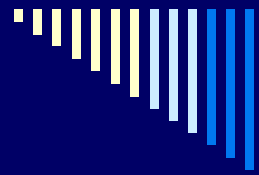


Software Engineering Experimentation

Based on *C. Wohlin et al.,*



Introduction

The main objective of experimentation is to evaluate quantitatively a hypothesis or a relationship.

Testing is usually made by using statistical methods.

Introduction

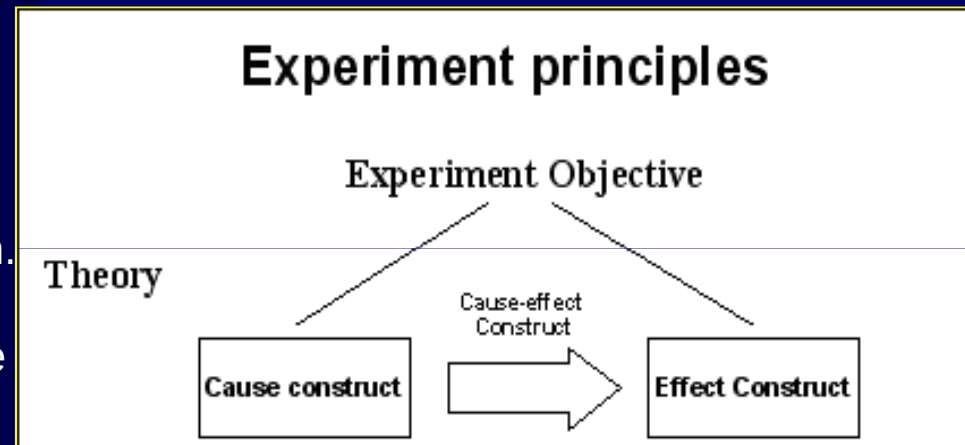
During the experiment process, the researchers usually pass into two main levels, the **theoretical** level and the **observational** level.

Theoretical Level

Cause Construct: it is to define the **entities** that could **cause** the **change** that we aim to investigate; we start thinking and expecting causes of the change and reasons behind them.

Effect construct: is to define entities that are affected by **changes** in the cause.

Cause-effect construct: includes the ability to define a reasonable **relationship** between the cause construct and the effect construct, including definition of what are the appropriate **conditions** that we should provide in order to realize such a change.



Introduction

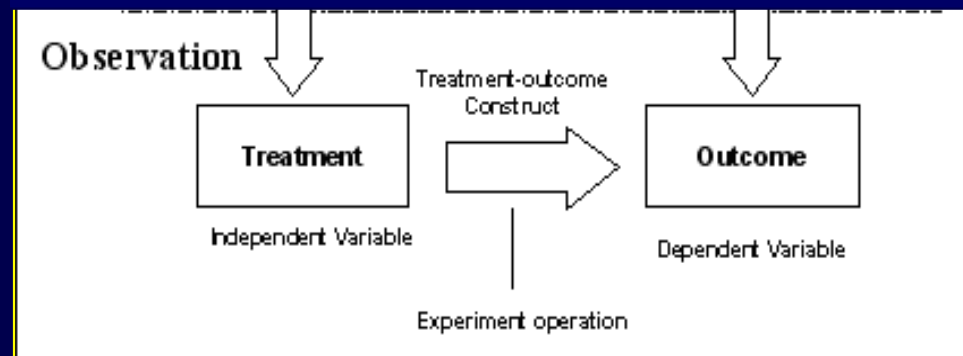
During the experiment process the researchers usually pass into two main levels, the theoretical level and the observational level.

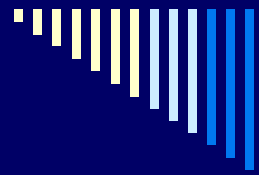
Observational Level

Treatment: is any of the (fix | random) values that the experimenter uses as an instance of the Cause construct. Here we use fix values that the experimenter selects.

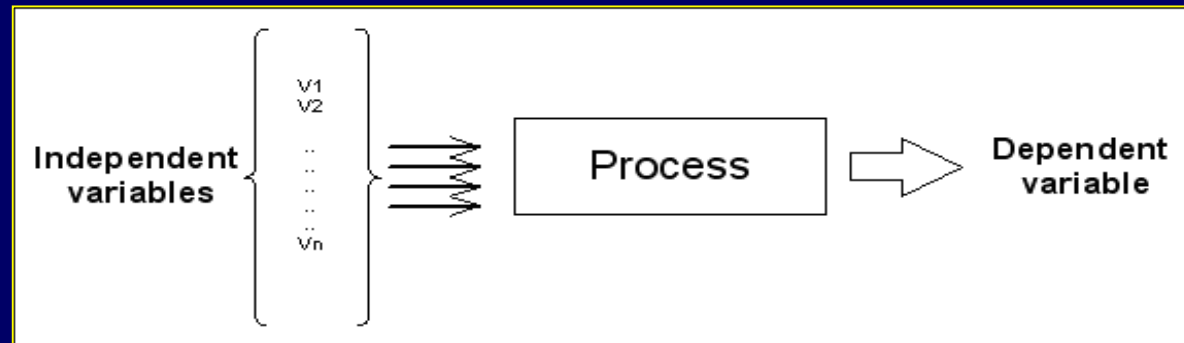
Outcome: any of the entities that are affected by **changes** in the cause. In the experimenter view, an outcome is the instance with parameter Treatment of the effect construct.

Treatment-Outcome Construct: is to verify that **changes in the outcomes** result just and significantly **from changes in the treatments**.

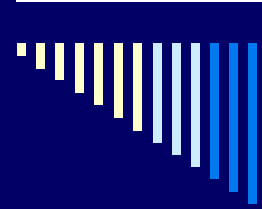




Experiment Variables



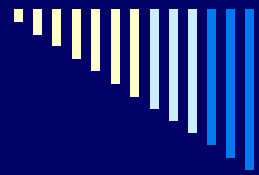
Some kinds of variables are involved with an experiment process.



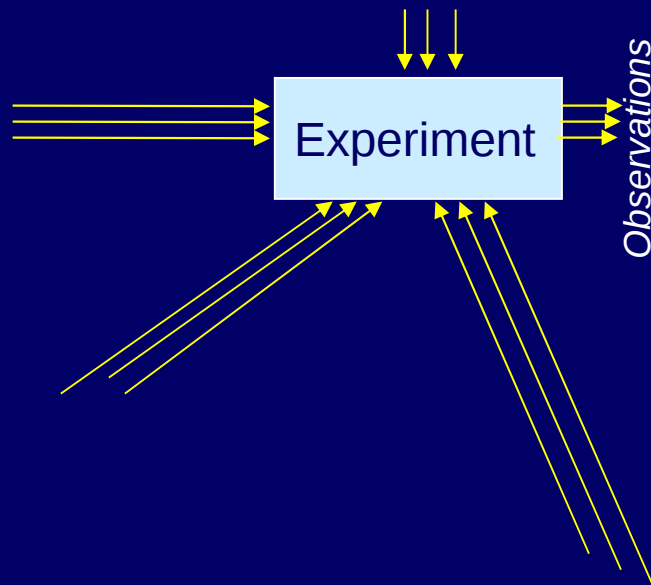
Dependent and Response Variables

A **Dependent variable** is an output variable of the experiment process. The **Response variables** of an experiment derive from the experiment goals; they are the characteristics we want to investigate: if directly measurable, it is a Dependent variables. Otherwise we use simple Dependent variables to obtain compound Response variables.

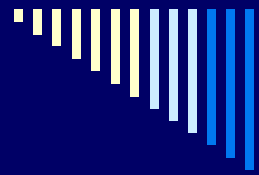
Usually we utilize the mean and/or standard deviation of each characteristic we want to investigate.



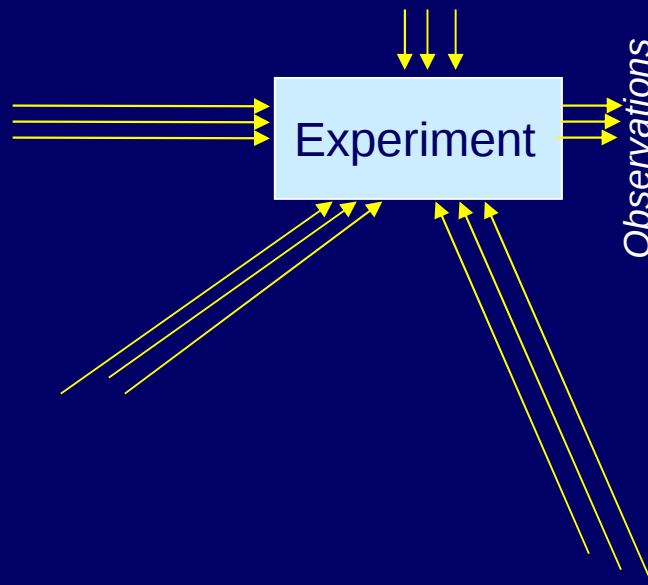
Response Variables



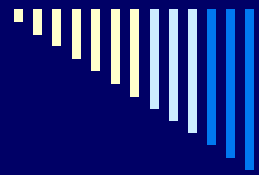
Dependent
variables
(Output variables)



Response Variables



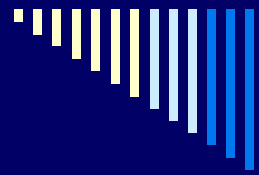
Dependent
variables
(Output variables)



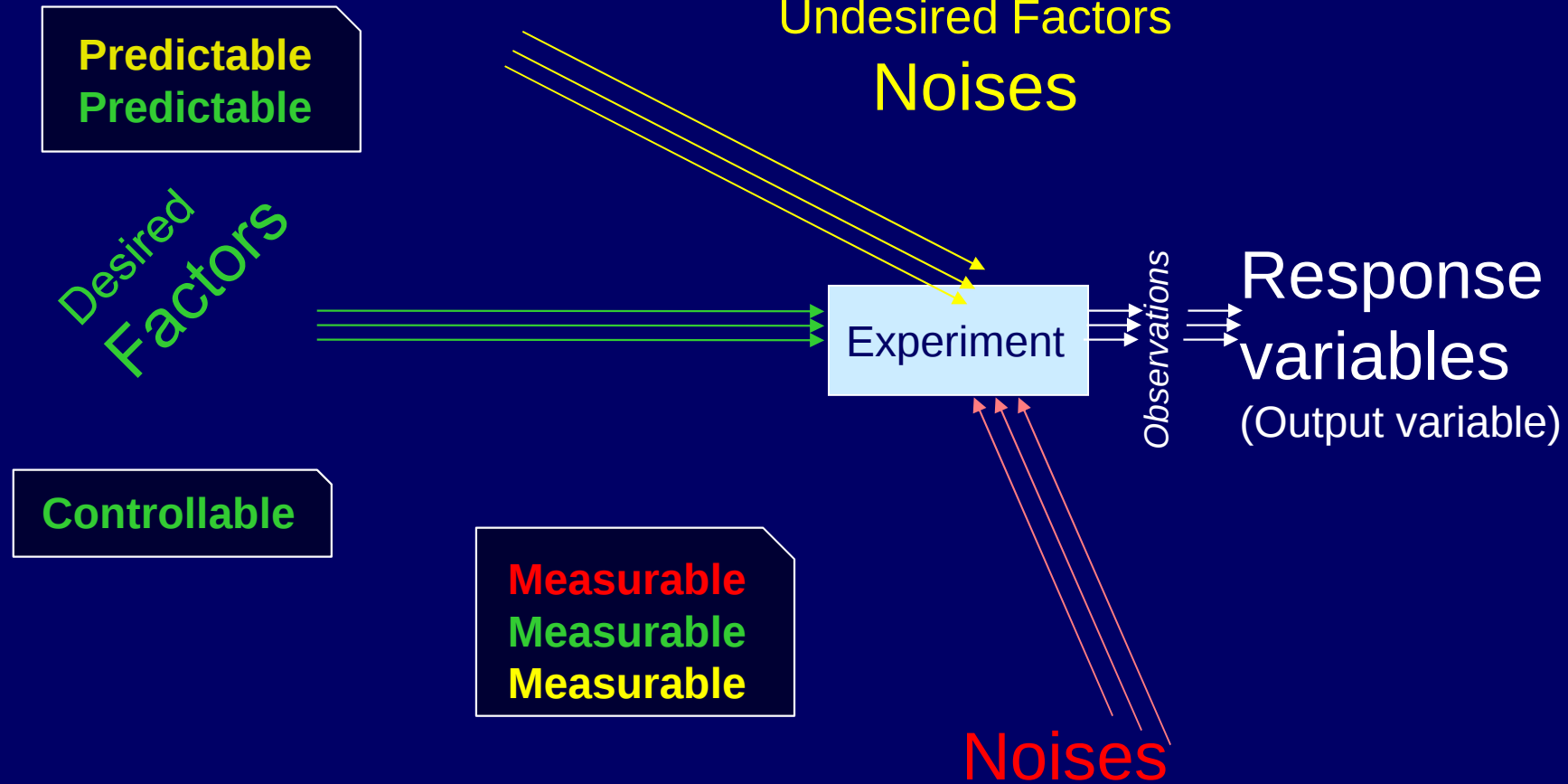
Input Variables or Alternatives

Input variables are **Independent variables**, which affect output.

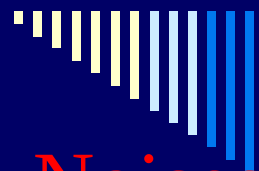
They can be classified as **Factors** or **Alternatives**, and **Noises** | **Noises** (i.e., **Undesired variables factors** included).



Independent Variables



/* They are measurable uninteresting input variables that cannot be controlled and may or may not change during the experiment */

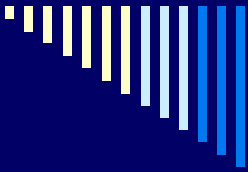


Factors and Noises

Noises are **measurable** inputs which affect output and we **cannot** control.

There are:

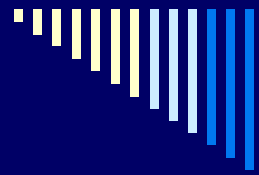
- Variations that we are *able to predict*:
 - **Factors** that we allow change, i.e., desired variations
 - **Noise** (**Undesired Variable Factors**), i.e., undesired variations that we predict and handle as **Blocking Variables**
 - Instances of the latter are the Level of expertise (LOW, HIGH) and the Gender of student subjects participating to an experiment where those variables are not of interest.
- **Noise** that we are *unable to predict*.



Factors

Beside the **Undesired Variable Factors**, as already mentioned, further **Factors** are variables which effects on output and we are able to control. They include:

- **Parameters (or Constant Factors)**; we are not intended to investigate the effect of these input variables on output; we set each of them to some value and control them at that *constant level*.
- **Design Factors**, i.e. those **Input variables**, which effects on output we want to investigate. We call **Treatment** each of the values we select for these variables.



Independent Variables

Factors
Factors

Design Factors

/* They are input variables and the experimenter wants to assign each of them some different values*/

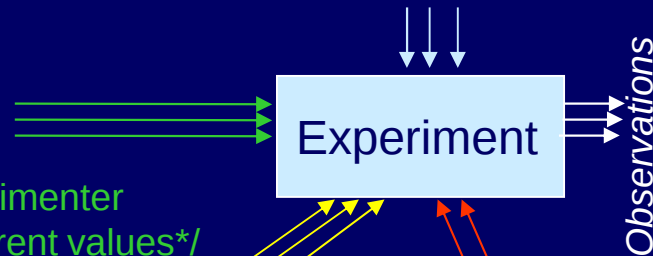
Controllable
Controllable

Noises: to Block

/* They are undesired input variables that we can predict and measure

Constant Factors (or Parameters)

// They are input variables that can be controlled
// They are controlled at constant level

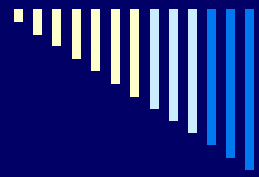


Predictable
Predictable
Predictable

Dependent variables (Output variable)

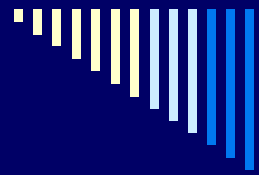
Measurable
Measurable
Measurable
Measurable
Measurable

Noises



Searching for Relationships among Variables

- Descriptive relationship
- Correlations
- Causal relationship
 - Deterministic relationship
 - Statistic relationship



Other Definitions

- Internal/External Replication
- Experimental Error