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Empirical Strategies

Eduardo Figueiredo

http://www.dcc.ufmg.br/~figueiredo

Types of Research

- We can identify two main types of research for empirical studies
  - Exploratory Research
  - Explanatory Research
- The two types are complementary rather than competitive

Exploratory Research

- It is concerned with studying objects in their natural settings
  - Letting the findings emerge from observations
- It has a flexible research design
- It is usually supported by qualitative data

Explanatory Research

- It is mainly concerned with quantifying a relationship or comparing groups
  - The aim often is to identify a cause-effect relationship
- It is usually conducted through a controlled experiment (fixed design)
  - Supported by quantitative data
  - Promotes comparison and statistical analysis

Quantitative vs. Qualitative

- A quantitative investigation can answer
  - How much a new inspection method decreases the number of faults found in tests?
- A qualitative investigation can answer
  - What are the sources of faults between different inspection groups?

Empirical Strategies

- The main empirical strategies are
  - Survey
  - Case Study
  - Experiment / Quasi-Experiment
- Empirical strategies are not orthogonal
  - Some studies may be viewed as a combination of strategies

Survey

- A survey is a system for collecting information from people
  - Used to describe, compare, or explain their knowledge, attitudes and behavior
- Data is collected by interviews or questionnaires
- Data is analyzed to derive conclusions
  - Conclusions can sometimes be generalized

Examples of Survey

- Survey is often performed in retrospect
- Example 1:
  - A tool has been used for a while
  - A survey is conducted to assess its advantages and drawbacks
- Example 2
  - A pool is used to determine how a population will vote in the next election

Case Study

- Case Study is an empirical enquiry that draws on multiple sources of evidences
  - It relies on one instance (or small set of instances) within its real-life context
- It normally aims at tracking a specific attribute or at establishing relationships between attributes

Advantages and Drawbacks

- Advantages
  - Case studies are easier to plan
  - Results are more realistic
- Drawbacks
  - Data are hard to interpret
  - Results are difficult to generalize

Survey vs. Case Study

- Survey is usually done in retrospect
  - Case study is done while a project is executed
- The purpose of surveys is to understand the population
  - Case Study targets a particular project

Experiment

- Experiment is an empirical enquiry that manipulates one factor (or variable) of the studied setting
- Different treatments are applied to the variable (or variables)
  - Other variables are kept constant
- Experiments are mostly done in a laboratory
  - Requires a high level of control

Quantitative (+ Qualitative)

- Experiments are almost pure quantitative
  - Statistical methods are usually applied
- Qualitative data may be used to help in the interpretation and conclusions

Quasi-Experiment

- Quasi-Experiment is similar to experiment where the treatments cannot be based on randomization
  - They emerge from characteristics of the subjects or objects

Case Study vs. Experiment

- The level of control is lower in a case study
- Case studies are most observational
- Experiments are more controlled

Comparative Table

	Survey	Case Study	Experiment
Design Type	Fixed	Flexible	Both
Qualitative / Quantitative	Both	Both	Quantitative
Execution Control	No	No	Yes
Control of Measure	No	Yes	Yes
Costs	Low	Medium	High
Replication	High	Low	High

Bibliography

- C. Wohlin et al. **Experimentation in Software Engineering**, Springer. 2012.
  - Chapter 2 - Empirical Strategies (Sections 2.1 to 2.5)