

Unit 3: RESEARCH DESIGN

MEANING OF RESEARCH DESIGN

The formidable problem that follows the task of defining the research problem is the preparation of the design of the research project, popularly known as the “research design”. Decisions regarding what, where, when, how much, by what means concerning an inquiry or a research study constitute a research design. “A research design is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure.” In fact, the research design is the conceptual structure within which research is conducted; it constitutes the blueprint for the collection, measurement and analysis of data. As such the design includes an outline of what the researcher will do from writing the hypothesis and its operational implications to the final analysis of data. More explicitly, the desing decisions happen to be in respect of:

- (i) What is the study about?
- (ii) Why is the study being made?
- (iii) Where will the study be carried out?
- (iv) What type of data is required?
- (v) Where can the required data be found?
- (vi) What periods of time will the study include?
- (vii) What will be the sample design?
- (viii) What techniques of data collection will be used?
- (ix) How will the data be analysed?
- (x) In what style will the report be prepared?

Keeping in view the above stated design decisions, one may split the overall research design into the following parts:

- a) the sampling design which deals with the method of selecting items to be observed for the given study;
- b) the observational design which relates to the conditions under which the observations are to be made;
- c) the statistical design which concerns with the question of how many items are to be observed and how the information and data gathered are to be analysed; and
- d) the operational design which deals with the techniques by which the procedures specified in the sampling, statistical and observational designs can be carried out.

From what has been stated above, we can state the important features of a research design as under:

- I. It is a plan that specifies the sources and types of information relevant to the research problem.
- II. It is a strategy specifying which approach will be used for gathering and analysing the data.
- III. It also includes the time and cost budgets since most studies are done under these two constraints.

In brief, research design must, at least, contain (a) a clear statement of the research problem; (b) procedures and techniques to be used for gathering information; (c) the population to be studied; and (d) methods to be used in processing and analysing data.

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) well thought out and prepared by an expert architect, similarly we need a research design or a plan in advance of data collection and analysis for our research project. Research design stands for advance planning of the methods to be adopted for collecting the relevant data and the techniques to be used in their analysis, keeping in view the objective of the research and the availability of staff, time and money. Preparation of the research design should be done with great care as any error in it may upset the entire project. Research design, in fact, has a great bearing on the reliability of the results arrived at and as such constitutes the firm foundation of the entire edifice of the research work.

Even then the need for a well thought out research design is at times not realised by many. The importance which this problem deserves is not given to it. As a result many researches do not serve the purpose for which they are undertaken. In fact, they may even give misleading conclusions. Thoughtlessness in designing the research project may result in rendering the research exercise futile. It is, therefore, imperative that an efficient and appropriate design must be prepared before starting research operations. The design helps the researcher to organize his ideas in a form whereby it will be possible for him to look for flaws and inadequacies. Such a design can even be given to others for their comments and critical evaluation. In the absence of such a course of action, it will be difficult for the critic to provide a comprehensive review of the proposed study.

FEATURES OF A GOOD DESIGN

A good design is often characterised by adjectives like flexible, appropriate, efficient, economical and so on. Generally, the design which minimises bias and maximises the reliability of the data collected and analysed is considered a good design. The design which gives the smallest experimental error is supposed

to be the best design in many investigations. Similarly, a design which yields maximal information and provides an opportunity for considering many different aspects of a problem is considered most appropriate and efficient design in respect of many research problems. 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. A design may be quite suitable in one case, but may be found wanting in one respect or the other in the context of some other research problem. One single design cannot serve the purpose of all types of research problems.

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, if any;
- (iii) the objective of the problem to be studied;
- (iv) the nature of the problem to be studied; and
- (v) the availability of time and money for the research work.

If the research study happens to be an exploratory or a formulative one, wherein the major emphasis is on discovery of ideas and insights, the research design most appropriate must be flexible enough to permit the consideration of many different aspects of a phenomenon. But when the purpose of a study is accurate description of a situation or of an association between variables (or in what are called the descriptive studies), accuracy becomes a major consideration and a research design which minimises bias and maximises the reliability of the evidence collected is considered a good design. Studies involving the testing of a hypothesis of a causal relationship between variables require a design which will permit inferences about causality in addition to the minimisation of bias and maximisation of reliability. But in practice it is the most difficult task to put a particular study in a particular group, for a given research may have in it elements of two or more of the functions of different studies. It is only on the basis of its

primary function that a study can be categorised either as an exploratory or descriptive or hypothesis-testing study and accordingly the choice of a research design may be made in case of a particular study. Besides, the availability of time, money, skills of the research staff and the means of obtaining the information must be given due weightage while working out the relevant details of the research design such as experimental design, survey design, sample design and the like.

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:

A concept which can take on different quantitative values is called a variable. As such the concepts like weight, height, income are all examples of variables. Qualitative phenomena (or the attributes) are also quantified on the basis of the presence or absence of the concerning attribute(s). Phenomena which can take on quantitatively different values even in decimal points are called 'continuous variables'.* But all variables are not continuous. If they can only be expressed in integer values, they are non-continuous variables or in statistical language 'discrete variables'.** Age is an example of continuous variable, but the number of children is an example of non-continuous variable. If one variable depends upon or is a consequence of the other variable, it is termed as a dependent variable, and the variable that is antecedent to the dependent variable is termed as an independent variable. For instance, if we say that height depends upon age, then height is a dependent variable and age is an independent variable. Further, if in addition to being dependent upon age, height also depends upon the individual's sex, then height is a dependent variable and age and sex are independent variables. Similarly, readymade films and lectures are examples of independent variables, whereas behavioural changes, occurring as a result of the environmental manipulations, are examples of dependent variables.

[* A continuous variable is that which can assume any numerical value within a specific range.

** A variable for which the individual values fall on the scale only with distinct gaps is called a discrete variable.]

2. Extraneous variable:

Independent variables that are not related to the purpose of the study, but may affect the dependent variable are termed as extraneous variables. Suppose the researcher wants to test the hypothesis that there is a relationship between children's gains in social studies achievement and their self-concepts. In this case self-concept is an independent variable and social studies achievement is a dependent variable. Intelligence may as well affect the social studies achievement, but since it is not related to the purpose of the study undertaken by the researcher, it will be termed as an extraneous variable. Whatever effect is noticed on dependent variable as a result of extraneous variable(s) is technically described as an 'experimental error'. A study must always be so designed that the effect upon the dependent variable is attributed entirely to the independent variable(s), and not to some extraneous variable or variables.

3. Control:

One important characteristic of a good research design is to minimise the influence or effect of extraneous variable(s). The technical term 'control' is used when we design the study minimising the effects of extraneous independent variables. 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 by an extraneous variable(s).

5. Research hypothesis:

When a prediction or a hypothesised 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. Usually a research hypothesis must contain, at least, one independent

and one dependent variable. Predictive statements which are not to be objectively verified or the relationships that are assumed but not to be tested, are not termed research hypotheses.

6. Experimental and non-experimental hypothesis-testing research:

When the purpose of research is to test a research hypothesis, it is termed as hypothesis-testing research. It can be of the experimental design or of the non-experimental design. Research in which the independent variable is manipulated is termed 'experimental hypothesis-testing research' and a research in which an independent variable is not manipulated is called 'non-experimental hypothesis-testing research'. For instance, suppose a researcher wants to study whether intelligence affects reading ability for a group of students and for this purpose he randomly selects 50 students and tests their intelligence and reading ability by calculating the coefficient of correlation between the two sets of scores. This is an example of non-experimental hypothesis-testing research because herein the independent variable, intelligence, is not manipulated. But now suppose that our researcher randomly selects 50 students from a group of students who are to take a course in statistics and then divides them into two groups by randomly assigning 25 to Group A, the usual studies programme, and 25 to Group B, the special studies programme. At the end of the course, he administers a test to each group in order to judge the effectiveness of the training programme on the student's performance-level. This is an example of experimental hypothesis-testing research because in this case the independent variable, viz., the type of training programme, is manipulated.

7. Experimental and control groups:

In an experimental hypothesis-testing research when a group is exposed to usual conditions, it is termed a 'control group', but when the group is exposed to some novel or special condition, it is termed an 'experimental group'. In the above illustration, the Group A can be called a control group and the Group B an experimental group. If both groups A and B are exposed to special studies programmes, then both groups would be termed 'experimental groups.' It is possible to design studies which include only experimental groups or studies which include both experimental and control groups.

8. Treatments:

The different conditions under which experimental and control groups are put are usually referred to as 'treatments'. In the illustration taken above, the two treatments are the usual studies programme and the special studies programme. Similarly, 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.

9. Experiment:

The process of examining the truth of a statistical hypothesis, relating to some research problem, is known as an experiment. For example, we can conduct an experiment to examine the usefulness of a certain newly developed drug. Experiments can be of two types viz., absolute experiment and comparative experiment. If we want to determine the impact of a fertilizer on the yield of a crop, it is a case of absolute experiment; but if we want to determine the impact of one fertilizer as compared to the impact of some other fertilizer, our experiment then will be termed as a comparative experiment. Often, we undertake comparative experiments when we talk of designs of experiments.

10. Experimental unit(s):

The pre-determined plots or the blocks, where different treatments are used, are known as experimental units. Such experimental units must be selected (defined) very carefully.

DIFFERENT RESEARCH DESIGNS: Different research designs can be conveniently described if we categorize them as:

(1) Research design in case of exploratory research studies

Research design in case of exploratory research studies: Exploratory research studies are also termed as formulative research studies. The main purpose of such studies is that of formulating a problem for more precise investigation or of developing the working hypotheses from an operational point of view. The major emphasis in such studies is on the discovery of ideas and insights.

(2) Research design in case of descriptive and diagnostic research studies

Descriptive research studies are that study which are concerned with describing the characteristics of a particular individual, or of a group, whereas diagnostic research studies determine the frequency with which something occurs or its association with something else. The studies concerning whether certain variables are associated are examples of diagnostic research studies. As against this, studies concerned with specific predictions, with narration of facts and characteristics concerning individual, group or situation are all examples of descriptive research studies. The difference between research designs in respect of the above two types of research studies can be conveniently summarised in tabular form as under:

<i>Research Design</i>	<i>Type of study</i>	
	<i>Exploratory of Formulative</i>	<i>Descriptive/Diagnostic</i>
Overall design	Flexible design (design must provide opportunity for considering different aspects of the problem)	Rigid design (design must make enough provision for protection against bias and must maximise reliability)
(i) Sampling design	Non-probability sampling design (purposive or judgement sampling)	Probability sampling design (random sampling)
(ii) Statistical design	No pre-planned design for analysis	Pre-planned design for analysis
(iii) Observational design	Unstructured instruments for collection of data	Structured or well thought out instruments for collection of data
(iv) Operational design	No fixed decisions about the operational procedures	Advanced decisions about operational procedures.

(3) Research design in case of hypothesis-testing research studies

Hypothesis-testing research studies (generally known as experimental studies) are those where the researcher tests the hypotheses of causal relationships between variables. Such studies require procedures that will not only reduce bias and increase reliability, but will permit drawing inferences about causality. Usually experiments meet this requirement. Hence, when we talk of research design in such studies, we often mean the design of experiments.
