



Preparation for the 2nd Exam

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14. Systematic Literature Reviews

- SLR are conducted to identify, analyze and interpret all available evidence related to a specific research question
- Their goal is to give a complete and comprehensive picture of the evidence
- SLR must be conducted in a scientifically and rigorous way

[The SLR Process]

- The SLR process for Software Engineering was adapted from other areas (mainly medicine)
- It is structured in three steps
 - Planning
 - Conducting
 - Reporting

[Mapping Studies and SLR]

- Comparing mapping studies to SLR
 - Research questions are broader
 - Field of study is less explored
- A mapping study follows the same principles of SLR, but searches for a broader scope
 - Analysis tend to be more qualitative

[Mapping Studies vs. SLR]

	Mapping Study	SLR
Goal	Classification of a topic	Identify best practice (state of the art)
Research Question	Generic	Specific
Search Process	Defined by a topic	Defined by a research question
Scope	Broader	Focused

[Bibliography]

- C. Wohlin et al. **Experimentation in Software Engineering**, Springer. 2012.
 - Chapter 4. Systematic Literature Reviews

[15. Case Study]

- A case study is defined as an empirical method aimed at investigating a object (or phenomena) in its context
 - It relies on multiple sources of evidence
- Unlike experiments, case studies do not aim for generalization
 - It is often criticized for being of less value

[Case Study vs. Action Research]

- Action research is closely related to case study
- Main difference
 - Case study is purely observational
 - Action research is focused on the process change (e.g., software process improvement)

[The Case Study Process]

- It involves five main activities
 1. Planning (define its goal and protocol)
 2. Preparation for data collection
 3. Data collection
 4. Data Analysis
 5. Reporting

- It has a flexible design and can iterate over the activities (Collection, Analysis)

[Bibliography]

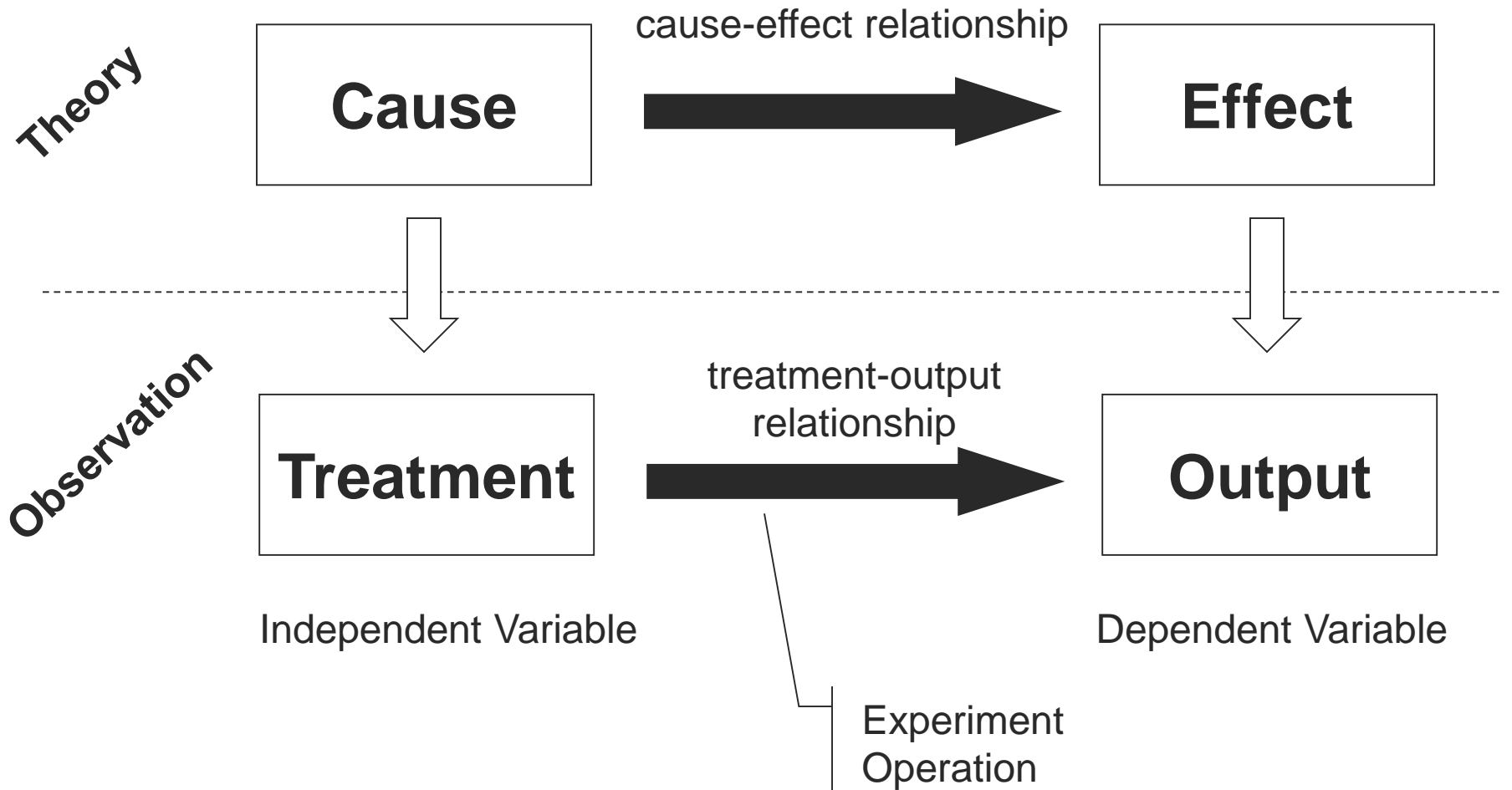
- C. Wohlin et al. **Experimentation in Software Engineering**, Springer. 2012.
 - Chapter 5 – Case Studies

[16. Experiment Process]

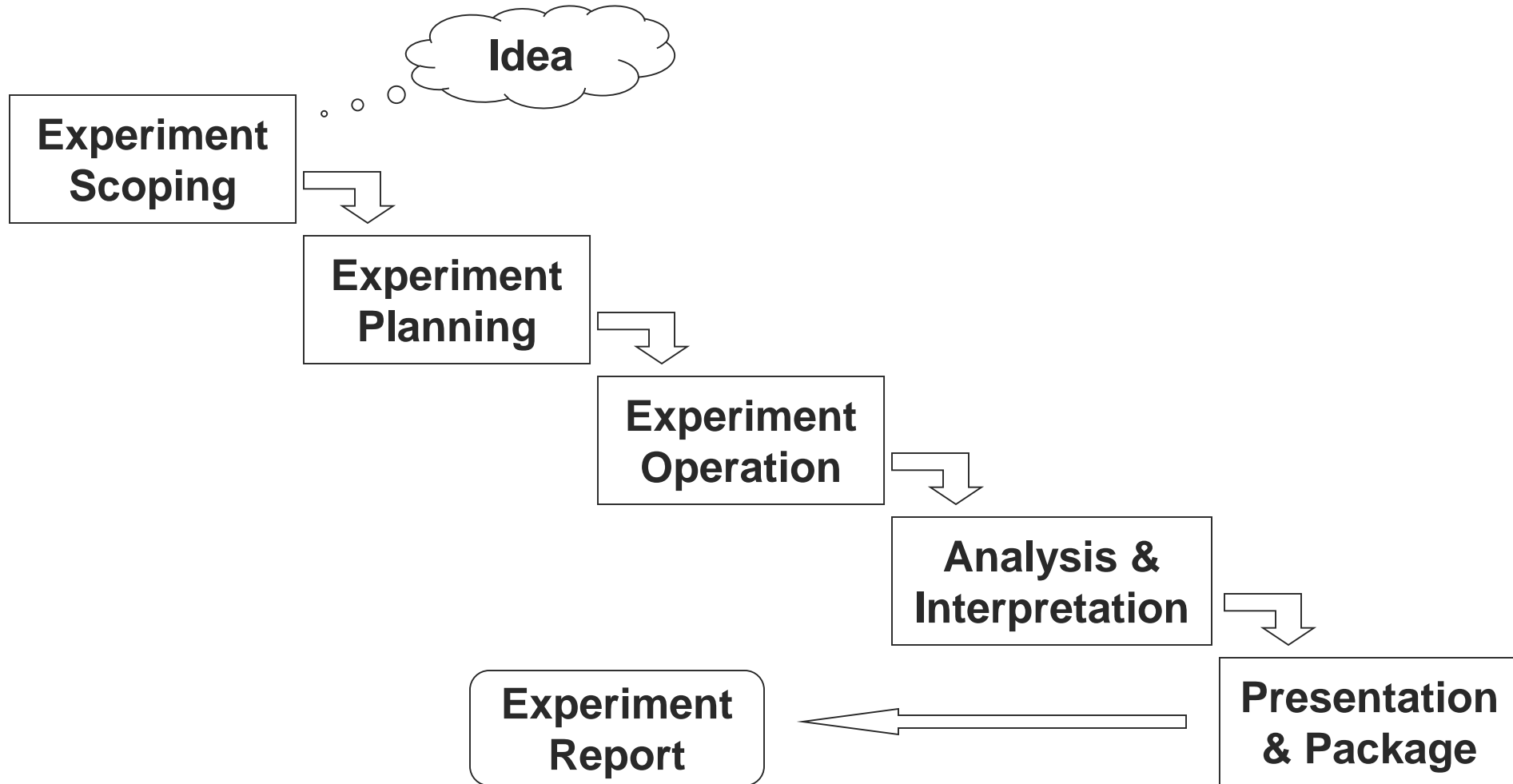
- Experiment is based on the idea of a cause and effect relationship
 - We then formulate a hypothesis about this relationship
- The experiment tests the relationship between a treatment and the outcome
 - That is, it tests the hypothesis
- The goal is draw conclusions about the relationship between cause and effect



[Experiment Principles]



Overview of the Process



[Bibliography]

- C. Wohlin et al. **Experimentation in Software Engineering**, Springer. 2012.
 - Chapter 6 – Experiment Process

[17. Paper Discussion]

- Why Don't Software Developers Use Static Analysis Tools to Find Bugs?
ICSE 2013.

[18. Presentation of Group Work]

- Results of the Group Work

19. Experiment Scoping

- In the scoping phase, the foundations of the experiment if determined
- Its purpose is to define the goals of the experiment
 - The Goal-Question-Metric (GQM) method can be used



[Template for Scoping]

Analyze *<object of study>*

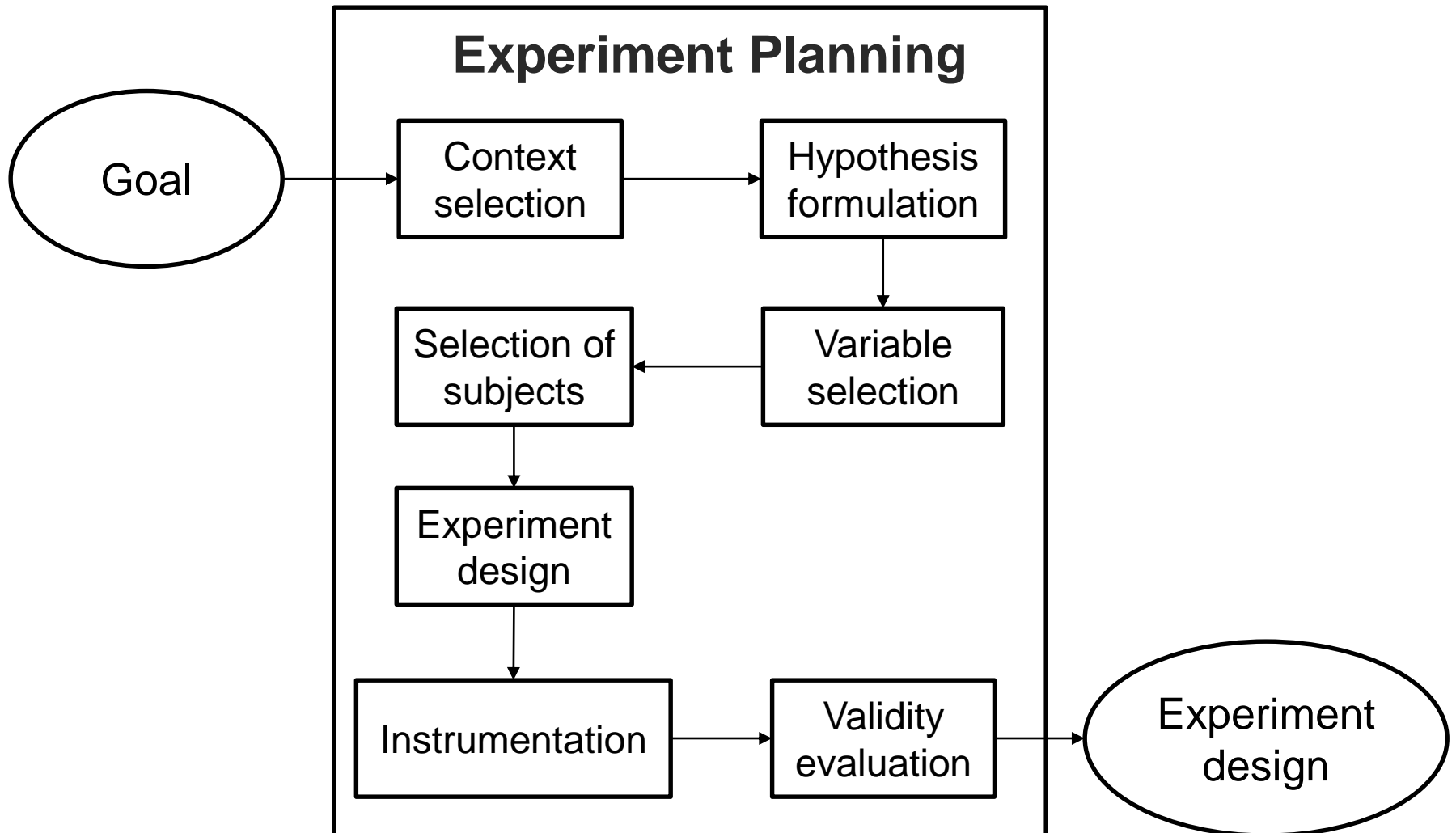
from the purpose of *<purpose>*

with respect to their *<quality focus>*

from the point of view of the *<perspective>*

in the context of *<context>*

Planning Phase Overview



[Bibliography]

- C. Wohlin et al. **Experimentation in Software Engineering**, Springer. 2012.
 - Chapter 7 – Scoping
 - Chapter 8 – Planning

[20. Experiment Design]

- To get the most out of the experiment, it must be carefully planned and designed
 - Design is closely related to interpretation
- An experiment consists of a series of tests of the treatments
 - A design describes how the tests are organized and run

[General Design Principles]

- Most experiment designs use some combination of three design principles
- General design principles
 - Randomization
 - Blocking
 - Balancing

[Standard Design Types]

- Some of the most frequently used experiment designs are
 - One factor with two treatments
 - One factor with more than two treatments
 - Two factors with two treatments
 - More than two factors, each factor with two treatments

[Bibliography]

- C. Wohlin et al. **Experimentation in Software Engineering**, Springer. 2012.
 - Section 8.5 – Experiment Design

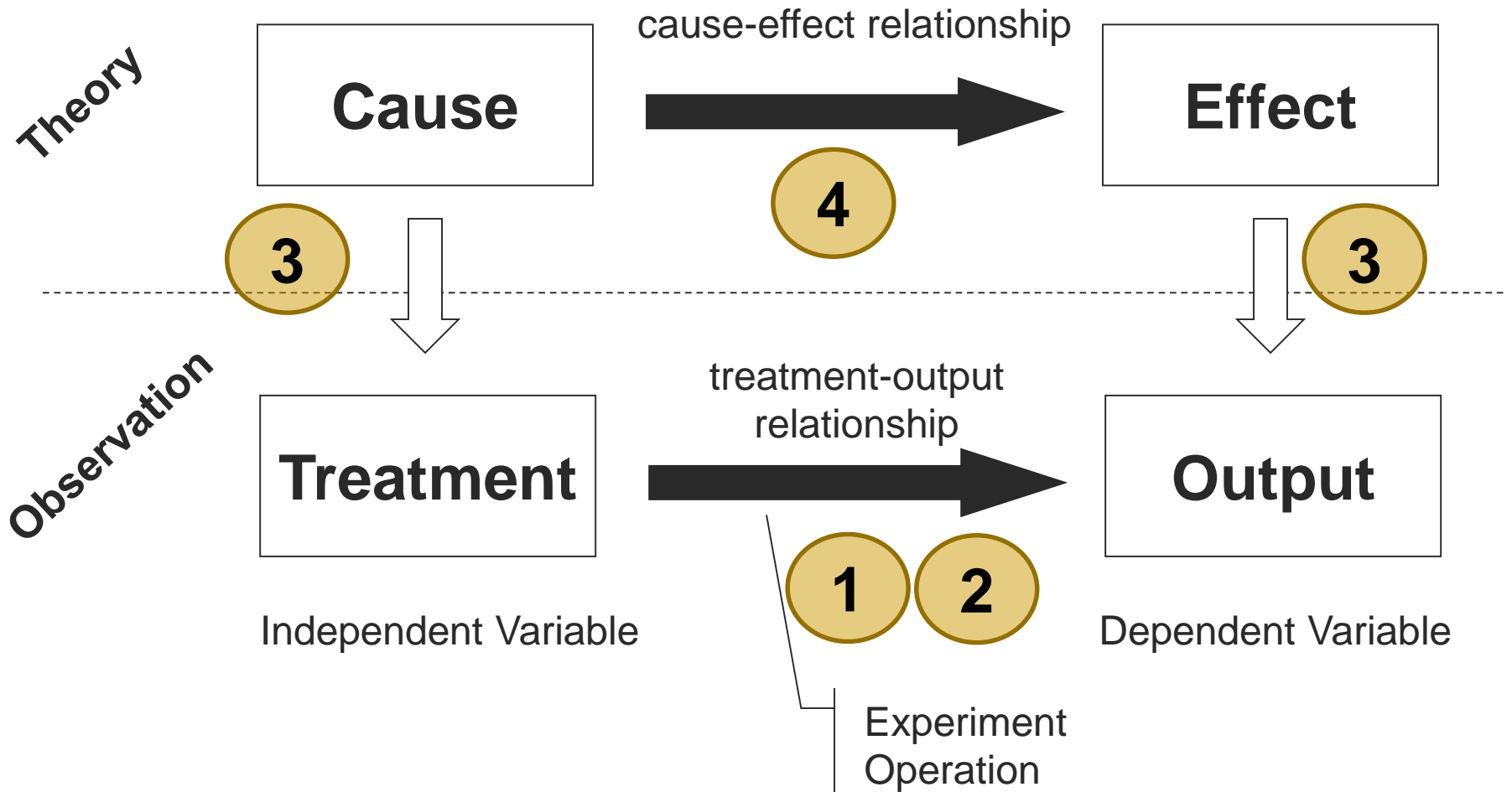
[21. Paper Discussion]

- Are Students Representatives of Professionals in Software Engineering Experiments? ICSE 2015.

22. Exercise

- Revisão sobre: objetivos (GQM), variáveis dependentes e variáveis independentes, perfil dos participantes, hipóteses e questões de pesquisa, objetos usados e medições, ameaças a validade, etc.

23. Threats to Validity



[Four Categories of Threats]

1. **Conclusion Validity:** concerned with the relationship between treatment and outcome
2. **Internal Validity:** there is a causal relationship between treatment and outcome
3. **Construct Validity:** concerned with the relationship between theory and observation
4. **External Validity:** there is a causal relationship between cause and effect

[Conclusion Validity]

- It affects the ability to draw correct conclusion about relations between treatment and outcome
- Examples
 - Choice of statistical tests
 - Choice of sample size
 - Measurement of the experiment

[Internal Validity]

- It can affect the independent variable with respect to causality
 - The results may indicate a causal relationship, although there is none
- Factors to consider
 - How subjects are selected
 - How they are divided in groups
 - How are subjects treated during the experiment



[Construct Validity]

- It refers to the extent to which the experiment setting reflects the theory
- Examples
 - Are students representative of professionals?
 - Does the number of classes taken reflect experience?

[External Validity]

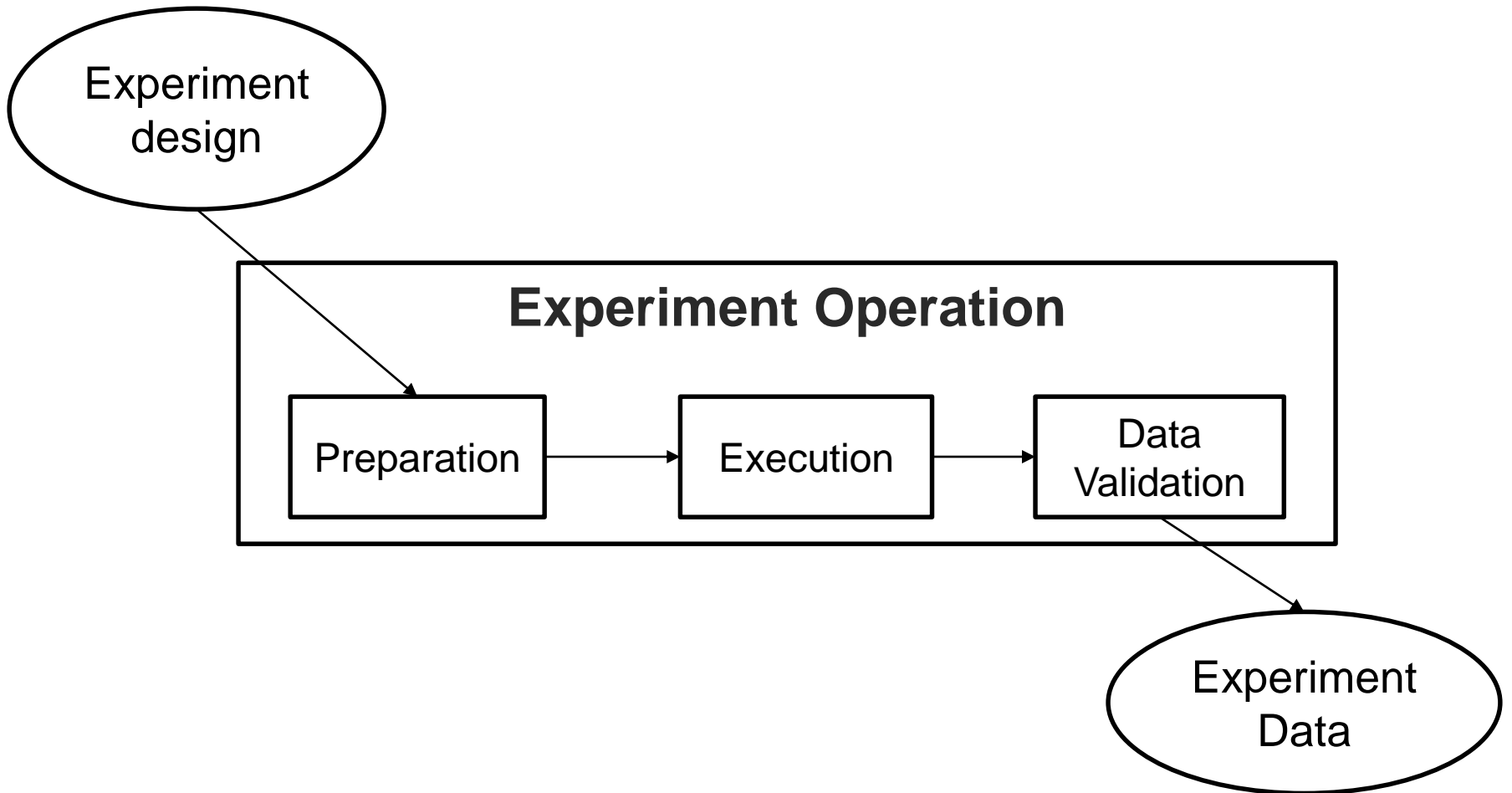
- It limits the ability to generalize the results beyond the experiment setting
 - These treats are reduced by making the experimental environment more realistic
- Three main risks
 - Wrong participants as subjects
 - Wrong environments (too artificial)
 - Timing that affects the results



[Bibliography]

- C. Wohlin et al. **Experimentation in Software Engineering**, Springer. 2012.
 - Section 8.7 – Validity Evaluation
 - Section 8.8 – Detailed Description of Validity Threats
 - Section 8.9 – Priority Among Types of Validity Threats

[Experiment Operation]



[Bibliography]

- C. Wohlin et al. **Experimentation in Software Engineering**, Springer. 2012.
 - Chapter 9 – Operation

[24. Paper Presentation]

- Almost There: A Study on Quasi-Contributors in Open-Source Software Projects. ICSE 2018.
- Writing Good Software Engineering Research Papers. ICSE 2003.

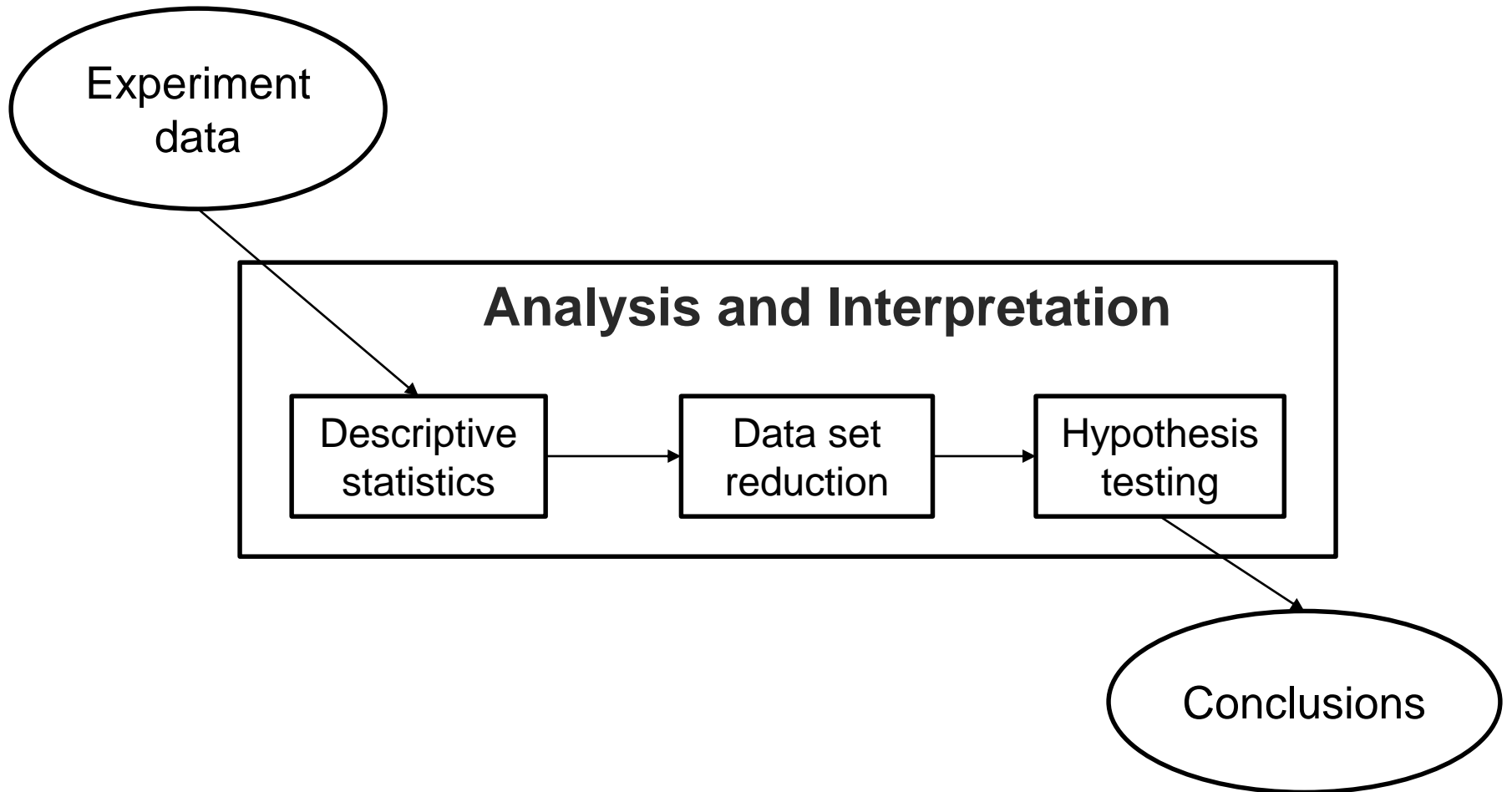
[25. Invited Talk]

- VarXplorer: Reasoning about Feature Interactions by Larissa Soares.

[26. Analysis and Operation]

- After collecting data in the operation phase, we want to draw conclusions
 - The analysis and operation phase aims to interpret the collected experimental data
- This phase has three main steps
 - Descriptive statistics
 - Data set reduction
 - Hypothesis testing

Analysis and Operation Overview



[Hypothesis Testing]

- Its goal is to see if it is possible to reject a null hypothesis (H_0)
 - The experimenter wants to reject H_0 with a given significance
- Example
 - H_0 : Work experience does not impact on productivity
 - H_1 : Work experience impacts on productivity

[Tests for Different Designs]

Design	Parametric	Non-parametric
One factor, one treatment		Chi-2, Binomial
One factor, two treatments (random)	t-test, F-test	Mann-Whitney, Chi-2
One factor, two treatments (paired)	Paired t-test	Wilcoxon, Sign test
One factor, more than two treatments	ANOVA	Kruskal-Wallis, Chi-2
More than one factor	ANOVA	

[Bibliography]

- C. Wohlin et al. **Experimentation in Software Engineering**, Springer. 2012.
 - Chapter 10 – Analysis and Interpretation