

# Research Methodology

## Chapter 3 : Research Design

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## 3.1. MEANING OF RESEARCH DESIGN

- **A detailed outline** of how an investigation will take place. A research design will typically include how **data** is to be collected, what **instruments** will be employed, how the instruments will be used and the **intended means for analyzing data collected**.
- Decisions regarding what, where, when, how much
- **General plan to answer the research questions**
- Clear objectives
- Methods employed
- Constraints

# 3.1. MEANING OF RESEARCH DESIGN

- Based on Wyk Brian explanation “ research design articulates what data is required, what methods are going to be used to collect and analyze this data, and how all of this is going to answer your research question (Wyk 2010)” .
- A research design is the set of methods and procedures used in collecting and analyzing measures of the variables specified in the problem research .

## 3.1. MEANING OF RESEARCH DESIGN

- Do you have all the means to do the research ?  
Data, Time , Location, Money, etc.
- Factors affecting the choice are the research problem itself, the background and interests of the researcher, and the intended audience.

## 3.2. DESIGN VERSUS METHOD (DEVAUSE 2001)

- *Research design is different from the method by which data are collected.*
- *Many research methods texts confuse research designs with methods.*
- *It is not uncommon to see research design treated as a mode of data collection rather than as a logical structure of the inquiry.*

## 3.2. DESIGN VERSUS METHOD (DEVAUSE 2001)

- *Research methods and research design are terms you must know before starting a research project.*
- *Both these elements are essential to the success of a research project.*

## 3.2. DESIGN VERSUS METHOD (DEVAUSE 2001)

- *Research design is the overall structure of a research project. For example, if you are building a house, you need to have a good idea about what kind of house you are going to build; you cannot do anything without knowing this. A research design is the same – you cannot proceed with the research study without having a proper research design’* <https://peditaa.com/difference-between-research-methods-and-research-design/>

## 3.2. DESIGN VERSUS METHOD (DEVAUSE 2001)

- *Research methods are the procedures that are used to collect and analyze data.*
- *Thus, the **main difference** between research methods and research design is that **research design is the overall structure of the research study** whereas **research methods are the various processes, procedures, and tools used to collect and analyze data.***



## 3.2. DESIGN VERSUS METHOD (DEVAUSE 2001)

<b>Research Methods</b>	<b>Research design</b>
<b>Research methods are the procedures that will be used to collect and analyze data</b>	Research design is the overall structure of the research
<b>Focus on what type of methods are more suitable to collect and analyze the evidence needed</b>	Focuses on what type of study is planned and what kind of results are expected from the research
<b>Depend on the research design</b>	Based on the research question

## 3.2. NEED FOR RESEARCH DESIGN

- **Research design is needed because it facilitates the smooth sailing of the various research operations, thereby making research as efficient as possible yielding maximal information with minimal expenditure of effort, time and money.**
- **Just as for better, economical and attractive construction of a house, we need a blueprint (or what is commonly called the map of the house) prepared by an architect, *similarly we need a research design or a plan in advance of data collection and analysis for our research project.***

## 3.2. NEED FOR RESEARCH DESIGN

- Helps to give directions
- Helps in decision making
- Prevents blind searching
- Helps to get a reliable result
- Makes research to be efficient

### 3.3. FEATURE OF A GOOD DESIGN

- The design which gives the **smallest experimental error** is supposed to be the best design in many investigations.
- A research design which **yields maximal information** with minimal expenditure of effort, time and money.
- Thus, the question of good design is related to **the purpose or objective of the research problem** and also with the nature of the problem to be studied.

### 3.3. FEATURE OF A GOOD DESIGN

- A research design appropriate for a particular research problem, usually involves the consideration of the following factors:
  - (i) The means of obtaining information
  - (ii) The availability and skills of the researcher and his staff
  - (iii) The objective of the problem to be studied
  - (iv) The nature of the problem to be studied
  - (v) The availability of time and money for the research work

## 3.4. HOW TO DEVELOP A RESEARCH DESIGN ?

- *Classify the intended outcome*
- *Developing the research question*
- *What needs to be measured*
- *Select the population for the experiment*
- *Identify the ideal data collection method*
- *Use correct analysis tools*
- *Choose a channel for disseminating your findings*

## 3.5. COMPONENTS OF RESEARCH DESIGN (CRESWELL 2014)

- *The research design should be able to provide answers of the following reserve queries:*
- *What is the study about and, what type of data is required?*
- *What is the purpose of study?*
- *What are the sources of needed data?*
- *What should be the place or area of the study?*

## 3.5. COMPONENTS OF RESEARCH DESIGN (CRESWELL 2014)

- *What time, approximately, is required for the study?*
- *What should be the amount of materials or number of cases for the study?*
- *What type of sampling should be used?*
- *What method of data collection would be appropriate?*
- *How will data be analyzed?*
- *What should be the approximate expenditure?*
- *What should be the specific nature of the study?*



## 3.6. IMPORTANT CONCEPTS RELATING TO RESEARCH DESIGN

- Before describing the different research designs, it will be appropriate to explain the various concepts relating to designs so that these may be better and easily understood.

### 1. Dependent and independent variables

**Independent variable** : It is a variable that stands alone and isn't changed by the other variables you are trying to measure. For example, **someone's age** might be an independent variable. Other factors (such as what they eat, how many times they go to school) aren't going to change a person's age.

## 3.6. IMPORTANT CONCEPTS RELATING TO RESEARCH DESIGN

- **Dependent variable** : is something that depends on other factors. For example, a test score could be a dependent variable because it could change depending on several factors such as how much you studied, how much sleep you got the night before, etc.

## 3.6. IMPORTANT CONCEPTS RELATING TO RESEARCH DESIGN

### 2. Extraneous variable

- **Extraneous Variables** are unwanted variables that influence the relationship between the variables that an experimenter is examining. Another way to think of this, is that **these are variables that influence the outcome of an experiment**, though they are not the variables that are actually of interest.
- These are variables which mix up the relationship between the dependent and independent variables.

## 3.6. IMPORTANT CONCEPTS RELATING TO RESEARCH DESIGN

### 3. Control

- In experimental researches, the term 'control' is used to refer to **restrain** experimental conditions.

### 4. Confounded relationship

- When the dependent variable is not free from the influence of extraneous variable(s) the relationship between the dependent and independent variables is said to be **confounded/confused** by an extraneous variable(s).

## 3.6. IMPORTANT CONCEPTS RELATING TO RESEARCH DESIGN

### 5. Research hypothesis

- When a prediction or a hypothesized relationship is to be tested by scientific methods, it is termed as **research hypothesis**.
- The research hypothesis is a predictive statement that relates an independent variable to a dependent variable

## 3.6. IMPORTANT CONCEPTS RELATING TO RESEARCH DESIGN

6. Experimental and non-experimental hypothesis-testing research

7. Treatments

- The different conditions under which experimental and control groups are referred to as treatment.
- For example, if we want to determine through an experiment the comparative impact of three varieties of fertilizers on the yield of wheat, in that case the three varieties of fertilizers will be treated as three treatments.

## 3.6. IMPORTANT CONCEPTS RELATING TO RESEARCH DESIGN

### 8. Experiments

- **Experiment** is the systematic procedure carried out under controlled conditions in order to discover an unknown effect and to establish a hypothesis. **Ex.**, an experiment to examine the usefulness of a certain newly developed drug

### 9. Experimental unit(s)

- The pre-determined plots or the blocks, where different treatments are used, are known as experimental units. Example : Animal, human , plants....

## 3.7. BASIC PRINCIPLES OF EXPERIMENTAL DESIGN

- **Experiment** is defined as the **systematic procedure** carried out under controlled conditions in order to discover an unknown effect, to test or establish a hypothesis.
- There are three principles of experimental designs:
  - 1. The Principles of Replication**
    - The experiment should be repeated more than once



## 3.7. BASIC PRINCIPLES OF EXPERIMENTAL DESIGN

### 2. The Principles of randomization

- Equal out the effects of unknown or uncontrollable sources of variation (factors).
- For instance, if we grow one variety of rice, say, in the first half of the parts of a field and the other variety is grown in the other half, then it is just possible that the soil fertility may be different in the first half in comparison to the other half.

# Examples

## ***Research design***

- ***Title: Simulation and Experimental analysis of used tire pyrolysis system***
- ***Objective: To design, simulate and test tire pyrolysis system***
- ***Methodology:***
  - ***Data required:***
    - ***Daily generation of used tire***
    - ***Sample preparation : particle size***
  - ***Testing of the sample : proximate and ultimate analysis, heating value***
  - ***Sizing of the pyrolysis unit considering hourly input and Energy Balance***
  - ***Manufacturing and testing of the system***
- ***Expected result***
  - ***Comparison of simulation and experimental result***
  - ***Product characterization : Ultimate and proximate analysis, heating value***
  - ***Sensitivity analysis by varying important parameters : Temperature, size of the input, flow rate and catalyst***
- ***Budget Required : 20,000 birr***
- ***Time required to finish the project : 8 months***
- ***Constraints : Input of daily waste***

End of Module 3