Module II.
Concepts of Research

Basic Concepts of Research

Meaning

- **Research in common parlance refers to a search for knowledge.**
- **One can also define research as a scientific and systematic search for pertinent information on a specific topic. In fact, research is an art of scientific investigation.**

Objectives

- **The purpose of research is to discover answers to questions through the application of scientific procedures.**

- **The main aim of research is to find out the truth which is hidden and which has not been discovered as yet.**

- **Though each research study has its own specific purpose, we may think of research objectives as falling into a number of following broad groupings:**

1. **To gain familiarity with a phenomenon or to achieve new insights into it (studies with this object in view are termed as *exploratory* or *formulative* research studies);**

2. **To portray accurately the characteristics of a particular individual, situation or a group (studies with this object in view are known as descriptive research studies);**

3. To determine the frequency with which something occurs or with which it is associated with something else (studies with this object in view are known as *diagnostic* research studies);

4. To test a hypothesis of a causal relationship between variables (such studies are known as *hypothesis-testing* research studies).

Motivation

- **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.**

Approaches.

- **The two basic research approaches are quantitative and qualitative research.**

- **Quantitative research is statistics-based. It involves questions that can best be answered in numbers. To get the statistics, researchers often conduct experiments or give surveys. They then analyze the numbers with statistical models to see what the data tells them.**

- **This approach can be further sub-classified into *inferential, experimental* and *simulation* approaches to research.**

- **The purpose of *inferential approach* to research is to form a data base from which to infer characteristics or relationships of population. This usually means survey research where a sample of population is studied (questioned or observed) to determine its characteristics, and it is then inferred that the population has the same characteristics.**

- ***Experimental approach*** **is characterised by much greater control over the research environment and in this case some variables are manipulated to observe their effect on other variables.**

- ***Simulation approach*** **involves the construction of an artificial environment within which relevant information and data can be generated. This permits an observation of the dynamic behaviour of a system (or its sub-system) under controlled conditions.**

- **The term ‘simulation’ in the context of business and social sciences applications refers to “the operation of a numerical model that represents the structure of a dynamic process.**

- **Given the values of initial conditions, parameters and exogenous variables, a simulation is run to represent the behaviour of the process over time.” Simulation approach can also be useful in building models for understanding future conditions.**

- **Qualitative research is description-based. Qualitative researchers observe and interview people. They take observations of people or events and analyze it through qualitative methods. They look for trends, just as quantitative researchers do with statistics, but they don't use numbers to find them**

- ***Qualitative approach*** **to research is concerned with subjective assessment of attitudes, opinions and behaviour.**

- **Research in such a situation is a function of researcher's insights and impressions. Such an approach to research generates results either in non-quantitative form or in the form which are not subjected to rigorous quantitative analysis. Generally, the techniques of focus group interviews, projective techniques and depth interviews are used.**

Types of Research

The basic types of research are as follows:

1. Descriptive vs. Analytical:

- **Descriptive research includes surveys and fact-finding enquiries of different kinds.**

- **The major purpose of descriptive research is description of the state of affairs as it exists at present.**

- **In social science and business research we quite often use the term *Ex post facto* research for descriptive research studies.**

- **The main characteristic of this method is that the researcher has no control over the variables; he can only report what has happened or what is happening.**

- **Most ex post facto research projects are used for descriptive studies in which the researcher seeks to measure such items as, for example, frequency of shopping, preferences of people, or similar data.**

- **The methods of research utilized in descriptive research are survey methods of all kinds, including comparative and correlational methods.**

- **In analytical research, on the other hand, the researcher has to use facts or information already available, and analyse these to make a critical evaluation of the material.**

2. Applied vs. Fundamental:

- **Research can either be applied (or action) research or fundamental (to basic or pure) research.**

- **Applied research aims at finding a solution for an immediate problem facing a society or an industrial/business organisation, whereas fundamental research is mainly concerned with generalisations and with the formulation of a theory.**

- **“Gathering knowledge for knowledge’s sake is termed ‘pure’ or ‘basic’ research.”**

- **Research concerning some natural phenomenon or relating to pure mathematics are examples of fundamental research.**

- **Similarly, research studies, concerning human behaviour carried on with a view to make generalisations about human behaviour, are also examples of fundamental research, but research aimed**

at certain conclusions (say, a solution) facing a concrete social or business problem is an example of applied research.

- **Research to identify social, economic or political trends that may affect a particular institution or the copy research (research to find out whether certain communications will be read and understood) or the marketing research or evaluation research are examples of applied research.**

- **Thus, the central aim of applied research is to discover a solution for some pressing practical problem whereas basic research is directed towards finding information that has a broad base of applications and thus, adds to the already existing organized body of scientific knowledge.**

3. Quantitative vs. Qualitative:

- **Quantitative research is based on the measurement of quantity or amount. It is applicable to phenomena that can be expressed in terms of quantity.**

- **Qualitative research, on the other hand, is concerned with qualitative phenomenon, i.e., phenomena relating to or involving quality or kind. For eg., when we are interested in investigating the reasons for human behaviour (i.e., why people think or do certain things),**

we quite often talk of ‘Motivation Research’, an important type of qualitative research.

- **This type of research aims at discovering the underlying motives and desires, using in depth interviews for the purpose.**

- **Other techniques of such research are word association tests, sentence completion tests, story completion tests and similar other projective techniques**

- **Attitude or opinion research i.e., research designed to find out how people feel or what they think about a particular subject or institution is also qualitative research.**

- **Qualitative research is specially important in the behavioural sciences where the aim is to discover the underlying motives of human behaviour.**

- **Through such research we can analyse the various factors which motivate people to behave in a particular manner or which make people like or dislike a particular thing.**

- **It may be stated, however, that to apply qualitative research in practice is relatively a difficult job and therefore, while doing such research, one should seek guidance from experimental psychologists.**

4. Conceptual vs. Empirical:

- **Conceptual research is that related to some abstract idea(s) or theory.**
- **It is generally used by philosophers and thinkers to develop new concepts or to reinterpret existing ones.**
- **On the other hand, empirical research relies on experience or observation alone, often without due regard for system and theory**

- **It is data-based research, coming up with conclusions which are capable of being verified by observation or experiment.**

- **It is called as experimental type of research.**

- **In such a research it is necessary to get at facts first hand, at their source, and actively to go about doing certain things to stimulate the production of desired information.**

- **In such a research, the researcher must first provide himself with a working hypothesis or guess as to the probable results. He then works to get enough facts (data) to prove or disprove his hypothesis. He then sets up experimental designs which he thinks will manipulate the persons or the materials concerned so as to bring forth the desired information.**

- **Such research is thus characterised by the experimenter's control over the variables under study and his deliberate manipulation of one of them to study its effects.**

- **Empirical research is appropriate when proof is sought that certain variables affect other variables in some way. Evidence gathered through experiments or empirical studies is today considered to be the most powerful support possible for a given hypothesis.**

Serendipity

- **Serendipity means a "fortunate happenstance" or "pleasant surprise".**
- **The notion of serendipity is a common occurrence throughout the history of scientific innovation.**
- **As originally coined, serendipity meant an ability to apply sagacity to chance observation and thereby find something other than what one was looking for.**

- **This meaning was soon extended to refer to the process as well as the aptitude; thus discoveries made in this fashion are considered examples of serendipity.**

- **Examples are Alexander Fleming's accidental discovery of penicillin in 1928.**

Famous Accidental Discoveries

1. Penicillin

Perhaps the most famous accidental discovery of all is penicillin, a group of antibiotics used to combat bacterial infections. In 1928, Scottish biologist Alexander Fleming took a break from his lab work investigating staphylococci and went on holiday. When he returned, he found that one Petri dish had been left open, and a blue-green mould had formed. This fungus had killed off all surrounding bacteria in the culture. The mould contained a powerful antibiotic, penicillin, that could kill harmful bacteria without having a toxic effect on the human body.

2. X-rays

In 1895, German physicist Wilhelm Roentgen was working with a cathode ray tube. The tube was covered, but a fluorescent screen nearby would still glow when the tube was on and the room was dark. The rays were illuminating the screen. Roentgen tried blocking the rays, but most things he placed in front made no difference. However, when he placed his hand in front of the tube, he noticed he could see his bones in the image projected onto the screen. The tube was replaced with a photographic plate, and the first x-ray images produced.

Research Methods versus Methodology

- **Research methods may be understood as all those methods/techniques that are used for conduction of research.**

- **Research methods or techniques, thus, refer to the methods the researchers use in performing research operations.**

- **In other words, all those methods which are used by the researcher during the course of studying his research problem are termed as research methods.**

- **Since the object of research, particularly the applied research, it to arrive at a solution for a given problem, the available data and the unknown aspects of the problem have to be related to each other to make a solution possible.**

- **Keeping this in view, research methods can be put into the following three groups:**

1. **In the first group we include those methods which are concerned with the collection of data. These methods will be used where the data already available are not sufficient to arrive at the required solution;**

1. **The second group consists of those statistical techniques which are used for establishing relationships between the data and the unknowns;**

3. The third group consists of those methods which are used to evaluate the accuracy of the results obtained.

- **Research methods falling in the above stated last two groups are generally taken as the analytical tools of research.**

- **Research methodology is a way to systematically solve the research problem. It may be understood as a science of studying how research is done scientifically.**

- **In it we study the various steps that are generally adopted by a researcher in studying his research problem along with the logic behind them.**

- **It is necessary for the researcher to know not only the research methods/techniques but also the methodology.**

- **Researchers not only need to know how to develop certain indices or tests, how to calculate the mean, the mode, the median or the standard deviation or chi-square, how to apply particular research techniques, but they also need to know which of these methods or techniques, are relevant & which are not, & what would they mean and indicate and why.**
- **Researchers also need to understand the assumptions underlying various techniques and they need to know the criteria by which they can decide that certain techniques and procedures will be applicable to certain problems & others will not.**

- **Research methodology has many dimensions and research methods do constitute a part of the research methodology.**

- **The scope of research methodology is wider than that of research methods. Thus, when we talk of research methodology we not only talk of the research methods but also consider the logic behind the methods we use in the context of our research study & explain why we are using a particular method or technique & why we are not using others so that research results are capable of being evaluated either by the researcher himself or by others**

- **Why a research study has been undertaken, how the research problem has been defined, in what way and why the hypothesis has been formulated, what data have been collected and what particular method has been adopted, why particular technique of analysing data has been used and a host of similar other questions are usually answered when we talk of research methodology concerning a research problem or study.**

Research and Scientific Method

- **The two terms, research and scientific method, are closely related.**

- **Karl Pearson writes, “The scientific method is one and same in the branches (of science) and that method is the method of all logically trained minds … the unity of all sciences consists alone in its methods, not its material; the man who classifies facts of any kind whatever, who sees their mutual relation and describes their sequences, is applying the Scientific Method and is a man of science.”**

- **Scientific method is the pursuit of truth as determined by logical considerations.**

- **The ideal of science is to achieve a systematic interrelation of facts.**

- **Scientific method attempts to achieve “this ideal by experimentation, observation, logical arguments from accepted postulates and a combination of these three in varying proportions.”**

- **In scientific method, logic aids in formulating propositions explicitly and accurately so that their possible alternatives become clear.**

- **Further, logic develops the consequences of such alternatives, and when these are compared with observable phenomena, it becomes possible for the researcher or the scientist to state which alternative is most in harmony with the observed facts.**

- **The scientific method is, thus, based on certain basic postulates which can be stated as under:**

1. **It relies on empirical evidence;**

2. **It utilizes relevant concepts;**

3. **It is committed to only objective considerations;**

4. **It presupposes ethical neutrality, i.e., it aims at nothing but making only adequate and correct statements about population objects;**

5. It results into probabilistic predictions;

6. Its methodology is made known to all concerned for critical scrutiny are for use in testing the conclusions through replication;

7. It aims at formulating most general axioms or what can be termed as scientific theories.

- **Thus, “the scientific method encourages a rigorous, impersonal mode of procedure dictated by the demands of logic and objective procedure.”**

- **Accordingly, scientific method implies an objective, logical and systematic method, i.e., a method free from personal bias or prejudice, a method to ascertain demonstrable qualities of a phenomenon capable of being verified, a method wherein the researcher is guided by the rules of logical reasoning, a method wherein the investigation proceeds in an orderly manner and a method that implies internal consistency.**

Research Process

- 1. Observation/phenomenon/incident
- 2. Assigned study.

Research Process

1. Observation/phenomenon/incident

1. EXPERIMENT TO DEMONSTRATE THE METHOD OF SCIENCE

The method of science includes a natural observation, definition of a problem, deriving a hypothesis, experimentation and conclusion or inference.

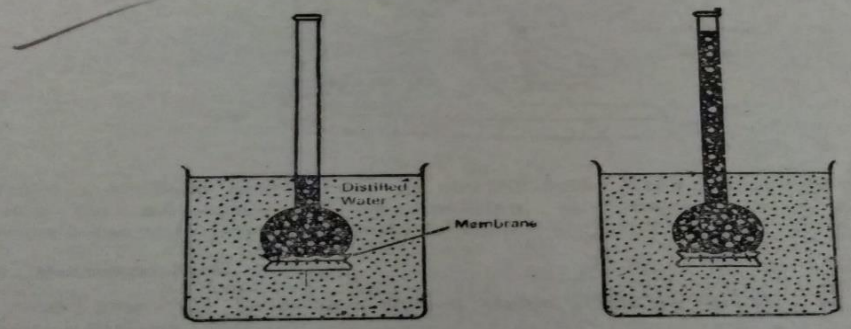
Osmosis is taken as a model experiment to demonstrate the method of science.

Observation – Normally roots absorb water from the soil but water does not pass from the root into the soil. Similarly if a suspension of RBC is placed in distilled water, the RBC gains water from the medium but RBC does not loose water into the medium (subsequently RBC swells up with water and finally bursts – a process known as haemolysis).

Definition of a Problem. In the above observations water molecules move towards one direction only – Why ?

Hypothesis. When two solutions of different concentrations are separated by a semipermeable membrane the solvent molecules pass from the region of low concentration to region of high concentration. This phenomenon is called osmosis.

Experimentation. Osmosis can be demonstrated by the **thistle funnel experiment.** A thistle funnel is taken whose mouth is closed by an egg



membrane or cellophane membrane. The funnel is partially filled with sugar solution. Distilled water is taken in a beaker and the mouth of the thistle funnel is immersed in the water. The funnel is held in position by a stand. The initial level of sugar solution in the funnel is noted.

After sometime it is observed that the level of solution in the thistle funnel rises up. This is because of the passage of water from the beaker into the funnel.

Sugar solution is more concentrated than water. When two solutions of different concentrations are separated by a semipermeable membrane the solvent (water) molecules pass from the low concentrated region to the high concentrated region.

Conclusion. The living cells contain protoplasm which is often more concentrated than an external medium like distilled water. This is how water molecules enter into the RBC when it is placed in distilled water. Similarly cell sap of the root is more concentrated and hence water is absorbed from the soil.

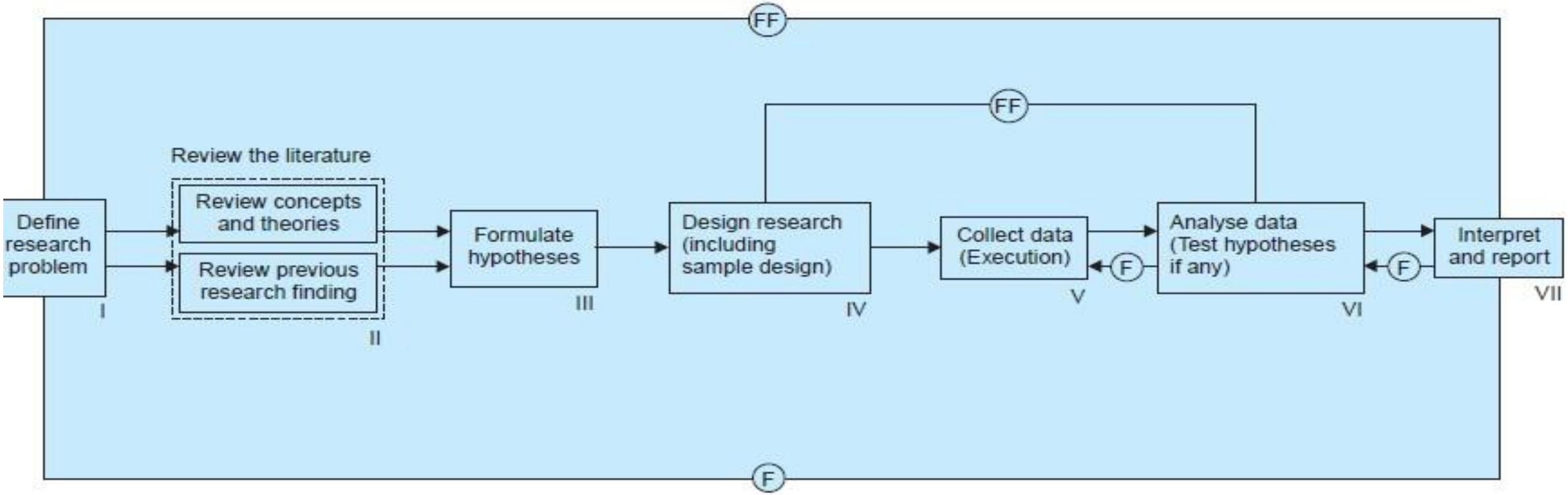
Research Process

2. Assigned study

- **Research process consists of series of actions or steps necessary to effectively carry out research and the desired sequencing of these steps.**

- **The chart shown in Figure 1.1 well illustrates a research process.**

RESEARCH PROCESS IN FLOW CHART



Where (F) = feed back (Helps in controlling the sub-system to which it is transmitted)

(FF) = feed forward (Serves the vital function of providing criteria for evaluation)

Fig. 1.1

1. Formulating the research problem:

- **There are two types of research problems, viz., those which relate to states of nature and those which relate to relationships between variables.**

- **At the very outset the researcher must single out the problem he wants to study, i.e., he must decide the general area of interest or aspect of a subject-matter that he would like to inquire into.**

- **Initially the problem may be stated in a broad general way and then the ambiguities, if any, relating to the problem be resolved. Then, the feasibility of a particular solution has to be considered before a working formulation of the problem can be set up.**

- **The formulation of a general topic into a specific research problem, thus, constitutes the first step in a scientific enquiry.**

- **Essentially two steps are involved in formulating the research problem, viz., understanding the problem thoroughly, and rephrasing the same into meaningful terms from an analytical point of view.**

- **The researcher must at the same time examine all available literature to get himself acquainted with the selected problem.**

- **He may review two types of literature—the conceptual literature concerning the concepts and theories, and the empirical literature consisting of studies made earlier**

which are similar to the one proposed.

- **The basic outcome of this review will be the knowledge as to what data and other materials are available for operational purposes which will enable the researcher to specify his own research problem in a meaningful context.**

- **After this the researcher rephrases the problem into analytical or operational terms i.e., to put the problem in as specific terms as possible. This task of formulating, or defining, a research problem is a step of greatest importance in the entire research process.**

- **The problem to be investigated must be defined unambiguously for that will help discriminating relevant data from irrelevant ones.**

- **Care must, however, be taken to verify the objectivity and validity of the background facts concerning the problem.**

- **Professor W.A. Neiswanger correctly states that the statement of the objective is of basic importance because it determines the data which are to be collected, the characteristics of the data which are relevant, relations**

which are to be explored, the choice of techniques to be used in these explorations and the form of the final report.

- **If there are certain pertinent terms, the same should be clearly defined along with the task of formulating the problem.**

2. Extensive literature survey:

- **Once the problem is formulated, a brief summary of it should be written down. It is compulsory for a research worker writing a thesis for a Ph.D. degree to write a synopsis of the topic and submit it to the necessary Committee or the Research Board for approval.**

- **At this juncture the researcher should undertake extensive literature survey connected with the problem. For this purpose, the abstracting and indexing journals and published or unpublished bibliographies are the first place**

to go to.

- **Academic journals, conference proceedings, government reports, books etc., must be tapped depending on the nature of the problem.**

- **In this process, it should be remembered that one source will lead to another.**

- **The earlier studies, if any, which are similar to the study in hand should be carefully studied. A good library will be a great help to the researcher at this stage.**

3. Development of working hypotheses:

- **After extensive literature survey, researcher should state in clear terms the working hypothesis or hypotheses.**

- **Working hypothesis is a tentative assumption made in order to draw out and test its logical or empirical consequences.**

- **As such the manner in which research hypotheses are developed is particularly important since they provide the focal point for research.**

- **They also affect the manner in which tests must be conducted in the analysis of data and indirectly the quality of data which is required for the analysis.**

- **In most types of research, the development of working hypothesis plays an important role.**

- **Hypothesis should be very specific and limited to the piece of research in hand because it has to be tested.**

- **The role of the hypothesis is to guide the researcher by delimiting the area of research and to keep him on the right track. It sharpens his thinking and focuses attention on the more important facets of the problem. It also indicates the type of data required and the type of methods of data analysis to be used.**

- **How does one go about developing working hypotheses? The answer is by using the following approach:**

(a) Discussions with colleagues and experts about the problem, its origin and the objectives in seeking a solution;

(b) Examination of data and records, if available, concerning the problem for possible trends, peculiarities and other clues;

(c) Review of similar studies in the area or of the studies on similar problems; and

(d) Exploratory personal investigation which involves original field interviews on a limited scale with interested parties and individuals with a view to secure greater insight into the practical aspects of the problem.

- **Thus, working hypotheses arise as a result of a-priori thinking about the subject, examination of the available data and material including related studies and the counsel of experts and interested parties.**

- **Working hypotheses are more useful when stated in precise and clearly defined terms.**

4. Preparing the research design:

- **The research problem having been formulated in clear cut terms, the researcher will be required to prepare a research design, i.e., he will have to state the conceptual structure within which research would be conducted.**

- **The preparation of such a design facilitates research to be as efficient as possible yielding maximal information.**

- **In other words, the function of research design is to provide for the collection of relevant evidence with minimal expenditure of effort, time and money.But how all these can be achieved depends mainly on the research purpose.**

- **Research purposes may be grouped into four categories, viz., (i) Exploration, (ii) Description, (iii) Diagnosis, and (iv) Experimentation.**

- **A flexible research design which provides opportunity for considering many different aspects of a problem is considered appropriate if the purpose of the research study is that of exploration.**

- **But when the purpose happens to be an accurate description of a situation or of an association between variables, the suitable design will be one that minimises bias and maximises the reliability of the data collected and analysed.**

- **There are several research designs, such as, experimental and non-experimental hypothesis testing.**

- **Experimental designs can be either informal designs (such as before-and-after without control, after-only with control, before-and-after with control) or formal designs (such as completely randomized design, randomized block design, Latin square design, simple and complex factorial designs), out of which the researcher must select one for his own project.**

- **The preparation of the research design, appropriate for a particular research problem, involves usually the consideration of the following:**

(i) the means of obtaining the information;

(ii) the availability and skills of the researcher and his staff

(iii) explanation of the way in which selected means of obtaining information will be organised and the reasoning leading to the selection;

(iv) the time available for research; and

(v) the cost factor relating to research, i.e., the finance available for the purpose.

5. Determining sample design:

- **The researcher must decide the way of selecting a sample or what is popularly known as the sample design. In other words, a sample design is a definite plan determined before any data are actually collected for obtaining a sample from a given population.**

- **All the items under consideration in any field of inquiry constitute a ‘universe’ or ‘population’. A complete enumeration of all the items in the ‘population’ is known as a census inquiry.**

- **Even the slightest element of bias in such an inquiry will get larger and larger as the number of observations increases.**

- **Moreover, there is no way of checking the element of bias or its extent except through a resurvey or use of sample checks.**

- **Besides, this type of inquiry involves a great deal of time, money and energy.**

- **Samples can be either probability samples or non-probability samples. With probability samples each element has a known probability of being included in the sample but the non-probability samples do not allow the researcher to determine this probability.**

- **Probability samples are those based on simple random sampling, systematic sampling, stratified sampling, cluster/area sampling whereas non-probability samples are those based on convenience sampling, judgement sampling and quota sampling techniques.**

A brief mention of the important sample designs is as follows:

(i) Deliberate sampling:

- **Deliberate sampling is also known as purposive or non-probability sampling.**

- **This sampling method involves purposive or deliberate selection of particular units of the universe for constituting a sample which represents the universe.**

- **When population elements are selected for inclusion in the sample based on the ease of access, it can be called convenience sampling.**

- **If a researcher wishes to secure data from, say, gasoline buyers, he may select a fixed number of petrol stations and may conduct interviews at these stations. This would be an example of convenience sample of gasoline buyers.**

- **At times such a procedure may give very biased results particularly when the population is not homogeneous.**

- **On the other hand, in *judgement sampling* the researcher's judgement is used for selecting items which he considers as representative of the population. For example, a judgement sample of college students might be taken to secure reactions to a new method of teaching. Judgement sampling is used quite frequently in qualitative research where the desire happens to be to develop hypotheses rather than to generalise to larger populations**

(ii) Simple random sampling:

- **This type of sampling is also known as chance sampling or probability sampling where each and every item in the population has an equal chance of inclusion in the sample and each one of the possible samples, in case of finite universe, has the same probability of being selected.**

- **For example, if we have to select a sample of 300 items from a universe of 15,000 items, then we can put the names or numbers of all the 15,000 items on slips of paper and conduct a lottery.**

(iii) Systematic sampling:

- **In some instances the most practical way of sampling is to select every 15th name on a list, every 10th house on one side of a street and so on. Sampling of this type is known as systematic sampling.**

- **An element of randomness is usually introduced into this kind of sampling by using random numbers to pick up the unit with which to start.**

- **This procedure is useful when sampling frame is available in the form of a list.**

- **In such a design the selection process starts by picking some random point in the list and then every *n*th element is selected until the desired number is secured.**

iv) Stratified sampling:

- **If the population from which a sample is to be drawn does not constitute a homogeneous group, then stratified sampling technique is applied so as to obtain a representative sample.**

- **In this technique, the population is stratified into a number of nonoverlapping subpopulations or strata and sample items are selected from each stratum.**

- **If the items selected from each stratum is based on simple random sampling the entire procedure, first stratification and then simple random sampling, is known as *stratified random sampling*.**

v) Quota sampling:

- **In stratified sampling the cost of taking random samples from individual strata is often so expensive that interviewers are simply given quota to be filled from different strata, the actual selection of items for sample being left to the interviewer’s judgement. This is called quota sampling.**

- **The size of the quota for each stratum is generally proportionate to the size of that stratum in the population.**

- **Quota sampling is thus an important form of non-probability sampling.**

- **Quota samples generally happen to be judgement samples rather than random samples.**

(vi) Cluster sampling and area sampling:

- **Cluster sampling involves grouping the population and then selecting the groups or the clusters rather than individual elements for inclusion in the sample.**

- **Suppose some departmental store wishes to sample its credit card holders. It has issued its cards to 15,000 customers. The sample size is to be kept say 450. For cluster sampling this list of 15,000 card holders could be formed into 100 clusters of 150 card holders each. Three clusters might then be selected for the sample randomly.**

- **The sample size must often be larger than the simple random sample to ensure the same level of accuracy because is cluster sampling procedural potential for order bias and other sources of error is usually accentuated.**

- **The clustering approach can, however, make the sampling procedure relatively easier and increase the efficiency of field work, specially in the case of personal interviews.**

- **Area sampling is quite close to cluster sampling and is often talked about when the total geographical area of interest happens to be big one.**

- **Under area sampling we first divide the total area into a number of smaller non-overlapping areas, generally called geographical clusters, then a number of these smaller areas are randomly selected, and all units in these small areas are included in the sample.**

- **Area sampling is specially helpful where we do not have the list of the population concerned.**

- **It also makes the field interviewing more efficient since interviewer can do many interviews at each location.**

(vii) Multi-stage sampling:

- **This is a further development of the idea of cluster sampling.**
- **This technique is meant for big inquiries extending to a considerably large geographical area likeban entire country.**
- **Under multi-stage sampling the first stage may be to select large primary sampling units such as states, then districts, then towns and finally certain families within towns.**

- **If the technique of random-sampling is applied at all stages, the sampling procedure is described as multi-stage random sampling.**

(viii) Sequential sampling:

- **This is somewhat a complex sample design where the ultimate size of the sample is not fixed in advance but is determined according to mathematical decisions on the basis of information yielded as survey progresses.**

- **This design is usually adopted under acceptance sampling plan in the context of statistical quality control.**

- **In practice, several of the methods of sampling described above may well be used in the same study in which case it can be called mixed sampling. It may be pointed out here that normally one should resort to random sampling so that bias can be eliminated and sampling error can be estimated.**
- **The sample design to be used must be decided by the researcher taking into consideration the nature of the inquiry and other related factors.**

6. Collecting the data:

- **In dealing with any real life problem it is often found that data at hand are inadequate, and hence, it becomes necessary to collect data that are appropriate.**

- **There are several ways of collecting the appropriate data which differ considerably in context of money costs, time and other resources at the disposal of the researcher.**

- **Primary data can be collected either through experiment or through survey.**

- **If the researcher conducts an experiment, he observes some quantitative measurements, or the data, with the help of which he examines the truth contained in his hypothesis. But in the case of a survey, data can be collected by any one or more of the following ways:**

(i) By observation:

- **This method implies the collection of information by way of investigator's own observation, without interviewing the respondents.**
- **The information obtained relates to what is currently happening and is not complicated by either the past behaviour or future intentions or attitudes of respondents.**
- **This method is no doubt an expensive method and the information provided by this method is also very limited. As such this method is not suitable in inquiries where large samples are concerned.**

(ii) Through personal interview:

- **The investigator follows a rigid procedure and seeks answers to a set of pre-conceived questions through personal interviews.**

- **This method of collecting data is usually carried out in a structured way where output depends upon the ability of the interviewer to a large extent.**

(iii) Through telephone interviews:

- **This method of collecting information involves contacting the respondents on telephone itself.**

- **This is not a very widely used method but it plays an important role in industrial surveys in developed regions, particularly, when the survey has to be accomplished in a very limited time.**

(iv) *By mailing of questionnaires:*

- **The researcher and the respondents do come in contact with each other if this method of survey is adopted.**
- **Questionnaires are mailed to the respondents with a request to return after completing the same.**
- **It is the most extensively used method in various economic and business surveys.**

- **Before applying this method, usually a Pilot Study for testing the questionnaire is conduced which reveals the weaknesses, if any, of the questionnaire.**

- **Questionnaire to be used must be prepared very carefully so that it may prove to be effective in collecting the relevant information.**

(v) *Through schedules:*

- **Under this method the enumerators are appointed and given training. They are provided with schedules containing relevant questions. These enumerators go to respondents with these schedules. Data are collected by filling up the schedules by enumerators on the basis of replies given by respondents. Much depends upon the capability of enumerators so far as this method is concerned. Some occasional field checks on the work of the enumerators may ensure sincere work.**

- **The researcher should select one of these methods of collecting the data taking into consideration the nature of investigation, objective and scope of the inquiry, financial resources, available time and the desired degree of accuracy**

7. Execution of the project:

- **Execution of the project is a very important step in the research process.**

- **If the execution of the project proceeds on correct lines, the data to be collected would be adequate and dependable.**

- **The researcher should see that the project is executed in a systematic manner and in time. Conducting surveys, experiments etc.**

8. Analysis of data:

- **After the data have been collected, the researcher turns to the task of analysing them.**

- **The analysis of data requires a number of closely related operations such as establishment of categories, the application of these categories to raw data through coding, tabulation and then drawing statistical inferences.**

- **The unwieldy data should necessarily be condensed into a few manageable groups and tables for further analysis. Thus, researcher should classify the raw data into some purposeful and usable categories.**

- ***Coding* operation is usually done at this stage through which the categories of data are transformed into symbols that may be tabulated and counted.**

- ***Editing* is the procedure that improves the quality of the data for coding. With coding the stage is ready for tabulation.**

- ***Tabulation*** **is a part of the technical procedure wherein the classified data are put in the form of tables. The mechanical devices can be made use of at this juncture.**

- **Analysis work after tabulation is generally based on the computation of various percentages, coefficients, etc., by applying various well defined statistical formulae. In the process of analysis, relationships or differences supporting or conflicting with original or new hypotheses should be subjected to tests of significance to determine with what validity data can be said to indicate any conclusion(s).**

9. Hypothesis-testing:

- **After analysing the data as stated above, the researcher is in a position to test the hypotheses, if any, he had formulated earlier.**

- **Do the facts support the hypotheses or they happen to be contrary? This is the usual question which should be answered while testing hypotheses.**

- **Various tests, such as Chi square test, t-test, F-test, have been developed by statisticians for the purpose.**

- **The hypotheses may be tested through the use of one or more of such tests, depending upon the nature and object of research inquiry.**

- **Hypothesis-testing will result in either accepting the hypothesis or in rejecting it.**

- **If the researcher had no hypotheses to start with, generalisations established on the basis of data may be stated as hypotheses to be tested by subsequent researches in times to come.**

10. Generalisations and interpretation:

- **If a hypothesis is tested and upheld several times, it may be possible for the researcher to arrive at generalisation, i.e., to build a theory.**

- **As a matter of fact, the real value of research lies in its ability to arrive at certain generalisations. If the researcher had no hypothesis to start with, he might seek to explain his findings on the basis of some theory. It is known as interpretation.**

- **The process of interpretation may quite often trigger off new questions which in turn may lead to further researches.**

11. Preparation of the report or the thesis:

- **Finally, the researcher has to prepare the report of what has been done by him.**

- **Writing of report must be done with great care keeping in view the following:**

1. The layout of the report should be as follows:

(i) the preliminary pages;
(ii) the main text, and
(iii) the end matter.

- **In its preliminary pages the report should carry title and date followed by acknowledgements and foreword. Then there should be a table of contents followed by a list of tables and list of graphs and charts, if any, given in the report.**

The main text of the report should have the following parts:

a) Introduction:

- **It should contain a clear statement of the objective of the research and an explanation of the methodology adopted in accomplishing the research. The scope of the study along with various limitations should as well be stated in this part.**

b) Summary of findings:

- **After introduction there would appear a statement of findings and recommendations in non-technical language. If the findings are extensive, they should be summarised.**

(c) Main report:

- **The main body of the report should be presented in logical sequence and broken-down into readily identifiable sections.**

(d) Conclusion:

- **Towards the end of the main text, researcher should again put down the results of his research clearly and precisely. In fact, it is the final summing up.**

- ***At the end of the report,*** **appendices should be enlisted in respect of all technical data. Bibliography, i.e., list of books, journals, reports, etc., consulted, should also be given in the end. Index should also be given specially in a published research report.**

2. Report should be written in a concise and objective style in simple language avoiding vague expressions such as ‘it seems,’ ‘there may be’, and the like.

3. Charts and illustrations in the main report should be used only if they present the information more clearly and forcibly.

4. Calculated ‘confidence limits’ must be mentioned and the various constraints experienced in conducting research operations may as well be stated.