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**Module : 18** Basics of Research Methodology



### Development Team

Principal Investigator  
&  
Subject Coordinator

Dr. Jagdish Arora, Director  
INFLIBNET Centre, Gandhinagar

Paper Coordinator

Dr I K Ravichandra Rao  
Retd Professor, Documentation Research and  
Training Centre

Content Writer

Prof A Y Asundi  
Retd Professor, Bangalore University

Content Reviewer

Dr I K Ravichandra Rao  
Retd Professor, Documentation Research and  
Training Centre

## **Module 18**

### **Basics of Research Methodology**

#### **Module Structure**

Objectives

Summary

1. Introduction
2. Steps in Research Process
  - i) Research Problem- Identification
  - ii) Formulation of Objectives
  - iii) Formulation of Hypothesis
  - iv) Literature Review
  - v) Research Design
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  - vii) Sampling
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  - i) Data Collection
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4. Data Collection Methods Tools/Instruments
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  - iv) Contact Method
  - v) Case Study Method
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  - vii) Observation Method
5. Data Presentation
  - i) Tabulation of Data
  - ii) Graphical Representation of Data
6. Data Analysis and Interpretation

## 7. Report Writing and Conclusions

- Conclusions
- References

### **OBJECTIVES**

- To know the basics of Research – Meaning, definition and types;
- To elaborate the steps involved in the Research Process;
- To understand the steps in Research Design;
- To understand the different research methods, tools of data collection and methods of measurement of data;
- To know the different methods of presentation of data;
- To explain the process of analysis and interpretation of data; and
- To know the basics of preparing Research Report.

### **SUMMARY**

Research means the act of searching into a matter closely and carefully. It is a process of inquiry directed at discovering truth. Research is undertaken to discover answers to questions by applying scientific method. It is also said that “Research is finding out something, adding something to what is already known; research is the process of discovering something new.. Research is widely classified as pure and applied researches. It is also important to know the components of research such as Research Process the preparation of research design. The method and tools of data collection, analysis and interpretation are presented. Finally the unit discusses the structure and components of a research report or a thesis/dissertation.



## INTRODUCTION

Research has proved to be an essential and powerful tool that man has utilized towards achieving progress. It is a process of inquiry directed at discovering the truth. The Webster's dictionary highlights that research is not merely a search for truth, but it is a prolonged, intensive and purposeful search. Research is undertaken to discover answers to questions by applying scientific method which is the basis of every applied science and is used for investigation and research.

Ranganathan elaborates and elucidates the meaning of research as a "critical and exhaustive investigation to discover new facts, to interpret them in the light of the known ideas – laws and theories – to revise the current laws and theories in the light of the newly discovered facts and to apply the conclusions to some practical purpose".

Broadly speaking, "Research" is a conscious and planned intellectual activity devoted to investigation of a phenomenon with the objective of expanding the frontiers of existing stock of knowledge. So research *is a systematic effort of collecting, organizing, analyzing and interpreting the problems and arriving at a solution for the benefit of society.* In other words, such a process of investigation becomes scientific when a designated set of methods or techniques are applied to secure, record, measure, analyze and interpret the data in a cycle of research ranging from the choice of a problem to the writing of the final report. In simple words it is a thinking process and a scientific method of studying a problem and finding solution. Though this is a common view of research, its design, application and implementation of the results vary from subject to subject.

Some authors have classified approaches to research as a) exploratory research and b) conclusive research. Some have also classified research approach, purpose and nature of research activity as a) pure, fundamental and theoretical research and b) applied research.

The conduct of research involves several stages; such as formulation of entire research process, research design, identification of data collection methods and tools. The last component of any research is preparation of report. All these stages are briefly explained here. The research questions are usually formulated as well defined hypotheses. The formulation of hypotheses or propositions as possible answers to the research questions or problems is an important step in the research

process. The empirical part of research draws conclusions based upon hard evidences gathered from data collected from a well defined population or observations. In this Unit therefore a brief descriptive account on conduct of research is presented.

### **STEPS IN THE RESEARCH PROCESS**

The process of research invariably consists of three stages – the primary stage, secondary stage and final stage. Each of these stages consist of several steps and thus the any research process comprises the following steps:

- i) Identifying and Formulating the Research Problem
- ii) Defining the objectives
- iii) Formulation of Hypotheses
- iv) Literature Review
- v) Research Design
- vi) Sample Design
- vii) Data Collection
- viii) Analysis and Interpretation of Data
- ix) Writing Research Report
- x) Conclusions

Some of these steps of research process are briefly described here.

#### **i) Research problem**

A research problem rightly and rationally selected solves half of the research problem. Identifying a research problem is a crucial issue. To begin with, in any research, we have to define the problem. This step itself is a process and presupposes a reasonable level of knowledge in the broad subject area within which the study is to be undertaken. Without such knowledge it is difficult to clearly and adequately 'dissect' a subject area. Further, this step involves:

- Identification of the broad field or subject area of interest;
- Narrowing down the broad area into sub areas;
- Selecting a topic of interest as well as the currently most important topic;
- Raise research questions;

- Formulate objectives; and
- Assess the objectives.

## **ii) The formulation of objectives**

The main objective of research however is to assess the need for research in the subject or problem selected.

Objectives are the goals we set out to attain in our study. It is extremely important to word them clearly and specifically. Objectives are generally listed as main and sub-objectives, the main objective is an overall statement, with regard to the core of the study. The sub-objectives are the specific aspects of the topic that we want to investigate within the main framework of our study.

## **iii) Identifying the Variables and Formulation of Hypotheses**

In this step, we must clearly identify the variables (independent and dependant) involved in the research. Are the hypotheses specific enough to carry out the testing of the hypothesis in terms of statistical statements. Formulation of hypotheses and their verification are the fundamental aspects of research process. A hypothesis is a belief or speculation about the phenomenon. Scientific research is a process of forming hypotheses and checking them by means of observed data. If the observed data is found to be inconsistent with the hypothesis, the hypothesis is rejected and if there is agreement it is accepted. For example, there is 'no relation between circulation of books and in-library use'.

## **iv) Literature review**

After selection of research problem the researcher is to ascertain what literature is available on his/her research problem. It also involves finding out in what way the problem has been dealt with and what amount of additional information is available in recent years. The researcher in this context has to consult some relevant sources and today World Wide Web and Internet are also relevant sources. So literature review is an integral part of research. This helps us to study and identify the exact research problem. It brings clarity and focus to the research problem; it helps us in improving the methodology. The literature review involves search for existing literature in the area of study and reviewing the literature selected.

### **vi) Preparing the Research Design**

The overall strategy of carrying out the research is termed as research design. Preparing a Research Design is an important stage in the process of conducting a Research. According to Young, "Research design is the logical and systematic planning and directing a piece of research". Research design is the conceptual structure within which research would be conducted. Research design contributes the blue print for the collection, analysis and measurement of data. A research design simply is a logical and systematic plan prepared for directing a research study. The function of research design is to provide for the collection of relevant information with minimal expenditure of effort, time and money.

The meaning of research design can be illustrated with an example. An architect prepares a blue print (plan) before he approves the construction. Similarly, researcher makes a plan of his/her own study before he undertakes his/her work. Such a plan of study or blue print for study is called a Research Design or Research Strategy. The design may be a specific presentation of the various steps in the research process. They are:

- The selection of research problem;
- The presentation of the problem;
- Literature Review;
- The formulation of hypotheses;
- Research Methodology;
- Data collection;
- Hypotheses Testing;
- Interpretation; and
- Report Writing.

### **vii) Types of Research Design**

The design of research varies with the type of research. The problem for research determines the type of research and type in its turn determines the methods or procedure to be employed. The hypothesis determines the kind of data that are required which, in turn, determine the techniques of data collection and analysis. Thus the design of research changes with the type of research. Boyd has



suggested two broad classes of research designs – Exploratory and Conclusive. They include further some subdivisions which also fall within the above two classes. There are therefore, as many designs as there are types. So there are basically three types of research designs in use: Survey, Historical and Experimental.

### **viii) Sampling**

A sample is a smaller representation of the larger whole. It is a small piece of the population obtained by a probability process that mirrors with known precision, the various patterns and sub-classes of the population. In technical terms a Sampling is concerned with the selection of a subset of entities from a population to estimate characteristics of the population; the entities may be individuals, books, trees, patients, customers, etc., depending on the population. Thus, a sample is a segment of the population selected to represent the population as a whole. A sample should exhibit the characteristics of the universe. It should be a microcosm – a word which literally means “Small Universe” Ideally, the sample should be representative and allow us to make estimates of parameters, such as mean, standard deviation, correlation and regression coefficients, etc. of the population. There are three factors in designing a sample -- sample units, sample size and sampling

To begin with we must decide, what are the sampling units; for example, to study a pattern of the use of the books, shall we take a sample of books and then find out the use of books from the due date slips or shall we take a sample of transaction records and then find out the number of times a book is issued out! Then we have to decide the sample size -- How many books will be examined to find out their use (the number of times checked-out). Some believe that large samples give more reliable results than small samples. However it is not necessary to sample the entire population. Finally, we must decide how to select a sample? (Say for example, how to select 100 books from a population of 50000 books) How should the sample be chosen? Let us now know in brief different sampling methods which will help to select the proper sampling method in relation to the population.

### **viii) Sampling methods**

Sampling methods are classified into two types:

- a) Probability Sampling; and

b) Non-probability Sampling

**The probability sampling includes:**

- i) Simple Random Sample: Every unit of the population is known and has equal;
- ii) chance of being selected;
- iii) Stratified Random Sample: Population is divided into mutually exclusive groups such as age groups, geographical divisions, and random samples are drawn from each group;
- iv) Systematic Random Sample: It means forming a sample in some systematic manner, usually taking items at regular intervals;
- v) Multi-stage Sampling: Sampling procedure carried out in several stages; and
- vi) Cluster sample: The population is divided into mutually exclusive groups such as blocks, and the researcher draws a sample of the group to interview.

**Non-probability sampling includes**

- i) Convenience sample: Selection of the easiest population units from which to obtain data.
- ii) Purposive / Judgment sample: Use judgement to select population units which are enough to get the accurate data. Sometimes, identify a few people to interview them to get the data.
- iii) Quota sampling: Quota sampling is a special form of stratified sampling. The number to be selected from each stratum, which is known as quota, is selected in advance.

**ix) Common Pitfalls of Sampling**

A good part of research involving human beings for the purpose of devising a public policy and arriving at a desired solution to the problem is made through surveys, and the survey is based on the sample population. The design of questionnaire and formulation of questions is one of the issues concerned with the selection a sample and the questions asked to the population are selected in

relation to the sample. So in these processes six major pitfalls of sample-based information or data collection are observed.

## **DATA COLLECTION AND MEASUREMENT**

### **i) Data Collection**

After the selection of a proper research problem, and design of research the final step is to make a framework on plan of action for the conduct of research and this involves the data collection. After all these steps, comes the stage involving the collection of the data; this data is required during the various phases of study. So now we will study about the details of the sources of data collection, importance of data collection and also about the various methods that can be used for data collection. The construction of a research instrument or tool for data collection is an important part of a research. The research findings are totally dependent on valid and reliable data, one has to be careful in selecting the tool for data collection. The sources of data can be divided into;

- a) Documentary source and;
- b) Field source; but the more popular and accepted sources of data are classified as;
  - Primary Source and
  - Secondary Source
- c) Primary data are information generated to meet the specific requirements of the investigation to be made. A method refers to the way of gathering data and some of the methods are;
  - Observation
  - Questionnaire and Schedules
  - Experimentation
  - Simulation
  - Interview
  - Projective Technique
- d) The method of collecting secondary data is briefly classified into two main factors:

- Internal – available within organisations and institutions
- External – consisting of personal sources and the public sources

## **ii) Measurement of Data**

There are four main levels of measurement used in statistics: Nominal, Ordinal, Interval, and Ratio. Each of these has different degrees of usefulness in research.

Nominal measurements have no meaningful rank order among values. Nominal data differentiates between items or subjects based only on qualitative classifications they belong to. Examples include gender, nationality, ethnicity, language, genre, style, biological species, visual pattern, etc.

Ordinal data allows for rank order (1st, 2nd, 3rd, etc) by which data can be sorted, but it still does not allow for relative degree of difference between them. Examples of ordinal data include dichotomous values such as "sick" versus "healthy" when measuring health, "guilty" versus "innocent" when making judgments in courts, "false" versus "true", when measuring truth value. Examples also include non-dichotomous data consisting of a spectrum of values, such as "completely agree", "mostly agree", "mostly disagree", or "completely disagree" when measuring opinion.

Interval data allows for the degree of difference between items, but not the ratio between them. However, ratios of differences can be expressed; for example, one difference can be twice another. Interval type variables are sometimes also called "scaled variables".

Ratio measurements have both a meaningful zero value and the distances between different measurements are defined; they provide the greatest flexibility in statistical methods that can be used for analyzing the data. Ratios are not allowed with interval data since 20°C cannot be said to be "twice as hot" as 10°C, nor can multiplication/division be carried out between any two dates directly.

## **DATA COLLECTION METHODS, TOOLS/INSTRUMENTS:**

After identifying and formulating the research problem, developing a study design, constructing a research instrument and selecting a sample, data collection is made from which inferences and conclusions are drawn for the study. Depending

upon the plans, start interviews, mail questionnaires, conduct experiments and/or make observations. Some of the methods are briefly described below:

**i) Historical Method**

Historical Research is systematic and synthesis objective location evaluation and synthesis of evidence in order to establish facts and draw conclusions regarding past events. It is not just digging up of facts, an integral part of interpretation of legitimate research. The historical research must concern with critical evaluation of source documents in terms of authority, content and meaning and interpretation of records in terms of general laws, trends and hypothesis.

**ii) Survey Method**

There are two types -- structured and unstructured surveys. In structured surveys, formal questions are put to all respondents in the same way. In unstructured surveys, we probe respondents and guide the interview according to their answers. Survey research may be direct or indirect. In direct approach, we ask direct questions about behaviours and thoughts. e.g. Why don't you buy Nokia cell phone? In indirect approach, we may ask: What kind of cell phone you like? From the response, we may be able to discover consumer's preference for certain cell phones. It can be used to collect many different kinds of information. However, respondents may be reluctant to answer questions asked by unknown interviewers about things they consider private; busy respondents may not want to take the time; some may be unable to answer because they cannot remember or never gave a thought to what they do.

**iii) Experimental method**

It is also called empirical research based on data. Such research is characterised by the experimenter's control over the variables under study and the deliberate manipulation of one of them to study its effects. In such a research, it is necessary to get at facts first hand, at their source, and actively go about doing certain things to stimulate the production of desired information. Further, experiments can be repeated and generally get the same results!

**iv) Contact Method**

Data may be collected by mail, telephone, personal interview, etc. It can be used to collect large amounts of data at a low cost per respondent. Response rate is often very low. We have no control over who answers

**v) Case Study Method**

The case study research has been one of the important methods of research. It has been traditionally a method of qualitative analysis. A case study is deep and intensive study of a particular social unit. Some experts refer to it as an insight – simulation study.

**vi) Questionnaire Method**

The Questionnaire is a well known tool to collect the data. In structured surveys/ interviews, we use questionnaires. A questionnaire consists of a set of questions presented to a respondent for answers. The respondents read the questions, interpret what is expected and then write down the answers themselves. It is called an Interview Schedule when the researcher asks the questions and records the respondent's reply on the interview schedule. Because there are many ways to ask questions, the questionnaire is very flexible. Questionnaire should be developed and tested carefully before being used on a large scale.

**vii) Observation Method**

Involves human or mechanical observation of what people actually do. It may be structured or Unstructured. In this method, quite often, we get the correct data. However, characteristics such as feelings, beliefs, and attitudes are difficult to observe!

**DATA PRESENTATION**

After the data has been collected, the next question is 'What is to be done with the data that is collected'? The next step is the data has to be processed and presented for facilitating its analysis as per the plan of research process. The processing of data comprises, editing, coding, classification and then presentation of the data in Tabular, Graphical forms. It is desirable that appropriate tables and graphical methods are employed for the logical presentation of the data.

Broadly, the types of tables and graphical representation of data are listed below:

### **i) Tabulation of Data**

After the classification of data, they are presented in the Tabular form, to make the implicit qualities and quantities of data explicit and meaningful. The tabulation of data can be only means and useful for research analysis. There are different types of statistical tables. They are:

- a) Simple and complex tables;
- b) One way tables;
- c) Two way tables;
- d) Three way tables; and
- e) Manifold Tables.

Further the Tables may be f) Frequency table or g) Response table.

### **ii) Graphical Representation of Data**

Several types of graphs and/or charts are used to present the collected/ tabulated data. The common graphical methods used are; bar charts, two dimensional diagrams, pictographs, pie-charts and arithmetic or line graphs/charts. Four popular methods used are:

- Bar Diagram;
- Histogram;
- Frequency Polygon; and
- Ogive or Cumulative Frequency Curve.

### **DATA ANALYSIS AND INTERPRETATION:**

Analysis and interpretation of data are the most crucial aspects of research. Processing and analysing data involves a number of closely related operations; these are performed with the purpose of summarizing the collected data; this also involves organization of database in a manner that they answer the research

objectives. It is through a systematic analysis that the underlying features of data are revealed and valid generalisations are arrived at.

Analysis of data is to be made with reference to the object of the study and its possible effect on scientific discovery, and with reference to the research problem at hand or hypothesis. Interpretation means drawing inferences from the collected facts after the analytical study. Interpretation has two major aspects, namely establishing continuity in research through linking the results of a given study with those of another and the establishment of some relationship with the collected data. In order to make the collected data to be more meaningful, after its tabulation and representation is to lay down the procedure for its analysis. To be effective the procedures employed are:

- An intensive review of the data, with reference to research objectives;
- Analysis with suitable techniques and results; and
- Selection of the results to study hypothesis and objectives of research.

The types of analysis of data include; Descriptive analysis – consisting of Bivariate, Sequential and Multivariate analysis and Casual analysis – consisting of Correlative analysis and Inferential analysis.

If you want to analyse data using computer, you should be familiar with the appropriate software. In this area, knowledge of computer and statistics play an important role. The most common software is SPSS for windows. However, data input can be a long and laborious process, and if data is entered incorrectly, it will influence the final results. In present day contest, the software EXCEL has many features for statistical computations.

The interpretation of e data is the final step, after the tabulation and or representation and analysis of data. The interpretation in simple terms is the analysis of the results which has to be done very carefully and logically taking into consideration the object of research. The interpretation should avoid wrong and erroneous expression that may lead to misinterpretation of the data.

## **REPORT WRITING AND CONCLUSIONS**

Report writing is the culmination of any research investigation, as the research worker is obliged to report his/her study on its completion, it is a social obligation.



The contents of research report can be targeted to various users. Target users for any research report may be among the,

- a) Academic community
- b) Sponsors of research or
- c) Layman.

The components and contents of report may include among others;

- a) Materials and methods
- b) Tabular and Pictorial Representations
- c) Implications and suggestions for further research.

## **CONCLUSIONS**

In this Unit a brief and simple description of Research Methodology is presented as a prelude to the conduct of research. More descriptive account on each one of the topics presented in this Unit can be obtained by referring to any standard textbook on Research Methods, as broad and a macro structure of the topics to be studied is given here.

However, at the end of the research a reporting has to be done of the entire research work. In this process, the end result would to answer the following questions:

- Was our initial hypothesis correct?
- What if my findings are negative?
- What are the implications of the findings for the theory, for the background assumptions, or relevant literature?
- What recommendations can we make for public policies or programs in this area?
- What suggestions can be made for further research on this topic?

In the entire process of research, mostly several statistical methods are applied. This involves summarization and presentation of data in textual, tabular and graphical form, which are in short described in the preceding sections. Some of the common quantitative and statistical computational methods employed to aid

interpretation of the data involve are enumerated here below. Some of the simple arithmetic procedures and few are complex statistical techniques. They are:

- Measurements of central tendency :mean, median, mode;
- Measures of dispersion: range, mean deviation, variance and standard deviation);
- Probabilities and probability distributions;
- Correlation coefficient, regression coefficient, estimates of dependent variables ; fitting various linear and nonlinear models;
- Analysis of variance; and
- Testing of Hypothesis: z-statistic, t-statistic, chi-square, F-statistic. In the Unit – 19 the Testing of Hypothesis is discussed.

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