: Ensure strategy for data validity*

*Step 5: Define the data collection strategy and process*

*Step 6: Design the case study plan step by step*

*Step 7: Have the draft plan externally checked*

*Step 8: Update the plan based on feedback*

*Step 9: Undertake pilot case study*

## 3.1 Step 5: Define the data collection strategy and process

- A data collection strategy establishes what kind of evidence will be collected and how.
- There are six main sources of evidence: documentation, archival records, interviews, direct observations, participant observation and physical artifacts.
- And for interviews: Who are you going to talk to and in what order? Interview questions should be formulated based on the hypotheses, concepts and measures. It is important however that there are enough opened questions so that the respondent can add any information he/she considers pertinent.

## 3.2 Step 6. *Design the case study plan*

- Define QA on conduct of the plan

Definition of quality assurance (QA) criteria ensures that the methods or tools under investigation are used correctly and that any factors that could bias the results are recorded. The purpose of the QA definition is so that at the end of the study, an evaluation report can be written up including recommendations for changes in procedures. One way to ensure that a certain level of quality is maintained throughout the case study is to seek independent feedback and review of progress at each stage. The original plan should be systematically compared with progress and results at each stage of the study.

# 4.Data collection

- data collection techniques

*direct methods*

- The three principles of data collection are:
  - 1) use multiple sources of evidence
  - 2) create a case study database
  - 3) validate data and maintain a chain of evidence.

These three principles correspond to the following three steps in the data collection phase

- 3 steps of data collection phase

*Step 1: Obtain the data from multiple sources*

*a) Interviews*

*b) Archival records*

*c) Documentation*

*d) Direct observation*

*e) Participant observation*

*f) Physical artifacts*

*Step 2: Store the data into the database*

*Step 3: Validate the data*

## 4.1 Step 1: Obtain the data from multiple sources

- 4.1.1 Interviews——*pyramid mode*

Interview preparation includes carefully constructing a set of interview questions, determining the sampling strategy and determining the number of interviewees and interviewers. Outputs of the interviewing process are: interview transcriptions, interview notes and any scheduled follow-up meetings. The researcher must allow for deviations to the interview schedule. For example, during the interviews, respondents may recommend other key persons who should be interviewed and may recommend other relevant sources of evidence.

- 4.1.2 Direct observation

Another useful data collection method is direct observation, i.e., observing events, tasks, etc., to find facts and other valuable information. Direct observation occurs when a researcher visits the case study “site” and observes certain events or phenomena relevant to the line of inquiry. The researcher will take notes and may record “actual” events. Text or numerical data may result and the events and their context should be recorded. The researcher will be able to obtain detailed and accurate information about the people she/he is studying.

直接观察时，研究员参看案例研究的网站，并指出某些事件或现象有关调查就行了。研究人员将做笔记，并可以记录“真实”的事件。

- 4.1.3 Participant observation

Although this method is generally characterized as qualitative research, it can include quantitative dimensions.

## 4.2 *Step 2: Store the data into the database*

- Input to this step is the raw material (including interview transcripts, the researcher's field notes, documents collected during data collection, and survey material) and the output is the case study database which will hold all facts and evidence. The data may consist of coded data; a coding scheme; memos and other analytic material; and data displays.

## 4.3 Step 3: *Validate the data*

- If data is: a) missing; b) wrong; c) invalid; d) or not enough, or if multiple sources of evidence cannot support data triangulation, the researcher will need to return to the collection of data. If quantitative and qualitative evidence do addresses the questions and propositions of the case study, then the data should be stored into the database.

# 5.Data analyze

- If there is sufficient data, appropriate statistical techniques should be used. If the data is continuous then parametric statistics will be appropriate (e.g., ANOVA, linear regression). However, if the data is categorical then non-parametric statistical techniques must be used (e.g., chi square, logistic regression). Nonparametric methods are widely used for studying populations that take on a ranked order (such as software reviews receiving one to four stars) and may be necessary when data has a ranking but no clear numerical interpretation, such as when assessing preferences.
- *Validity*  
internal validity

# 6. Reporting

- *Comparative*

This may include: academic colleagues, policy makers, practitioners, thesis committees or examiners and funders of research. With many different audiences, the researcher may find that several different reports may be required.

- *Theory-building*

We advise to start writing as soon as possible – the literature and design can be reported in the protocol. The methodology section can also be started during the case study focusing or planning phase. Descriptive data can be reported **prior to analysis**. The case study report must be complete with **the boundaries** between case and context defined; all relevant evidence must have been collected; the case study should have been completed to a predefined schedule and not finished purely because of time constraints.

**Thanks for listening !**