ICS 500: Research Methods and Experiment Design in Computing

Lecture

Experiment Process: Step 1. Scoping

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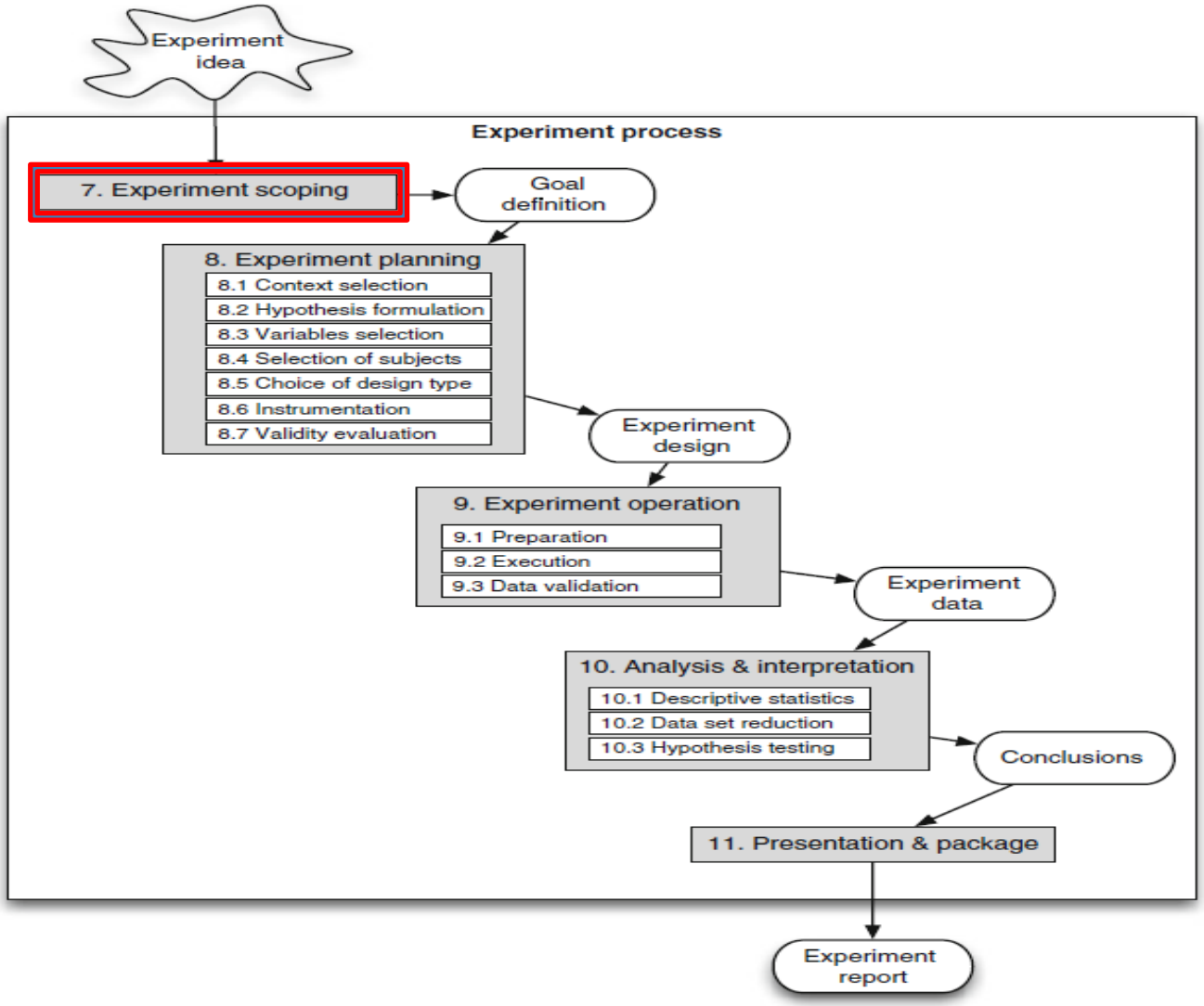
Lecture Objectives

- ✓ Scope definition

Experiment Process

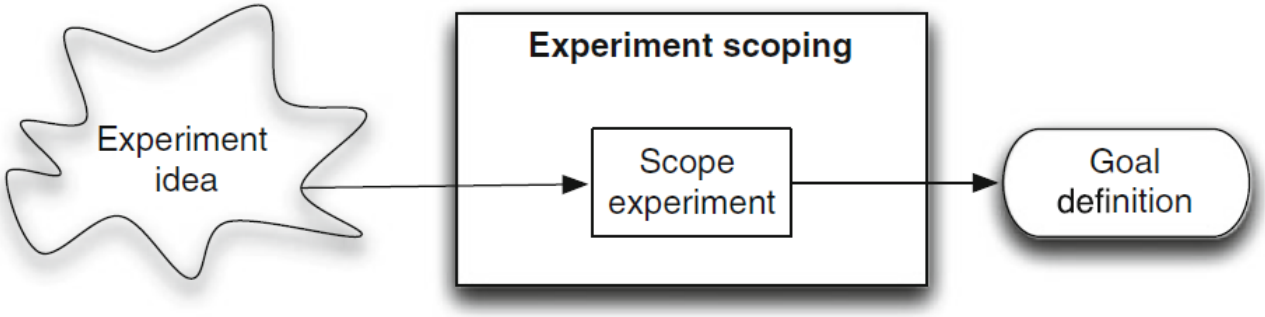


Experiment scoping

- The first activity in experiments is scoping (what should be included and excluded).
  - The hypothesis has to be stated clearly.
- The **objective** and **goals** of the experiment must be defined.
- The goal is formulated from the problem to be solved.

Experiment scoping

- The scope of the experiment is set by defining its **goals**.



The goal template:

Analyze <Object(s) of study>
for the purpose of <Purpose>
with respect to their <Quality focus>
from the point of view of the <Perspective>
in the context of <Context>.

Experiment scoping

- The ***object*** of study is the entity that is studied in the experiment.
  - e.g., products, processes, models, metrics or theories.
- The ***purpose*** defines what the intention of the experiment is.
  - e.g., to evaluate the impact of two different techniques.
- The ***quality focus*** is the primary effect under study in the experiment.
  - Quality focus may be effectiveness, cost, reliability, usability etc.
- The ***perspective*** tells the viewpoint from which the experiment results are interpreted.
  - Examples of perspectives are developer, project manager, customer and researcher.
- The ***context*** is the 'environment' in which the experiment is run.
  - The context briefly defines which personnel is involved in the experiment (subjects) and which software artifacts (objects) are used in the experiment.

Experiment scoping

- Subjects can be characterized by experience, team size, workload etc.

- Objects can be characterized by size, complexity, priority, application domain etc.
  - The experiment context can be classified in terms of the number of subjects and objects involved in the study

Experiment scoping

Experiment context

- **Single object** studies are conducted on a single subject and a single object.
  - Subject X uses Object Y
- **Multi-object** variation studies are conducted on a single subject across a set of objects.
  - Subject X uses Objects Y and Z
- **Multi-test within object** studies examines a single object across a set of subjects.
  - Subjects X and Y use Object Z
- **Blocked subject-object** studies examine a set of subjects and a set of objects.
  - Subjects X and Y use Objects Z and A

Goal definition framework

- The goal definition framework can be filled out with different objects of study, purposes etc.

Object of study	Purpose	Quality focus	Perspective	Context
Product	Characterize	Effectiveness	Developer	Subjects
Process	Monitor	Cost	Modifier	Objects
Model	Evaluate	Reliability	Maintainer	
Metric	Predict	Maintainability	Project manager	
Theory	Control	Portability	Corporate manager	
	Change		Customer	
			User	
			Researcher	

Example experiment

- A study definition example is constructed by composing the elements of the framework and is presented below.

- The example defines an inspection experiment for defect prediction in UML design documents where different inspection techniques are evaluated,
  - i.e., perspective-based reading vs. checklist-based reading.
  - PBR is based on the reviewers having different perspectives when performing the inspection (i.e., point of view of developer, tester etc.)
  - CBR is based on having a checklist for different items that are likely to relate to faults in requirements documents.
- A comparison between perspective- based reading and a checklist-based approach to find the effectiveness and efficiency of the reading techniques

Example experiment

- The starting point is that we have an idea of a cause and effect relationship, i.e. we believe that there is a relationship between a cause construct and an effect construct.

- Theory (hypothesis) = perspective-based reading OR checklist-based reading (cause) has effect on effectiveness and efficiency of the reading techniques (effect).

Example experiment

- The **objects** studied are the Perspective-Based Reading (PBR) technique and a checklist-based (CBR) technique.
- The **purpose** is to evaluate the reading techniques
- The **quality focus** is the effectiveness and efficiency of the reading techniques.

Example experiment *(Cont'd)*

- The **perspective** is from the researcher's point of view.

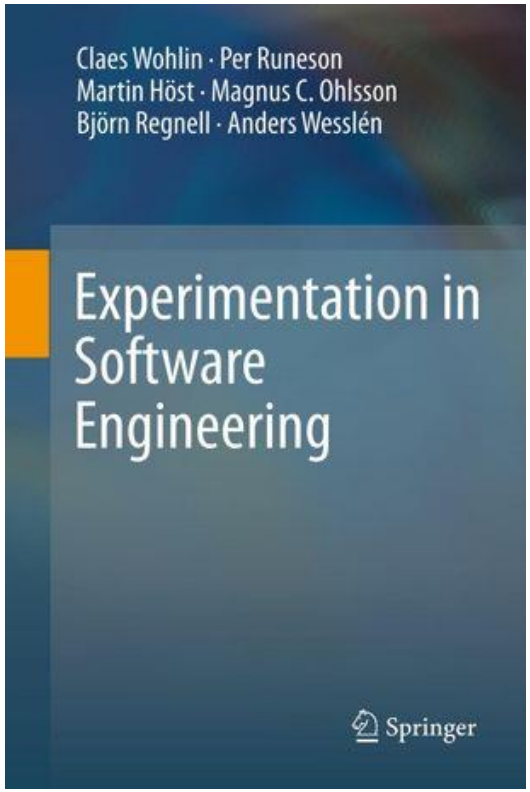
- The experiment is run using M.Sc. and Ph.D. students as subjects with textual requirements documents. (**Context**)

Example experiment *(Cont'd)*

- The goal:
  Analyze **the PBR and CBR techniques**
  for the purpose of **evaluation**
  with respect to **effectiveness and efficiency**
  from the point of view of the **researcher**
  in the context of **M.Sc. and Ph.D. students reading requirements documents.**

The goal template:
Analyze **<Object(s) of study>**
for the purpose of **<Purpose>**
with respect to their **<Quality focus>**
from the point of view of the **<Perspective>**
in the context of **<Context>**

Reference



Chapter 7