

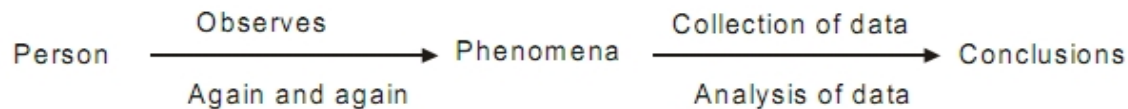
## CHAPTER ONE

### INTRODUCTION TO SCIENTIFIC RESEARCH

The term Research is related to seek out the information and knowledge on a particular topic or subject. In other words, research is an art of systematic process of collecting and analyzing information to increase our understanding of a phenomenon under study.

- a. The systematic investigation into and study of materials, sources, etc, in order to establish facts and reach new conclusions.
- b. An endeavor to discover new or collate old facts etc by the scientific study of a subject or by a course of critical investigation. [*Oxford Concise Dictionary*]

The word *research* is composed of two syllables, *re* and *search*. The dictionary defines the former as a prefix meaning again, anew or over again and the latter as a verb meaning to examine closely and carefully, to test and try, or to probe. Together they form a noun describing a careful, systematic, patient study and investigation in some field of knowledge, undertaken to establish facts or principles.



[Grinnel, 1993]

Research and experimental development (R&D) comprises creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications.

[*OECD Definition*]

In the world of business, research and development is the phase in a product's life that might be considered the product's 'conception':

- **Research phase:** basic science must exist to support the product's viability, and if the science is lacking, it must be discovered.
- **Development phase:** if the science exists, then turning it into a useful product.

To qualify as research the process must have the following characteristics:

- ✓ **Controlled** – in exploring causality in relation to two variables, the study must be set in a way to minimize the effects of other factors affecting the relationship.
- ✓ **Rigorous** – be scrupulous in ensuring that the procedures followed to find answers to questions are relevant, appropriate and justified.

- ✓ **Systematic** – the procedures adopted to undertake an investigation follow a certain logical sequence. Different steps cannot be taken in a hazardous way.
- ✓ **Valid and verifiable** – whatever is concluded on the basis of the findings must be correct and can be verified by the researcher and others.
- ✓ **Empirical** – any conclusions drawn are based upon hard evidence gathered from information collected from real-life experiences or observations.
- ✓ **Critical** – critical scrutiny of the procedures used and the methods employed. *[Kumar 2005]*

Research is a pedagogic action the term should be used in a technical sense. According to Clifford Woody research comprises defining and redefining problems, formulating hypothesis or suggested solutions; collecting, organizing and evaluating data; making deductions and reaching conclusions; and at last carefully testing the conclusions to determine whether they fit the formulating hypothesis.

### **Objectives of Research**

The major aim of any type of research is to find out the reality and facts which is unknown and which has not been exposed. Although each research activity has its own particular reason, the objectives of research can be grouped into the following categories:

1. To achieve skillfulness with a trend or to get novel opinions into it (studies with this objective can be termed as exploratory or formulative);
2. To find out the characteristics of a particular individual, situation or a grouping (research with this objective can be termed as descriptive research);
3. To establish the relationship with which something occur or with which it is associated with something else (research with this objective are known as diagnostic research);
4. To test a hypothesis of a reasonable liaison between different variables (this type of research can be grouped into hypothesis-testing research).

### **MOTIVATIONIN RESEARCH**

What makes people to undertake research? This is a question of fundamental importance. The possible motives for doing research may be either one or more of the following:

1. Desire to get a research degree along with its consequential benefits;
2. Desire to face the challenge in solving the unsolved problems, i.e., concern over practical problems initiates research;
3. Desire to get intellectual joy of doing some creative work;

4. Desire to be of service to society;
5. Desire to get respectability

However, this is not an exhaustive list of factors motivating people to undertake research studies. Many more factors such as directives of government, employment conditions, curiosity about new things, desire to understand causal relationships, social thinking and awakening, and the like may as well motivate (or at times compel) people to perform research operations.

## **TYPES OF RESEARCH**

The basic types of research are as follows:

### **1. Descriptive vs. Analytical**

Descriptive research consists of survey and fact-finding investigation of different kinds. The main purpose of descriptive research is explanation of the set of circumstances as it is present as such. The term Ex post facto research has been used to elaborate this type of research in different areas or subjects of research. The main feature of this method is that the scientist does not have direct control over the variables; he can only report what is happening or what has happened. For example, why peoples of the south side are suffering from lung cancer as compared to north-side neighbors and investigation revealed that south side persons have wood burning stoves and fire places, the researcher could hypothesize the reason that the wood smoke is a factor of lung cancer. The techniques used in descriptive research are can be of all kinds like survey methods, comparative and correlational methods etc. On the other hand, in analytical research, the researcher could be use the facts, information, data which is already available, and analyze these sources to make a hypothesis to evaluation of the material.

### **2. Applied vs. Fundamental**

Applied research refers to finding a solution for specific, practical problem facing by an individual, society or an industrial or business organization, for example how to abolish hate crime, what are the ways to market a product, what is causing increased poverty etc. whereas fundamental research is mainly concerned with overview and with the formulation of a theory. This is pure and basic type of research, for example an investigation looking for whether stress levels influence how often students engage in academic cheating or how caffeine consumption impacts the brain. Thus, the main aim of applied research is to find out a solution for some critical practical problem, whereas basic research is handling towards finding information that has a wide sense of applications to the already existing organized body of scientific knowledge.

### **3. Quantitative vs. Qualitative**

In natural sciences and social sciences, quantitative research is based on the aspect of quantity or extent. It is related to object that can be expressed in terms of quantity or something that can be counted. Such type of research involves systematic experimental analysis of observable phenomenon via statistical, mathematical or computational techniques in numerical form such as statistics, percentages, etc. whereas qualitative research is concerned with qualitative phenomenon, i.e., relating to quality or variety. Such type of research is typically descriptive and harder to analyze than quantitative data. Qualitative research involves looking in-depth at non-numerical data. It is more naturalistic or anthropological.

### **4. Conceptual vs. Empirical**

Conceptual research is that related to some abstract idea(s) or theory. It focuses on the concept and theory that explain the concerned theory being studied. It is generally used by logicians, philosophers and theorist to develop new concepts or to again understand the existing ones. On the other hand, empirical research relies on experience or observation alone. It is a way of gaining knowledge by means of direct and indirect observation or experience. We can also refer it as experimental type of research. In such a research it is necessary to get the facts and data firstly, their source, and then actively engaged to do certain things to stimulate the production of desired information.

### **5. Some Other Types of Research**

Other types of research may be of different types rather than above stated types like form the point of view of time one-time research or longitudinal research. In the former case the research is restricted to a single time-period, while in the latter case the research is carried on over several time-periods. Research can be field-setting research or laboratory research or model research, which will depend upon the environment in which it is to be carried out. Research may be understood as clinical or diagnostic research. Such research follows case-study methods or exhaustively approaches to reach the basic reasons behind the problems. The research may be exploratory or it may be formalized. The objective of exploratory research is the creation of hypotheses rather than their testing, whereas formalized research are those with significant structure and with specific hypotheses to be tested. The term historical research is refers to that which make use of historical resource like documents, papers, leaflets remains, etc. to study events or thoughts of the past, including the philosophy of persons and groups at any point of

time. Research can also be classified as conclusion-oriented and decision-oriented. While doing conclusion oriented research, a researcher having freethinking to choose a problem, redesign the queries as he proceeds and is prepared to conceptualize as he wants. Decision-oriented research is always for the need of a decision maker and the researcher in this case is not free to get on research according to his own preference. *Operation Research* is an example of decision oriented research since it is a scientific method of providing executive department with a quantitative basis for decisions regarding operation under their control.

### **Research approaches**

Research approaches are plans and the procedures for research that span the steps from broad assumptions to detailed methods of data collection, analysis, and interpretation. This plan involves several decisions, and they need not be taken in the order in which they make sense to me and the order of their presentation here. The overall decision involves which approach should be used to study a topic. Informing this decision should be the philosophical assumptions the researcher brings to the study; procedures of inquiry (called research designs); and specific research methods of data collection, analysis, and interpretation. The selection of a research approach is also based on the nature of the research problem or issue being addressed, the researchers' personal experiences, and the audiences for the study. Thus, in this book, research approaches, research designs, and research methods are three key terms that represent a perspective about research that presents information in a successive way from broad constructions of research to the narrow procedures of methods.

Three research approaches are advanced: (a) qualitative, (b) quantitative, and (c) mixed methods.

**Qualitative research:** is an approach for exploring and understanding the meaning individuals or groups ascribe to a social or human problem. The process of research involves emerging questions and procedures, data typically collected in the participant's setting, data analysis inductively building from particulars to general themes, and the researcher making interpretations of the meaning of the data. The final written report has a flexible structure. Those who engage in this form of inquiry support a way of looking at research that honors an inductive style, a focus on individual meaning, and the importance of rendering the complexity of a situation.

**Quantitative research** is an approach for testing objective theories by examining the relationship among variables. These variables, in turn, can be measured, typically on instruments, so that numbered data can be analyzed using statistical procedures. The final written report has a set

structure consisting of introduction, literature and theory, methods, results, and discussion. Like qualitative researchers, those who engage in this form of inquiry have assumptions about testing theories deductively, building in protections against bias, controlling for alternative explanations, and being able to generalize and replicate the findings.

**Mixed methods research** is an approach to inquiry involving collecting both quantitative and qualitative data, integrating the two forms of data, and using distinct designs that may involve philosophical assumptions and theoretical frameworks. The core assumption of this form of inquiry is that the combination of qualitative and quantitative approaches provides a more complete understanding of a research problem than either approach alone.

### **Significance of research**

Research promotes the logical habits of thinking. It makes the people critical, rational, and logical about the existing event and issue. The role of research is applied in several fields: economics, business, government, education, health etc. It provides the basis to build policies and systems in different areas. It has its special significance to solve various operational and planning problems of business and industry. It formulates the efficient policies and programme to assist the existing situation of infrastructures; education, health, transport, water supply, and industry, etc. It is also significant to study the social relationship and solve the various social problems of the society. Research can be significant to the different people distinctly as mentioned in the following points:

- i. To those students who are to write a master's or Ph D thesis, research may mean careerism or a way to attain a high position in the social structure;
- ii. To professionals in research methodology, research may mean a source of livelihood;
- iii. To philosophers and thinkers, research may mean the outlet for new ideas and insights;
- iv. To literary men and women, research may mean the development of new style and creative work
- v. To analysts and intellectuals, research may mean the development of new theories.

Thus, research is the fountain of knowledge for the sake of knowledge and an important source of providing guidelines for solving the problems of different fields of society, government and business as well.

## **CHAPTER TWO**

## **RESEARCH AND SCIENTIFIC METHODS**

**Research methods** are the various procedures, schemes and algorithms used in research. All the methods used by a researcher during a research study are termed as research methods. They are essentially planned, scientific and value-neutral. They include theoretical procedures, experimental studies, numerical schemes, statistical approaches, etc. Research methods help us collect samples, data and find a solution to a problem. Particularly, scientific research methods call for explanations based on collected facts, measurements and observations and not on reasoning alone. They accept only those explanations which can be verified by experiments.

**Research methodology** is a systematic way to solve a problem. It is a science of studying how research is to be carried out. Essentially, the procedures by which researchers go about their work of describing, explaining and predicting phenomena are called research methodology. It is also defined as the study of methods by which knowledge is gained. Its aim is to give the work plan of research.

### **Scientific Method**

Scientific method refers to a body of techniques for investigating phenomena, acquiring new knowledge, or correcting and integrating previous knowledge. To be termed scientific, a method of inquiry must be based on gathering observable, empirical and measurable evidence subject to specific principles of reasoning. A scientific method consists of the collection of data through observation and experimentation, and the formulation and testing of hypotheses.

The scientific method is a general set of procedures or steps through which the systematic approach is developed. The scientific method and systematic approach are synonymous. It is a more specific research process. A series of steps are used in the scientific method of research

The initial step of the scientific method is that of observing some phenomenon represents an insight into some experience. The need to resolve the problem is felt and the individual prepares to do something about the need.

The second step is to identify the problem more precisely. It involves the formulation of hypotheses based on observed phenomenon.

The third step of the scientific method is to develop and apply a design for the solution of the problem and testing the hypotheses.

The fourth step usually identified is a continuation of the third step - that continued testing

hypotheses. Results are subjected to further analyses and tests.

The final step is that of drawing conclusions based on data and “tests and integrating these conclusions with the existing body of knowledge.

### **Assumptions of Scientific Method**

The following are the main assumptions of this method

1. It is assumed that we are living in a real world i.e. there exists an objective reality, independent of whether or not. It has been discovered.

2. The assumption of the uniformity of nature is that what has been found to be true will continue to be true and that similarity of circumstances will produce consistently similar results. The assumption relates to the three postulates: (a) Natural kinds (b) Constancy and (c) Determination

(a) The postulate of natural kinds is the principle that natural phenomena can be classified according to common characteristics. We can classify student behaviour or performance e.g. divisions and grading system.

(b) The postulate of constancy assumes that in nature there is a certain degree of consistency.

The performances of students under certain conditions are expected to be the same as they have been in the past, given the same conditions.

(c) The postulate of determination assumes that within the orderliness of nature, the occurrence of a phenomenon is preceded by certain antecedent events or conditions.

### **TYPES OF RESEARCH METHODS**

George J. Mouly has classified research methods into three basic types: Survey, historical and experimental methods. The meanings and their further classification have been given in the following:

#### **1. Survey Method**

It is concerned with the present and attempts to determine the status of the phenomena under investigation. This method has been further classified into four categories:

(a) Descriptive (b) Analytical (c) School survey and (d) Genetic.

(a) Descriptive survey is of four types:

- Survey testing method,
- Questionnaire survey method,
- Interview survey method.

(b) Analytical survey is of five types:



- Documentary frequency,
- Observational survey,
- Rating survey,
- Critical incident,
- Factor analysis.

(c) School survey and

(d) Genetic survey.

## **2. Historical Method**

This method is concerned with the past and which attempts to trace the past as a means for seeing the present prospective.

The historical method can be classified into three types:

(a) Historical, (b) Legal, and (c) Documentary

## **3. Experimental Method**

It is oriented towards the discovery of basic relationship among phenomena as means of predicting and eventually, controlling their occurrence.

The experimental method has been further classified into four types as given below:

(a) Simple experimental designs,

(b) Multio-variate analysis,

(c) Case study, and

(d) Predictive or correlation.

## **Research Process**

Research process consists of sequence of actions or steps necessary to effectively carry out research and the desired progression of these steps.

**Identify research problem---Broad literature survey---Hypothesis formulation---Research and sample design---Data collection through carrying out of research---Data analysis and hypothesis testing---Generalization, Interpret and Report**

Fig. 1: Flow chart of research process

The figure shows that the research process having a number of closely related actions, as shown from step 1 to 7. But these activities should be following in a strictly prescribed sequence otherwise researcher may face the problem in completion of the research. In the research process,

each step is specific and they are separate and distinct from each other. However, the following order relating to various steps provides a useful procedural instruction regarding the research process:

- 1) Identification of research problem
- 2) Broad literature survey
- 3) Hypothesis formulation
- 4) Preparation of research design
- 5) Determining sample design
- 6) Data collection
- 7) Analysis of data
- 8) Hypothesis testing
- 9) Generalizations and interpretation
- 10) Preparation of the report or presentation of the results,

Brief descriptions of the above stated steps are as follows:

#### **1. Identification of research problem**

There are two types of research problems like, those which relate to states of nature means that denote the hypothetical conditions of what the lives of people might have been like before societies came into existence and those which relate to relationships between different variables. Initially the researcher must recognize the problem he wants to study, i.e., he must decide the general area of interest or part of a subject-matter that he would like to inquire into. At the onset the problem may be discussed in a broad way and then the doubts, if any, relating to the problem may be resolved. Then, the probability of a particular clarification has to be considered before working on formulation of the problem.