Research Methodology: Methods and Strategies

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Research Methodology: Methods and Strategies

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Abstract

The main purpose of this research project is to acquire understanding regarding the significance and meaning of research methodology. Research methodology is to make provision of methodical ways to provide solutions to the research problems. It is understood as the science of acquiring information, how research is put into practice in a systematic and methodical manner. The meaning of research is understood as the search for knowledge. It can be defined as the scientific and systematic research for relevant information on a specific subject area. It is an art of scientific investigation and is an organized effort to gain new knowledge. It is an academic activity and the term is used in technical sense. An individual needs to acquire understanding of research methodology, in order to acquire complete knowledge of the methods that are used within a research study. The researchers also need to understand the reasons behind making use of particular methods of study and why they are not making use of others. The main objective of the research methodology is to generate productive findings.

The main areas that are comprised within research includes, defining and redefining problems, formulating hypothesis or research questions, collecting, organising and evaluating data, making deductions and reaching conclusions. The other areas that highlight the significance of research methodology includes, statistical packages, types of data presentation, sociometry, biblio-metrics, sciento-metrics, info-metrics and webo-metrics, citation analysis, Delphi technique, trends in library and information science research, research evaluation, writing reports and thesis, aging and obsolescence, organization of reports and thesis and the role of computer technology in research. Research is an innovative contribution to the present knowledge. It primarily focuses upon the pursuit of facts and accuracy with the help of education, observation, comparison and experimentation. Research methods are the techniques and approaches that are used in the implementation of research. These are the methods that the researchers make use of in the performance of research operations. In other words, the methods that are made use of by the researcher during the course of studying his research problems are the research methods.

Chapter 1. Introduction

Research is undertaken within most professions. It is more than a set of skills. Research is a way of thinking, examining critically the various aspects of daily professional work; understanding and formulating the guiding principles that govern a particular procedure and developing and testing new theories that contribute towards the advancement of the practice as well as profession. It is a habit of questioning what one does, a methodical examination of clinical observations to explain and find the answers for what one perceives, with the motive to promote appropriate changes in order to encourage professionalism (Kumar, 2011). Research normally is referred to as a search for knowledge. It is a systematic and scientific search for pertinent information in relation to a particular subject. It is an art of scientific, and systematic investigation (Chapter 1, n.d.).

Research is an academic activity. It comprises of defining and redefining problems, formulating hypothesis or suggesting solutions, collecting, organizing and evaluating data, making deductions, reaching conclusions and sensibly testing the solutions to determine, whether they are in accordance to the hypothesis that have been formulated. In conducting research, manipulation of areas and concepts are required for the purpose of generalizing the extent, correcting or verifying knowledge, whether the knowledge contributes in the construction of theory or in the practice of art. Research is thus an original contribution to the existing stock of knowledge, making it appropriate for utilization. It is the pursuit of accuracy and facts, with the help of study, observation, comparison and experiment. It is the search for knowledge, through objective and systematic method of finding solutions to a problem. Enunciating a problem, formulating hypothesis, collecting facts or data, analysing the facts and reaching a conclusion, either in the form of solutions or in certain generalizations for some theoretical formulation (Chapter 1, n.d.).

Research is defined as a human activity that are based on intellectual application in the investigation of matter. The initial purpose of applied research is discovering, interpreting and the development of methods and systems for the advancement of human knowledge on a wide variety of scientific matters of the world and the universe (Bryman, & Cramer, 2000). Research Methods are the tools and techniques for conducting research. It is an investigation that aims to find out interesting or new facts. Research has gained significance in wide variety of subjects, these include, social science, natural sciences, anthropology, psychology, politics, leisure studies, sports, hospitality, health care and nursing, environment, business, administration, management, humanities and education. In higher educational institutions,

students carry out research in the form of research papers, projects, thesis and dissertations. The more advanced the degree, the greater is the research work. Research work helps in bringing about modern and innovative techniques and methods (Walliman, 2011).

Chapter 2. Concept and Definition of Research

The research is considered as a matter of raising a question and making an attempt to find an answer. Research means some sort of investigation of the research problem. The definition of research puts emphasis upon four connotations, which have been stated as follows:

Manipulation of Things

The manipulation of things focuses upon how the things are and how they respond under specific conditions. The scientists put them handling, called it 'manipulations'. Research involves manipulation of things or concepts or symbols.

Generality

The controlled things would result in propositions or conclusions, which may vary in their degree of generalities. Generality is regarded as one of the basic objectives of research.

Extending Knowledge

Extending generalization to its bounds of knowledge puts pressure upon the researchers to bring about changes or amendments to rectify disagreement by several propositions. The generalizations would render an effectual contribution in establishing corpus knowledge in a well-organized manner.

Building up Theory or Practice

New knowledge is derived from manipulation and generalization. They have two uses, namely theoretical and practical. Knowledge thus acquired may be used for building up theoretical models. The activities, which seek building up of theories of non-utilitarian impact are often known as 'pure' or 'basic' or 'theoretical research'. The research, which seeks knowledge for practical concerns are often called 'applied' or 'action-oriented' or 'practice-oriented research'.

Objectives of Research

There are two main objectives of research, academic and utilitarian. Manipulation of things, finding new propositions or concepts, resulting in generalizations and discovery of truth and intimate knowledge which by recording and reporting supplies or adds knowledge to the academicians. Rendering the society by offering solutions to the existing problems on the basis of the principles or theories, is the main function of utilitarian objective. The objective of research is to generate measurable and testable data, gradually that are adding to the accumulation of human knowledge. The aim of research is to find out solutions to the problems applications of scientific methods. Its purpose is to discover answers to the

questions. The major aim is to find out the hidden truth, which has not been discovered yet. The objectives have been stated as follows: (Bryman, & Cramer, 2000).

1. To get introduced with a process for achieving new insights into it. Studies with this objective in view are known as exploratory or formulative research studies.
2. To start testing a hypothesis of a causal relationship between two or more variables. These studies are termed as hypothesis testing research studies.
3. To draw the features of a particular individual situation or a group in a perfect manner. The study with this type of object in view are known as descriptive research studies.
4. To evaluate the frequency with which something takes place or when it is associated with something else. This type of studies, with this objective in view are known as diagnostic research studies.

Features of Research

The features of research have been stated as follows: (Kothari, 2004).

1. The purpose of the research should be clearly defined and the researcher should be aware of the common concepts to be used.

2. The research procedure used should be described in satisfactory detail to permit another researcher to reiterate the research for further progression, and keeping the continuity of what has already been acquired.

3. The procedure of the research design should be judiciously planned to yield the results that are objective to a major extent.

4. The researcher should report with complete honesty, and truthfulness. One should be able to adequately identify the flaws and inconsistencies in the procedural design and estimate their effects upon the findings.

5. The analysis of the data should be appropriately sufficient to reveal its significance and the methods of analysis used should be suitable. The validity and reliability of the data should be carefully checked.

6. Conclusions should be limited to those, justified by the data of the research and limited to those for which the data make provision of a sufficient basis.

7. Greater confidence in research is justified, if the researcher is experienced, has a good reputation in research and is a person of integrity and uprightness.

Systematic

It means that research is implemented in a structured manner with specified steps to be taken within a definite sequence, in accordance with the well-defined set of rules and procedures. Systematic characteristics of the research does not rule out creative thinking but it certainly does reject the utilization of estimating and intuition in arriving at conclusions.

Logical

This implies that research is guided by the rules of logical reasoning and the logical process of induction and deduction are of significance in the implementation of research. Induction is the process of reasoning, from a part to the whole, whereas deduction is the process of reasoning from some premise to a conclusion, which follows from that very premise. In fact, logical reasoning makes research more meaningful within the framework of decision making.

Empirical

Empirical research is based upon the observed phenomenon and generates knowledge from the actual experience, rather than theory or belief (Empirical Research in Education, 2017). It implies that research is related basically to one or more aspects of a real situation and deals with concrete data that provides a basis for external validity to research results.

Replicable

This characteristic permits the research results to be verified by replicating the study and thereby building a rigorous foundation for decisions. Replication is often used in terms of finding two independent studies that produce a result with similar levels of statistical significance in human genetics. The same word has been used to refer to redoing the experiments and recreating results from fixed data and code (Patil, Peng & Leek, 2016).

Ethical Aspects of Research

The ethical aspects of research have been stated as follows:

Reliance on Evidence

Truthfulness and accuracy are regarded as integral aspects of not only research, but in the case of all the steps and procedures that are involved within the research study. These are established on the basis of evident conclusion. They are admitted, only when they are based upon evidence. The answer to a question is not decided by any type of imagination or guess (Research Methodology, 2011).

Commitment to Objectivity

When the term ‘objectivity’ is made use of, then it primarily refers to neutrality, independence, fairness and impartiality. It is essential on the part of the researcher to possess

the traits of enthusiasm, willingness and ability to accept the truth and be honest and principled (Research Methodology, 2011).

Ethical Neutrality

The area of science does not pass normal judgment upon the facts. It does not say that they are either good or bad. Science never imposes anything. It does not aim at anything but has the main objective of making true and adequate statements about the object (Research Methodology, 2011).

Verifiability

The conclusions that have been generated through research should be supportable and verifiable. The researcher should have the ability to generate awareness among others, how he has reached his conclusion. Such verifications help in conducting additional research (Research Methodology, 2011).

Logical Reasoning Process

The scientific method involves the logical process of reasoning. Logical process of reasoning is primarily focused upon producing coherency, rationality and consistency within the approaches and strategies that are adopted in the research process. The reasoning process is used for drawing inferences from the findings of a study or for arriving at a conclusion (Research Methodology, 2011).

Controlled Research

There has been a long standing assumption in the scientific community that knowledge is good for its own sake. The presumption is that information produced by scientific methods is considered as more valuable to the individuals, as compared to folklore, common sense, intuition and custom. Science operates within the community of free enquiry and it must support all the scientific enquiry, irrespective of the area of research.

Uncontrolled Research

There are some serious problems, which allow the search for scientific knowledge to go on totally uncontrolled. The major problems are the possible harm to the particular subjects and the potential harm that the users of some knowledge may hold for the whole of humanity. Involving the subjects is one of the ethical considerations, several considerations should be made concerning, treating the subject as a person, treating the person with dignity and conducting research with fairness. An informed consent slip contains a written statement that the potential participant understands that he is participating, and that the process has been explained, confidentiality will be assured and he has agreed to participate. Implied consent is indicated by the subject's agreeing to be interviewed, or take part in a discussion.

Organizational consent is normally obtained at the beginning of the study, when access is negotiated.

Equal Opportunities and Rights

The rights of the subjects and clients need to be taken into consideration, but where research may be connected with such services. Such research is usually conducted in schools, hospitals, social agencies or rehabilitation settings. Accountability in such agencies is more important, both basic research and evaluation research become more frequent. The individuals involved in these agencies must possess the viewpoint that the opportunities and rights of the clients must be safeguarded. The individuals are expected to follow the instructions, rules and policies, be honest, and work to their best abilities.

Maintaining Self-Respect

When the researchers are working on a research project, it is a fact that they cannot work in isolation and have to integrate and collaborate with others. Hence, for this purpose, it is vital for the researchers to develop effective communication skills and maintain their self-respect. When help and assistance is to be obtained from others, then it is vital for the researchers to maintain their self-esteem. During the implementation of data collection methods, it is vital for the individuals to maintain self-respect, as they get positive as well as negative answers from the respondents in the field. Maintaining self-respect helps the individuals to work towards their research study with confidence.

Confidentiality and Anonymity

Confidentiality is referred to the concealment of the individual's identity and anonymity is subjects remaining nameless. It is essential that they be assured of confidentiality. Normally in the collection of quantitative data, the respondents need to be assured that their names will not be disclosed, only aggregate data will be made public. In the preparation of the report or the thesis, the researchers need to take these aspects into consideration.

Fabrication of Data and Plagiarism

Fabrication of data means falsifying the data. The researchers need to take this aspect into consideration that the information and data that they are using are genuine and reliable. The researchers need to be truthful and honest in their work. Plagiarism, on the other hand is referred to borrowing someone else's ideas or works without citing them. It is an ethical violation of the unacknowledged borrowing of ideas or data from others. The researchers need to be careful about in-text citations and putting the sources in the bibliography.

Exploitation of Assistants and/or Subjects

It is unlawful to make use of individuals that would enhance the position of the researcher in an unfair manner. The researcher should possess the attitude of care and consideration of the other individuals and not merely make use of their skills and abilities for their own benefit. Precautions should be taken to safeguard their well-being and to ensure that the social exchanges involved within the research project should be fair and equitable.

Chapter 3. Types of Research

The types of research have been stated as follows:

Descriptive Vs. Analytical

Descriptive research is also called statistical research. It includes surveys and fact finding enquiries of various types. The primary goal of this type of research is to describe the data and the characteristics about what is being studied. The main objective behind this type of research is to study the frequencies, averages and statistical calculations. Descriptive research is primarily put into practice, when the researcher wants to acquire a better understanding of the topic. The term Ex post facto research has been used for descriptive research. The main characteristic of this research is that the researcher does not have any control over the variables, he can only report what has happened or what is happening.

Most of the Ex post facto research projects are used for the descriptive research studies, in which the researcher seeks to measure the items, such as, frequency of shopping, preferences for people and other similar kinds of data. Attempts have been made by the researchers to discover the causes, even when they cannot control the variables. The methods of research that have been put into practice include, comparative and correlational methods. On the other hand, in analytical research, the researcher has to make use of facts or information already available and conduct an analysis to make a critical evaluation of the material.

Fundamental Vs. Applied

Applied research aims at evaluating a solution for an immediate problem facing the society or an industrial organization. Research that has been carried out to find out political, social or economic trends that may affect a particular institution or marketing research are examples of applied research. Fundamental research is mainly concerned with generalizations and with the formulation of theory. Fundamental research is also known as basic research. It is the study of life processes that are universal in their application to scientific knowledge. Research concerning some natural processes or relating to pure mathematics is an example of fundamental research. Gathering of knowledge for the sake of knowledge is termed as fundamental research. Research relating to some natural phenomenon or pure mathematics is an example of fundamental research. In the same manner, generalizations about human behaviour are also considered as examples of fundamental research.

Quantitative Vs. Qualitative

Quantitative descriptive research puts emphasis upon what it is and makes use of quantitative methods to describe, record, analyse and interpret the present conditions. It is based upon the measurement of amount or quantity and is applicable only to the process that can be expressed in terms of quantity. On the other hand, qualitative descriptive research, puts emphasis upon what is, and makes use of non-quantitative research methods in providing the description of the present conditions. It is concerned with qualitative phenomenon that is relating to or evolving quality or kind. It is considered as significant especially in the behaviour sciences, where the major objective is to discover the underlying motives of human behaviour. It is a complicated process. Other techniques of qualitative research are word association tests, sentence completion tests, and similar other projective techniques. Through this research, one is able to analyse various factors, which motivate people to behave in a particular manner or which make them like or dislike a particular thing.

Conceptual Vs. Empirical

Conceptual research is that which is related to some abstract ideas or theory. It is commonly used by other thinkers or philosophers to develop new concepts or to interpret the existing ones. On the other hand, empirical research relies on experience or observation alone, without due regard for the system and theory. It is a data based research, which come up with conclusion, which are capable of being verified by experiment or observation. It is essential to get facts first hand at their source, and actively to go about few things to stimulate the production of the needed information. It is suitable, when proof is sought that few variables affects the other variables in a certain manner.

Empirical research is also known as the experimental research. In this research, the researcher has to provide himself with the working hypothesis. He then works to get enough facts to prove or disprove the hypothesis. He then sets up the experimental designs, regarding which he possesses the viewpoints that will manipulate the materials and individuals as to bring forth the desired information. Such research is characterised by the researcher's control over the variables under the study and deliberate manipulation of one of them to study its effects. This research proves to be beneficial, when proof is sought that some variables affect the other variables in some manner. Evidence gathered through experiments or empirical studies are considered vital for testing a given hypothesis.

Other Types of Research

All the other types of research are the variations of one or more of the above stated approaches, based on either the purpose of research or the time required to accomplish those research, on the environment in which the research is undertaken or on the basis of some

other similar factors. The research can be thought of either as one-time research or longitudinal research. In the former case, the research is confined to a single time period. On the other hand, in the latter case, it is carried on over several time periods. Research can be field-testing research, or laboratory research or simulation research, depending upon the environment in which it is carried out. Clinical or diagnostic research follows the case study methods or the in-depth approaches to reach the basic casual relations (Chapter 1, n.d.).

Historical research is the one that utilizes historical documents, remains and so forth to study the events and ideas of the past, including the philosophy of the individuals and groups at any remote point of time. Research can also be classified as conclusion-oriented and decision-oriented. In conclusion-oriented research, the researcher is required to select a problem, redesign the enquiry as he proceeds further and is prepared to be conceptualized in accordance to his aspirations. Decision-oriented research is always for the need of the decision maker and the researcher in this case does not possess the independence to conduct research in accordance to his own ideas and viewpoints. Operations research is an example of decision-oriented research since it is a scientific method of providing executive departments with a quantitative basis of decisions regarding the operations under their control (Chapter 1, n.d.).

Interdisciplinary Approach in Research

Interdisciplinary research is a mode of research by groups or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to progress fundamental understanding or to provide solutions to the problems, whose solutions are beyond the scope of a single discipline or area of research practice (Report to Congress, 2008). The manifold and the multi-faceted implications of industrialization in India, typically spells out the need for scientific social research on an equitably large scale. Its purpose is to make provision for a systematic understanding of the nature of problems, a sound diagnosis and an effective treatment plan. In fact the complicatedness of the situation calls for some kind of an inter-disciplinary collaboration among researchers from specialized disciplines. These include, economists, political scientists, sociologists, psychologists and anthropologists, for making an operative multi-pronged attack on these social problems.

Interdisciplinary research brings out a number of new disciplines by way of lamination, loose assemblage, agglomeration and fusion. It is also called co-ordinated

research. It is characterized by an exchange of ideas and perspectives from one discipline to another. If various disciplines work under one roof or in co-ordination, then it may give rise to conductive or productive research. In this way, much time, effort and money are saved. Different characteristics of research include, it is a co-operative venture and a common object, different disciplines must work together and research is utilitarian in nature.

Interdisciplinary research occupy the spaces between the disciplines to create new knowledge. It occupies the most comprehensive perspective on the continuum. Cognate inter-disciplinary is within the natural or physical or social sciences. On the other hand, radical interdisciplinary is between the natural and the social. Disciplinary experts tend to regard the fields, other than their own with considerable suspicion. This type of research is not considered as common and is being discouraged. It is considered among other things as too theoretical. In the case of this research, it is vital for the individuals to understand what constitutes knowledge, intellectual traditions, methodological approaches and definitions of the problems. Its benefits constitute, making provision of useful means for dealing with various kinds of problems and difficulties and issues in terms of the real world require synthetic and integrative approaches (Davoudi, 2013).

In order to implement interdisciplinary research in an appropriate manner, it is vital to take into consideration various factors. These include, mutual understanding, trust, confidence and sense of humour. One should be confident and possess adequate knowledge regarding how to deal with various problems and situations. Research is a time-consuming process. It is vital for the individuals to devote sufficient time and resources towards this undertaking. The individuals need to share sufficient knowledge, frame the problems and construct the methods in an appropriate manner. The main aim is problem setting and problem solving. In these processes, it is vital for the individuals and the researchers to possess adequate knowledge and understanding, so that solutions can be provided in an appropriate manner (Davoudi, 2013). The individuals are required to work in collaboration with each other, have respect for their work, possess the traits of diligence, conscientiousness and resourcefulness and implement the processes appropriately.

Chapter 4. Methods and Techniques of Research

In order to implement the research tasks in an appropriate manner, it is vital to acquire understanding of different methods and techniques of research. The adoption of various methods and techniques are in accordance to the research problem, objectives and the area in which the research is conducted. The methods and techniques have been stated as follows:

Historical Research

Historical research is one of the accepted and established forms of research in the information professions. It is concerned with the study of past events, occurrences, in a truthful account of the integrated records, concerning the person, place, power, state, government finding relationship with time-magnitude and geography. Historical research is stated to be the induction of principles through research to the past and social forces, which have shaped the present. In this method, social insight and historical orientation is necessary to a major extent. For the operative application of this method, it is essential to take into account, analytical and synthetic view of the facts. The researcher should be aware and possess adequate knowledge and data should be reliable, relevant and adequate.

There are certain conditions that are necessary for historical research. These include, selection of a topic for research, social insight – cause and effect relations, historical orientation i.e. the occurrence of past events, knowledge regarding the related social sciences, broad educational background, familiarity with the topic and its objectives, dispassionate study, imaginative capacity, selection and rejection of the material, analysing and co-ordinating capacity, knowledge and awareness of the field, knowledge in terms of limitations and problems and availability of necessary facilities i.e. tools, materials, equipment, computers, machines, library and so forth.

Case Study Method

Case study permits exploration and understanding of complex issues. It can be considered as a strong research method, especially when a holistic and in-depth investigation is required (Zainal, 2007). It refers to the application of specific qualitative research methods within a specific setting. This method for the most part is limited to a single setting, subject or event. There are different kinds of case studies. These include, observational case studies, interview case studies, organizational case studies, life history case studies and multi-site and comparative case studies. In an observational case study, the data is gathered by participant

observation in a single information agency with focus upon the particular aspect, which include stacks, staff room etc. Case study method applies to a number of research types, each of which has particular benefits and procedures. In simple words, this method is a comprehensive study of a social unit. This unit can be a person, group, community, social institution, region or a district. Case data may be gathered exhaustively on an entire life cycle of a social unit, or a definite section of it. Whether the section or a whole life is studied, its aim is to ascertain natural history.

Survey Method

Survey research studies large and small populations by selecting and studying the samples chosen from those populations. The main purpose of this method is to discover the relative incidence, distribution and interrelations of sociological and psychological variables. Survey research is mostly devoted to the study of characteristics of the populations under investigation. The scope of survey research can be wide and not limited, i.e. the variables can be included which are economic in nature. This research is approached through the methods of personal interviews, mailed questionnaires, and personal discussions, besides indirect oral investigations. It is advantageous that a large amount of information can be collected from a population that is large in size. It is expensive, but the amount and quality of information collected makes it economical. The information collected is accurate within the range of sampling errors. The reason being, the individuals and the researchers, who are employed in this method possess adequate knowledge. In this method, one of the disadvantages is, researchers may receive considerable amount of negative responses and experience many problems during the collection of data. The common ones include, receiving incomplete and blank questionnaires or unwillingness on the part of the respondents in terms of providing their responses, such as, busy schedules, lack of understanding of the research study, regarding which they are being surveyed and so forth.

Evaluation Research Method

Evaluation research is sometimes known as program evaluation. It is referred to a research purpose rather than a specific method (Evaluation Research, n.d.). This research aims at evaluating programs that have been implemented or actions that have taken in order to get an objective. Evaluation means some sort of measurement of the end-product and impact of an effort in the light of the stated goals for which the program was undertaken. There have been initiation of many programs, in which economic gains are not available, the

evaluation of which calls for special techniques. There are three main types of evaluations, concurrent evaluation means continuous process and partakes the nature of an inspection and social audit. Phasic or periodic evaluation means a distinctive phase or stage completion on which the evaluation takes place. Terminal evaluation means evaluation is done after the completion of the program or objective. One should be clear of the goals and objectives of the program or project in evaluating it.

Pure Research

The research that is based upon development of scientific theories or basic principles is termed as pure, basic or fundamental research. Pure research is stimulated by the curiosity or interest of the researcher. The primary motive is to expand ones knowledge. This research is not involved in the creation and expansion of anything. There are not any apparent commercial values to the discoveries that are associated with pure research (Basic vs. Applied Research, n.d.). In this research, the researcher makes an attempt to view the increasing knowledge in the field of enquiry. Pure research helps in the development of general principles, helps to find out the central factors in practical problems and becomes a standard procedure for the researcher to find out an answer to the problem.

Applied Research

Applied research contributes to new facts, it can put theory to test, it may assist in the conceptual classification and it may integrate theory to previous studies or study. This research is designed to provide solutions to practical problems of the modern world, rather than acquiring knowledge just to gain more awareness. It can be stated that the goal of the researcher is to bring about improvements and transformations within the human conditions. In this research, it is the main job duty of the researchers to investigate the ways that may bring about improvements and transformations, aiming at productivity and profitability. The areas in which applied research is used are medical and health care, agricultural, farming and plantations, improvement in homes, bringing about civic amenities, facilities, changes within the office environment and improvements in infrastructure and modes of transportation (Basic vs. Applied Research, n.d.).

Research Process

The research process is referred to the generalized model of implementing research. The process is well understood and one does not usually follow the process stage by stage,

but continuously move back and forth in between the elements or carry out two or more elements concurrently, when one is undertaking a qualitative or an interpretative study (The Research Process, n.d.).

Formulating the Research Problem

The term problem is derived from a Greek word "proballein", which means anything thrown forward, a question proposed for solution, or a matter stated for examination. It is a state, in which one cannot find a solution. There are three types of problems in social science research:

Empirical Problems – When social researchers answer questions or problems on the basis of what they come to know through their sensory organs, these are termed as empirical problems. Social researchers base their conclusions and findings on what they perceive or sense or observe to verify or approve or reject the relationship between two or more variables.

Analytical Problems – These are not scientific, these are the questions, whose answers depend upon the meaning of the words in the sentences expressing them.

Normative Problems – These are the questions, whose answers primarily depend upon value judgments. Value judgments are the statements of what is desirable, preferred, moral, imperative or obligatory. These may either take an evaluative or a prescriptive form.

Formulating a research problem is the first and most important step in the research process. A research problem ascertains one's aim. The more specific the researcher is regarding the goals and objectives, as everything that follows within the research process, study design, measurement procedures, sampling strategy, frame of analysis and the style of writing of the dissertation or report is influenced on a large scale by the way in which one formulates his research problem. Hence, one should examine it systematically, judiciously and critically. The main function of formulating a research problem is to make a decision regarding what one intends to achieve. The formulation of a research problem depends to a large extent upon the knowledge and components of the problem. A researcher needs to identify five components of the problem: (Bryman, & Cramer, 2000).

There must be an individual or group which has the problem. In case, the individual or group utilizes research to solve a problem, then it may be termed as research consumer. Secondly, the research consumers must have some objectives, goals and desires or ends. Thirdly, the research consumers must have some alternative sources available for obtaining or achieving the goals and objectives. These means may be described as courses of action,

involving the use of objects as instruments. These sources are referred to as the patterns of behaviour, utilized for the achievement of objectives for research consumers. The instruments may be in the form of ideas or concepts, such as, mathematical formula, scientific definition, language and so forth. Fourthly, there should be more than one course of action available, so that it can be found out, which would be better and fifth, there should be availability of one environment, to which the problem pertains.

Extensive Literature Survey

Extensive literature survey is considered an important part of the presentation of research work. It is vital, the reason being, all research inevitably involves the use of books, reports, documents, articles, journals, internet and periodicals. Sources of information can be formal and informal. In the literature review, the sources used are primary, secondary and tertiary. Primary publications are those, in which the author for the first time supplies evidence, describes a discovery, makes or derives a new proposition or brings forward new evidence about previous proposition. These include, periodicals, trade journals, reports, reprints, patents and standards. Secondary publications include, encyclopaedias, reference books, indexes, guides, textbooks, journals, bibliographies, literature review etc. Tertiary publications are yearbooks and directories. In addition, the use of the internet is prominent in obtaining information to prepare the literature review.

In the review of the extensive literature survey, it is the role of the supervisor to help the students in making the selection of appropriate subjects. In masters and doctoral programs, when students are involved in the research project, then the direction and guidance of the supervisor is considered imperative. It is the job duty of the supervisor to guide the students to move towards the right direction and accomplish good results. They should be willing and enthusiastic to co-operate and co-ordinate the work. It is vital for the students to obtain scholarly sources in this part of the research project. Careful analysis of the sources should be put into practice and then it should be incorporated within the thesis.

Formulation of Hypothesis

Hypothesis is the statement of relationship between two or more concepts and/or social patterns. It is referred to as a piece of theory. It is a theoretical statement. It is also stated as a human devise for anticipating the events that are about to happen. It is referred to as a shrewd guess, a tentative generalization, a proposition, a condition or principle, which is assumed perhaps without belief, in order to draw out its logical consequences and by this method to test its accord with facts, which are known or may be determined. Hypothesis is a

conjectural statement of relationship between two or more variables. It is in a declarative sentence form, and they are related either generally or specifically variables to variables.

Active interrogation to discover the cause of a given event in nature often makes to resort to a preliminary supposition or hypothesis. It is proposed as an unverified conjuncture in an effort to explain the basis of the unknown phenomenon, subject to ensuing proof. A hypothesis is a tentative generalization in the form of the proposition and formed by the process of induction. The theory of induction undergoes two problems, i.e. a single instance can nullify the generalization and induction is based solely on observation. In a developed science, the cause may not be an observed phenomenon, it may be a creation of the mind.

Research Questions

Research questions are based upon the following aspects, these include, what is happening in the program, what are the salient themes, patterns, categories in the participants measuring of the social structure, how are these patterns connected to one another, what events, beliefs, attitudes and policies are shaping this phenomenon, how do these forces interact to result in the occurrence, salient events, behaviours, attitudes, structures and processes taking place that influence the research study, what will be the ultimate outcome and who will be affected and in what way.

Conceptualizing a Research Design

For any research, the selection of an appropriate research design is fundamental in enabling one to generate valid findings, comparisons and conclusions. In scientific areas, the strength of an empirical research is primarily evaluated in the light of the research design adopted (Kumar, 2011). When selecting a research design, it is important to ensure that it is valid, practicable and manageable. Details regarding the research design are most commonly used in quantitative and qualitative research. There is an enormous variety of study designs and one needs to be familiar with. The research design should be suitable to the study. The research designs differ in accordance to the research purpose. These may be grouped into four categories, exploration, description, diagnosis, and experimental. The design requirements would vary for different types of studies. The study whose purpose is exploration require a flexible research design and that aiming at diagnosis or description require a more rigid research design. The various steps of research design include, selecting the problem, determining the dependent variables, determining the independent variables, determining the number of levels of independent variables, determining the possible combinations, determining the number of observations, redesign, randomization, mathematical model, data collection, data reduction and data verification.

Determining Sample Design

The accuracy of the findings depends upon the way in which the sample is selected. The main objective of any sampling design is to minimize the gap between the values within the limitation of cost obtained from the sample and those prevalent in the study population. In determining the sample design, it is vital to take into consideration the following points. These include, type of universe, sampling unit, source list, size of sample, parameters of interest, budgetary constraint and sampling procedure.

Collecting the Data

To collect the data, there are various procedures that have been put into practice. These include, questionnaire method, interview method, schedule method, survey method, case study method, enquiry method, check-list method, inventory method, personality method, aptitude tests, protective devices, scoring, scaling, ranking, counting, rating, socio-metric method and census method. Data collection is an imperative aspect of the research study. The researchers are required to put into practice, appropriate data collection procedures for the purpose of collecting the data (Kumar, 2011).

Classification of Data

The data collected is in an unorganized form, hence in order to generate valid and accurate findings, it is vital to classify the data in an appropriate manner. Classification of data is stated as the process of arranging the data into groups or classes on the basis of the common characteristics. These include, geographical or area-wise, chronological or basing on timings or historical, quantitative is based on numerical values and qualitative is based upon the characteristics, attributes, abstracts, ideas, which are quantifiable and not being numerical.

Research Design

Research design is required because it facilitates the smooth understanding of research operations, thereby making research effectual by producing maximal information with minimal expenditure of time, effort and money. A research design or a plan is needed in advance of data collection and analysis for the research project. Research design stands for advance planning of the methods to be implemented for collecting the pertinent data and the techniques to be used in their analysis, keeping in view the objective of the research and the availability of human resources, time and financial resources. Preparation of the research design should be done with great caution as any error in it may impede the working of the entire project. Research design, in fact, has a major bearing on the reliability of the results

arrived at and as such establishes the firm foundation of the entire edifice of the research work (Kothari, 2004).

The researcher has to be methodical and systematic in the preparation of research design. When working upon a research design, the researcher has to make decisions regarding the techniques to be employed regarding the collection of relevant data, safeguards to be employed in the interest of reliability and validity, size of the sample, and methods of drawing samples from the universe. Sample is the part of organizing and analysing data, subjecting them to interpretation and presentation of the data in an appropriate manner. The researcher has to get involved into the process of formulating the research instruments, i.e. questionnaire, interview-schedule etc. Discussions, reading, studying and imaginative role taking are some of the aspects, put into practice by the researcher.

Purpose of a Research Design

The purposes of the research design have been stated as follows: (Pandey, & Pandey, 2015).

Minimization of the Expenditure – Research design has an important influence on the reliability of the results obtained. It therefore makes provision of a strong base for the entire research. This makes the research efficient by providing maximum information with the minimal spending of time, money and effort.

Facilitation of Smooth Scaling – Research design renders an imperative contribution in the smooth scaling of various research operations. In this manner, the operations of research are performed in a timely manner by making use of minimum resources and time.

Collection of Relevant Data and Techniques – Planning of techniques and methods to be adopted in the collection of relevant data is an integral aspect of research design. The methods, approaches and strategies that are used in the research operations, need to be planned, taking into consideration, the availability of human resources and financial resources.

Providing Blue Print for Plans – Research design facilitates the smooth working of many operations. It is like a blue print, which one needs in planning for the methods to be adopted in collecting the relevant data and techniques to be used in the analysis and in the implementation of the research project.

Providing a Framework to Other Experts – Research design provides a framework of the entire research process. With the help of the research design, one is able to obtain help and assistance from the other individuals. The design helps the investigator to obtain ideas

and perspectives, which are necessary to carry out the tasks and functions of the research project in a well-organized manner.

Providing a Direction – Within the course of implementation of research project, there are number of procedures and functions that the individuals have to carry out. The implementation of an effectual research design, helps the researchers to obtain a direction, which would assist them in carrying out their operations effortlessly.

Characteristics of a Good Research Design

The main characteristic of the good research design is to minimize prejudice and maximise the reliability of the data collected and analysed. The design that produces minimal faults is stated to be the best design. Similarly, the design which yields the maximum information and provides the opportunity for considering different aspects of the problem is considered as the most appropriate and efficient design. Characteristics of the good research design have been stated as follows: (Pandey, & Pandey, 2015).

Objectivity – It refers to the findings related to the methods of data collection and the scoring of responses. It should allow the measurement of instruments, which are primarily objective. In other words, the objectivity of the procedure may be judged by the degree of agreement, between the final scores assigned to different individuals by more than one independent observer. This ensures the objectivity of the collected data, which can be analysed and interpreted.

Reliability – It refers to the consistency throughout the series of measurements. The respondents need to be reliable and consistent, when they are giving their responses. He should give the same response to the items, even if he is asked repeatedly to provide the same answers. The researcher needs to frame the questionnaire in a manner that it should generate reliable and consistent responses.

Validity – Any measuring device or instrument is stated as valid, when it measures, what it is supposed to measure. For instance, the purpose of the research study is to obtain information regarding different kinds of teaching methods used within the classroom setting. Therefore, the questionnaire should be framed with all the items related to the teaching methods. In this manner, when the survey instrument measures what it is expected to measure, it can be regarded as valid.

Generalizability – It means how the data collected can be utilized for drawing certain generalizations applicable to a large group from which samples can be drawn. Research design helps the researcher to generalize his findings. One has to be methodical and systematic in the preparation of research design. For ensuring generalization, the research

problem should be clearly formulated, clearly defined, appropriate techniques of sample selection are used in formulating a sample design, statistical tests have been implemented in an appropriate manner and findings of the study are capable of generalizations.

Adequate Information – Good research design should provide adequate information, so that the analysis of the research problem can be conducted on a comprehensive perspective. It should be in terms of identifying the research problem, objectives of the research, processes of obtaining the information, availability of skilled and proficient human resources and the availability of adequate financial resources for carrying out research. These factors are considered important in generating productive outcomes.

Other Features – Some of the other features of a good research design are, flexibility, adaptability, effectuality, well-organization, consistency, economy and so forth. Positivity within the research design renders an imperative contribution in the implementation of the research study. The research study is able to proceed towards the right direction and the researchers are able to generate productive findings. A good research design should minimize prejudice and maximise reliability and generalizability.

Steps within the Research Design

The important steps of the research design have been stated as follows:

Developing a Broad Research Plan (BRP) – Making a selection of an appropriate data collection techniques or a set of techniques are referred to as the most appropriate activities, when developing a broad research plan. Research problems and questions can be divided into four types, exploratory, explanatory, descriptive and predictive. Exploratory is to investigate less understood phenomenon and to identify important variables; explanatory is to explain the forces, causing the phenomenon in question and to identify plausible causal networks shaping the phenomenon; descriptive is to document the phenomenon, based on interest and predictive is to predict the overall outcomes of the phenomenon to forecast the events and behaviours.

Time Frame – Time frame and time management are regarded as important aspects when developing a BRP. Time needs to be spent in carrying out all the activities and tasks, related to the research study. Introduction, formulation of the research problem, preparing the research design, preparing the sample design, collecting the data, organizing the data, conducting the analyses, reporting the findings and preparation of the research report or the thesis. These tasks require the researcher to put into practice appropriate time management techniques.

Conducting a Pilot Study – Conducting a pilot study is a draft research plan that allows the researcher to test several variables and scrutinize the initial problems, before planning for the BRP. The main purpose is to learn about the research process, interview schedule, observation techniques and so forth. The variables being tested thus include, the methods of data collection, the time frame of the investigation and the materials and tools that are used within the research study.

Types of Research Design

The various types of research designs have been stated as follows:

Exploratory Research Design – It is a systematic and scientific approach. It provides ideas and hypothesis and contribute in the formulation of the research problem and hypothesis. It is more effectively used in the case of problems regarding which less knowledge is available. Survey of the literature, experience survey, which means the survey of the individuals, who have had practical experience with the problem to be studied and the analysis of the insight stimulating cases. It is the study, which is concerned with the subject matter, in which the hypothesis have not yet been formulated. The aim of the experience survey is to obtain insights into the nature of the problem and useful leads to the possible hypothesis. Insight stimulating method consists of the intensive study of selected instances of the phenomenon, which are in the area of interest.

Descriptive Research Design – Descriptive studies aim at portraying in an accurate manner the characteristics of the particular group or situation. It may be carried out in terms of an organization or an institution. Formulation of hypothesis, objectives, population, problem statement, collection of data and analysis of the data, all are part of the descriptive studies. Descriptive statistics are used to describe the basic features of the data within the study. They make provision of simple summaries about the sample and the measures. They form the basis of the quantitative analysis of data (Descriptive Statistics, 2015).

Diagnostic Research Design – The diagnostic research design refers to the scientific differentiation among various conditions or phenomenon, for the purpose of accurately classifying these conditions. It corresponds to the fact finding aspect of clinical practice. Its objectives include screening, classification, personality description, prediction of outcome and attainment of insight by the client. It leads to the discovery of relevant variables that are associated with it in varying degrees. Data for diagnosis can be obtained in four major ways, a case history or the interview, clinical observation, informal testing and formal standardised testing. These are not accomplished simultaneously.

Experimental Research Design – The purpose of this research design is to test the hypothesis for the causal relationship between the variables. For this study, two groups are required and compared in terms of the assured effect of the experimental variable conditions. These are determined, which makes the effect of the given event or effect probable.

Important Concepts within the Research Design

Dependent and Independent Variables - A concept which can take on different quantitative values is called a variable. Qualitative phenomena or the attributes are also quantified on the basis of presence or absence of the concerning attributes. If one variable depends upon or is a consequence of the other variable, it is termed as a dependent variable, and the variable that is antecedent to the dependent variable is termed as an independent variable (Kothari, 2004).

Extraneous Variables - Independent variables that are not related to the purpose of the study, but may affect the dependent variables are termed as extraneous variables. Suppose the researcher wants to test the hypothesis that there is a relationship between children's gains in social studies achievement and their self-concepts. In this case, self-concept is an independent variable and social studies achievement is a dependent variable. Intelligence may as well affect the social studies achievement, but since it is not related to the purpose of the study undertaken by the researcher, it will be termed as an extraneous variable (Kothari, 2004).

Discrete Variables – Discrete variables are those, which are finite or exact and not normally fraction. Examples are, children within the household, rooms in a building, test scores in an exam, children in class etc. These are numbers like one, two etc. The variable is stated to be of discrete type, when there are differences between one value and the next.

Continuous Variables – These are those variables that one in units of measurement, which can be broken down into infinite gradations. The examples are, heights, weights, income, rainfall etc. They are capable of manifesting every conceivable fractional value. They fall in any numerical value within a certain range.

Control - The technical term 'control' is used when one designs the study, and minimises the effects of extraneous independent variables. In experimental researches, the term 'control' is used to refer to restrict the experimental conditions (Kothari, 2004).

Confounded Relationship - When the dependent variable is not free from the influence of extraneous variables, the relationship between the dependent and independent variables is stated to be confounded by extraneous variables (Kothari, 2004).

Research Hypothesis - When a prediction or a hypothesised relationship is to be tested by scientific methods, it is termed as research hypothesis. The research hypothesis is a

predictive statement that relates an independent variable to a dependent variable. A research hypothesis must contain, at least, one independent and one dependent variable. Predictive statements, which are not to be objectively verified or the relationships that are assumed but not to be tested, are not termed as research hypothesis (Kothari, 2004).

Experimental and Non-Experimental Hypothesis Testing Research - When the purpose of research is to test a research hypothesis, it is termed as hypothesis testing research. It can be of experimental design or of non-experimental design. Research in which the independent variable is manipulated is termed as experimental hypothesis testing research and a research in which an independent variable is not manipulated is called non-experimental hypothesis testing research (Kothari, 2004).

Experimental and Control Groups - In an experimental hypothesis testing research, when a group is exposed to usual conditions, it is termed as control group, but when the group is exposed to some novel or special condition, it is termed as experimental group (Kothari, 2004).

Treatments - The different conditions under which experimental and control groups are put are referred to as 'treatments'. The two treatments are the usual studies programme and the special studies programme (Kothari, 2004).

Experiment – Experiment is the process of examining the truth of the statistical hypothesis, related to some research problem. There are two types of experiments, absolute and comparative. Comparative experiments are more frequently used in the designing of research (Kothari, 2004).

Experimental Units – The pre-determined plots or the blocks, where different treatments are used are known as experimental units. One has to be cautious in the selection and determining of experimental units (Kothari, 2004).

Chapter 5. Research Methods

Research methods are the tools and techniques for doing research. They represent the tools of the skill, and make provision of the ways to collect, sort and analyse the information, so that one can come to certain conclusions. If one makes use of the right sort of methods for a particular type of research, then one should be able to satisfy the other individuals that the conclusions have some validity, and that the new knowledge that one has produced is thoroughly based (Walliman, 2011). The different research methods have been stated as follows: (Walliman, 2011).

Historical

This method aims at a methodical and organized evaluation and synthesis of evidence to generate facts and draw conclusions about the past events. It uses primary historical data, such as archaeological remains as well as documentary sources of the past. It is necessary to put into practice the tests in order to check the authenticity of these sources. Apart from informing the individuals about what happened in previous times and re-evaluating beliefs about the past, historical research can be used to find contemporary solutions based on the past and to inform the present and future trends. It focuses upon the significance of interactions and their effects.

Descriptive

This method relies on observation as a source of data collection. It attempts to examine situations to establish the norms, i.e. what can be predicted to happen again under the same circumstances. Observation may take many forms. Depending upon the type of information sought, individuals are interviewed, questionnaires are distributed, visual records are made, and sounds and indications are recorded. What is important in this case is, the observations are written down or recorded in some way, so that they can be subsequently analysed. The scale of the research is influenced by two major factors, i.e. the level of complexity of the survey and the scope or extent of the survey.

Correlation

This method is used to examine the relationship between two concepts. There are two broad classifications of relational statements: an association between two concepts, where there is some kind of influence of one on the other and a causal relationship, where one causes, changes to take place in the other. Causal statements describe, what is sometimes called ‘cause and effect’ relationship. The cause is referred to as an ‘independent variable’, the variable that is affected is referred to as a ‘dependent variable’. The correlation between

two concepts can either be none (no correlation); positive, i.e. where an increase in one results in the increase in the other, or decrease results in a decrease; or negative, where the increase in one results in the decrease in the other or vice versa. The degree of association is often quantifiable.

Comparative

This method, fundamental to the classic tradition is substantially dependent upon history. The approach consists of comparisons being drawn between different societies, with the perspective of explaining the variation in the social structure and culture. This comparison must involve in principle, the societies of the past as well as of the present. It is used to compare the past and present or different parallel situations, particularly when the researcher does not have any control over the events. It can look at situations at different scales, macro comprises of international, and national and micro consists of community, and individual. Analogy is used to categorize the similarities to predict the results, assuming that if two events are similar in certain features, they could well be similar to others as well. In this way, comparative design is used to explore and test the conditions that were necessary to cause certain events, so that it is possible, to understand the effects of making certain decisions.

Experimental

Experimental methods can be used to study causal relationships. This is primarily due to the use of true experimental designs, which make use of equivalent comparison groups, allowing manipulation of experimental variables and controlling influences on the dependent variables. This method attempts to separate and control every pertinent condition, which determines the events explored and then observes the effects, when the conditions are manipulated. At its simplest, changes are made to an independent variable and the effects are observed upon the dependent variable, i.e. cause and effect. Although experiments can be implemented to discover a particular event, they usually require a hypothesis or prediction to be formulated first, in order to determine what variables are to be tested and how they can be controlled and measured. There are several classes of experiment, i.e. pre, true, quasi, etc. which are categorized by the amount of checking and control involved in the methods.

Simulation

Simulation involves formulating a representation in a small and simplified form (model) of a system, which can be operated to measure effects. It is similar to experimental methods in respect of this operation, but it provides a more simulated environment in that, it does work with original materials at the same scale. Models can be mathematical or physical, or working with two or three-dimensional materials. The performance of the model must be

checked and standardized against the real system to check that the results are consistent. Simulation enables the testing of theoretical situations.

Evaluation

Evaluation method is a descriptive type of research. It is specifically designed to deal with complicated social issues. It aims to move beyond obtaining the facts, by making an attempt to make sense of the multiple human, political, social, cultural and appropriate components involved. There are a range of different approaches of evaluation models. For example, systems analysis, which is a holistic type of research looking at the complicated interaction of many variables, and responsive evaluation, which necessitates a series of investigative procedures to evaluate, how responsive a program is to all those taking part in it. A common purpose of evaluation research is to scrutinize the working of projects from the point of view of levels of cognizance, costs and benefits, cost-effectiveness, attainment of objectives and quality assurance. The results are normally used to prescribe changes to improve and develop the situation.

Action

Action research method is fundamentally an 'on the spot' procedure. This method is primarily designed to deal with a precise problem found in a particular situation. When there are occurrence of any kinds of problems or difficulties, then the individuals are required to put into operation, action research. In the present existence, there has not been any attempt made to separate the problem from its framework in order to study it in separation. What are thought to be the meaningful changes, in order to bring them about, constant monitoring and evaluation are carried out to observe the effects of the changes. The conclusions from the findings are applied directly, and further scrutinised to measure their efficacy. Action research depends primarily on observation and behavioural data. The reason being, it is so bound up in a particular situation, it is difficult to generalize the results, i.e. to gain confidence that the action will be successful in another framework.

Ethnological

Ethnological research focuses on individuals. In this approach, the researcher is interested in how the subjects of the research interpret their own behaviour rather than imposing a theory from outside. It takes place in the uninterrupted natural settings of the environment to which the subjects belong. It regards the framework to be as equally important as the accomplishments it researches upon, and endeavours to represent the entirety of the social, cultural and economic situation. Much of the culture is unknown and seldom made explicit and the cultural background and assumptions of the researcher may influence

the interpretations and descriptions. Moreover, there can be misunderstandings produced by the use of language and the different meanings, which may be given to words by the respondents and the researchers.

Feminist

This is more of a perspective than a research method that involves theory and analysis that highlight the differences between the lives of men and women. Researchers, who disregard these differences usually obtain improper conclusions. However, all individuals are males or females, so value neutrality is difficult as no researcher practises research outside his or her system of values. There are not any specific methods that are considered to be particularly feminist, but the methodology used is informed by theories of gender relations. Although feminist research is undertaken with a political assurance to recognize and transform gender relations, it is not individually political, but exposes all methods of social research as being political.

Cultural

Most of the prevailing theoretical debates, e.g. post-modernism, post-structuralism etc. are concerned with the subjects of language and cultural interpretation. Cultural research provides methodologies that permit a reliable analysis of the cultural manuscripts so that they can be compared, replicated, contradicted and comprehensive. Examples of approaches to the interpretation of cultural texts are, content analysis, semiotics and discourse analysis. The meaning of the term 'cultural texts' has been widened from that of purely literary works to that of the many different forms of communication, both formal such as opera, TV news programs, parties etc., and informal, such as how people get involved into communication processes.

Ex-Post Facto Research

It is a systematic empirical inquiry, in which the researcher does not have direct control of independent variables. The reason being, their manifestation has already taken place or because they are fundamentally not well-regulated. The researcher's control upon the behaviour of the independent variables is in a weak condition. In many cases, it is not possible to exercise any control, it has to take things as they are and examine separately their impact upon the explained variables. It may be carried out on a limited scale or on a large scale. It depends upon the research techniques and the nature of investigation.

Chapter 6. Methods of Data Collection

The task of data collection begins, after the research problem has been defined and the research design has been adequately formulated. The data collected in research is primarily of two types, primary and secondary. Primary data is the one, which the researcher collects for the purpose of the enquiry being pursued. It is original in character, collected for the first time for the given investigation. Secondary data is the one, which has been collected before by someone else, in other words, it is not new. Published and unpublished sources are the tools for collecting secondary data. Internal source data is generated by the government departments and individual organizations. The areas in terms of which this data is generated include, production, sales, salary, profit, wage, dividends etc. On the other hand, external source data is the information gathered from outside agencies. It can be obtained from either primary or secondary source. It can be gathered by sample or census method, and by conducting investigations and surveys.

Primary Data – For the collection of primary data, there are certain methods that have to be implemented by the researchers and these have been stated as follows:

Observation

Observation is a deliberate study through an eye. It is used as one of the methods for scrutinizing collective behaviour and complex of institutions as well as separate units comparing of totality. Observation is a careful and systematic viewing of facts, as they occur with regards to the cause and effect mutual relations. There are three types of observations, participant or non-participant, controlled or uncontrolled and structured or unstructured observation. In participant observation, the observer becomes a member of the group and actively participates in all the activities of the group. In non-participant observation, he stays isolated and observes the phenomenon, as it occurs.

Controlled observation is the universal experience of every science that the perception of the individual observer must be corrected in various ways. Checks on biases and vagueness must be built into this research. Uncontrolled observation is made in the natural environment, without being influenced by outside controls or external forces. In structured observation, careful definition of categories is used, under which the information is to be recorded. It is used in studies designed to provide systematic description or to test causal hypothesis. In unstructured observation, careful definition of units is to be observed, information is to be recorded, the selection of pertinent data is used for observation and the conditions for observation are standardized.

Mail Questionnaire

Mail questionnaire is one of the most frequently used and controversial techniques in applied social science research. Much of the controversy relates to the problems and difficulties involved in the achievement of response rates, high enough to ensure representativeness (Duncan, 1979). In this method a questionnaire is prepared, which comprises of questions in terms of the area of study and demographic information of the respondents. It is sent to the respondents for them to fill out. There are two types of questionnaires, structured and unstructured. Structured or standardized questionnaire contains definite and direct questions to obtain more additional responses. Unstructured questionnaire is often called the interview guide, which is primarily used for in depth and non-directive interview. Identification of information, social background and factual data and the subject matter of the survey are the kinds of questionnaire items.

Schedule

The enumerator is appointed by the investigator to collect the data. He communicates with the respondents, gets replies to the questionnaire items from them, but fills up the questionnaire by himself. There are four types of schedules: observation schedule contains specific topics, upon which the observer has to deal with the nature of information that has to get recorded. Rating schedule is used to measure the opinion or attitude. It is used in sociological or psychological researches. Document schedule is used for recording the data from written documents, such as diaries, autobiography or official records maintained by the government. Interview schedule is the schedule that is used for interview purpose. It contains standard questions that are meant to be asked to the interviewee, in order to obtain information from him.

Direct Personal Interviews

Direct personal interviews are oral communications, which are usually carried out face to face between the researcher and the respondent. In this case, open ended as well as close ended questions are asked to obtain the responses. Questions are primarily asked pertaining to enquiry and the information is collected. There are two types of interviews, structured and unstructured. Structured interviews are those that involve the use of the set of pre-determined questions and standardized techniques of recording. It mostly involves the use of fixed alternative questions and open-ended questions. On the other hand, unstructured interviews are characterised by the far greater flexibility of approach to questioning the respondents. They involve relatively much lesser standardization of relevant techniques and procedures.

Indirect Oral Investigation

Under this method, the investigator collects the data in an indirect manner by interviewing the third persons, who are supposed to be in close touch with the original informants or the incidence. This method of data collection is adopted, when the original informants are either not found or found to be hesitant to part with the desired information, or the incidence concerned is not available. Such type of method, generally adopted by the enquiry committees is not accessible. Such type of method is usually adopted by the enquiry committees or commissions appointed by the government, central or a state. In this type of enquiry, normally a small list of questions is prepared and the individuals involved with the matter, known as witnesses are independently invited and asked to provide answers to the questions. The replies given by them are recorded methodically by the investigatory. The accuracy of the data collected under this method would depend upon the individuals selected for interrogations and depositions (Indirect Oral Investigation Method, 2017). In this case, the researcher contacts the third parties or the witnesses, who are capable of providing the required information.

Information from Correspondents

The use of correspondence in qualitative research has traditionally been limited to a supporting role (Harris, 2002). The main part has been the collection of data. The researcher appoints correspondents in different areas and regions for the purpose of collecting information on his behalf. They collect the information and provide the same to the researcher. The correspondents may make use of different techniques and methods in order to collect data from the respondents. They may either use survey questionnaires or interviews. The information that has been collected orally is noted down by them and provided to the researcher.

Secondary Data – The collection of information through the documents concerning the institutions or the individuals are known as secondary or documentary sources. These sources normally represent social conditions, systems and incidents. The information collected through these sources are useful and efficient. These sources also provide information concerning the past, which is not possible to obtain through any other source. The historical background is necessary to become aware of and it can be known through documentary sources, which include, books, memories, survey scripts, letters and diaries along with historical inscriptions and materials published in the newspapers and magazines from time to time. Secondary data is the data, which is used for research studies and it is not necessary to conduct special surveys and investigations. One can obtain statistical

information from other institutions, or reports, which are already published by them as part of their routine work. This data may either be published or unpublished and it saves time and money. Published sources include, Government publications, publications of international organizations, semi-official publications, private publications and reports of committees and commissions.

Chapter 7. Scaling Techniques

The problem to which scaling techniques are applied is that of ordering a series of items along some sort of continuum. They are the methods of turning a series of qualitative facts referred to as attributes into a quantitative series, referred to as variables. Problems, which are common to all types of scaling are, definition of continuum, reliability, validity, weighing of items, nature of the items and equality of the units. Standards for scaling is that great care needs to be taken to achieve a high degree of reliability and validity. Scaling is the ability to assign numbers to the objects in such a manner that the numbers reflect the relationship between the objects with respect to the characteristics involved. It allows the researchers to make a comparison of quantity and transformation in the items being measured. Measurement is described as a way of obtaining symbols to represent the items in terms of the individuals, objects, events or states under the study. The symbols have the same relevant relationship to each other, as do the things represented (Kumar, n.d.). The various types of scales have been stated as follows: (Ghosh, n.d.).

Measurement Scales

There are four types of measurement scales, i.e. nominal, ordinal, interval and ratio.

Nominal - A nominal scale consists of two or more termed categories into which individuals, objects or responses are classified. In a nominal scale, it is possible to differentiate between two or more categories relating to the specified attribute. The members of these categories differ with respect to the identified attribute, which is being measured. It is a simple method of classification rather than an arrangement along a continuum. The question of dimension is not important in this type of scale. If preferred, the different groups may be numbered. Classification of individuals according to religion is an example of nominal scale.

Ordinal – In an ordinal scale, numbers, i.e., 1,2,3 etc. are allocated to specify only the relative position. The scale purports to give ranks to the individuals along the specified continuum. It does not measure the distance between the positions. It is essential to determine the order of position, in terms of more or less, and so forth in relation to the attribute, which is being measured. For instance, X is regarded as more rational than Y. The ordinal scale can indicate only a person's relative position, but it cannot cardinally measure the differences between persons. One can say, for example, X is greater than Y, but the extent of greatness cannot be predicted.

Interval - This scale has equal units of measurement and it is possible to understand, not only the order of scale scores but also the distance between them. Thus, two persons with scale positions of four and five are different as two persons with scale positions of 10 and 11. A person having the score of 10 cannot be regarded as twice higher or better than a person, whose score is five. In an interval scale, the intervals remain equal.

Ratio - This scale incorporates the properties of an interval scale along with a fixed origin or zero point. Weights, lengths and times are noticeable examples. On the basis of a ratio scale, one can compare both differences in scores and the relative magnitude of scores. For instance, the difference between ten and fifteen minutes is the same as that between fifteen and twenty minutes, and ten minutes is twice as long as five minutes.

Rating Scales

While preparing a rating scale, the individual places the other individuals at a particular point along a continuum, and a numerical value is attached to the point. There are three types of rating scales, graphic rating scale, itemised rating scale and comparative rating scale.

Graphic Rating Scale – Under this method, the individuals indicate their rating by putting a check mark against the point that is chosen by him for measuring the attribute and specifying the points from lowest to highest. The individuals are able to indicate their own preference. It is a simple and a suitable device to use and ensures a fair level of quality in scoring.

Itemised Rating Scale - This is also known as the specific category scale or numerical scale. In this scale, the individual has to select one of the limited number of categories that are in order of their scale position. Generally, in such a scale, there are five or seven categories. As a general rule, the more evidently defined the categories, the more reliable are the ratings. The number of specifications, however, depends upon the nature of the research problems.

Comparative Rating Scale - In the case of comparative rating scale, the positions on the rating scale are explicitly defined in terms of a given population or group, or in terms of people with known characteristics. The comparative ability of the individual or the group in question may be expressed in terms of percentage. The individual must have a clear knowledge of the abilities of the given groups or individuals.

Rank Order Scales

In this method, a person is required to rank the subjects or the individuals specifically in relation to one another. He indicates, which person rates the highest in terms of the

characteristics being measured, which person is the second highest and so forth. When the person may himself be the subject of rating, this is called self-rating. The method of rank order scales is paired comparison.

Paired Comparison - This is a simple method of ranking scale. In this type of scale, two stimuli are presented before the evaluators, out of which the other one is to be selected. The continuum is defined in an appropriate manner. The ranks for different types of jobs, for instance, in accordance to the qualifications of the individuals, can be determined. The researcher can make several pairs of jobs available. The respondents may be required to give preference to the jobs in accordance to their judgment. After all the pairs have been considered, any possible discrepancy may be located. This is a simple method and can be made more meaningful by constructing a paired comparison matrix.

Attitude Scales

In this type of scale, the attitude of the person towards a matter, thing, object or system can be known from the score of the responses expressed in a survey questionnaire. There are five types of attitudes scales, these are point scale, differential (Thurstone) scale, summated (Likert) scale, cumulative scales and scalogram scale.

Point Scale – In this scale, at first the selection of the words is made, regarding which the opinion of the respondents is required. One point is to be given to an agreement or disagreement, whichever is to be selected. In accordance to this method, the attribute of the respondents is known by calculating the number of words crossed or not crossed. The words selected depict the attitudes of the respondents and the opposite words should also be given at the same time.

Differential (Thurstone) Scale - This scale is associated with the name of L.L. Thurstone. Hence, this is also known as Thurstone scale. In this scale, a number of statements, whose position on the scale has been regulated by the evaluators, is used. The position is determined by the method of equal appearing intervals. Thurstone scale thus consists of a series of statements, whose positions have been fixed impartially by the evaluators. At the time of administration of scale questionnaire, the respondents are asked to check the statement or statements, with which they agree. The scale values are not shown in the questionnaire and the statements are prepared randomly.

Summated (Likert) Scale - This type of scale is primarily used in the measurement of social attitude and was first devised by Likert. Hence, it is known as Likert type scale. It uses only the positive and negative statements and excludes the intermediary views. This scale consists of statements in terms of which the respondents are required to express their

responses. The respondent specifies the degrees of agreement or disagreement. Each response is given a numerical score, and the total score of a respondent is found out by summing up his different scores for different responses. The total score indicates the position of the respondents on the continuum. The Likert scale uses several degrees of agreement or disagreement, for example, strongly agree, agree, not sure, disagree, and strongly disagree. The scale would comprise of these five points.

Cumulative (Bogardus) Scale – The cumulative scale was used by Bogardus, hence, it is known as the Bogardus social distance scale. In a cumulative scale, a respondent is provided with a number of questions to express his responses in agreement or disagreement. The items are organized in a manner that a respondent, who responds positively to item two also responds positively to item one. When a respondent responds positively to item three also responds positively to items one and two, and so on. The respondents, who give positive responses will have a higher total score as compared to the other, who do not give positive responses. The score of an individual is calculated by counting the number of items regarding which he expresses positive responses. His scores specify for him a particular position on the scale. The intervals between the positions may not be equal. The items may be organized in a systematic manner or randomly.

Scalogram Scale – This scale is constructed by the method of internal consistency. It contains more than one dimensions. This scale only gives a simple measure for the definition of what it actually measures. The items that it measures are always open to question. A scale might include a small cone, a medium sized sphere or a large cube. If more knowledge is required, then the volume is inadequate and the items must be scaled. None of which may include the combination of other dimensions. They could not be scaled by shape, since this is non-metrical, but they could be scaled by height, breadth or depth. These are also termed as uni-dimensional scales. Volume may be satisfactory, if that is all that is anticipated.

Chapter 8. Sampling Design

The selection of the sample is important in conducting research. The ways that are implemented in the selection of the respondents will determine the population in which one may generalize the research findings. The procedures that one uses in assigning the respondents to different treatment conditions, will determine, whether there is existence of prejudice within the treatment groups. Selection of some elements from the population is known as a sample (Chapter 7, n.d.). In the formulation of the sampling design, the following steps need to be taken into account: (Kothari, 2004).

Type of Universe

In the sampling design, the most important step is to identify the universe, which can be finite or infinite. In finite universe, the number of items are certain, examples, include, population in the city, number of workers in a factory. On the other hand, in the case of an infinite universe, the number of items is infinite, i.e. one is unable to obtain idea of the total number of items. Examples include, listeners of a specific radio program, etc.

Sampling Unit

The sampling unit may be a geographical one, such as a state, district, village etc. Construction unit such as a flat, house or a social unit, such as an association, family, school etc. have to be decided before the selection of the sample. The sampling units that are selected for the research study may be one or more.

Source List

Source list includes all the items, selected from finite universe only. It is also known as ‘sampling frame’ from which sample is to be drawn. It contains the names of all items of a universe in this case, only finite universe are taken into account. If source list is not available, researcher has to prepare it. Such a list should be broad, accurate, precise, consistent and appropriate. It is important for the source list to be representative of the population to a large extent.

Size of the Sample

This refers to the number of items to be selected from the universe to constitute a sample. The size of the sample should neither be excessively large, nor too small. It should be optimum. An optimum sample is the one, which fulfils the requirements of efficiency, representativeness, reliability and flexibility. While deciding the size of the sample, researcher must determine the desired accuracy as also an acceptable confidence level for the estimate. It is vital to consider the size of the population variance. In the case of larger

variance, usually a bigger sample is needed. The size of the population must be kept in view for this also limits the sample size. The parameters of interest in a research study must be kept in view, while deciding the size of the sample. The budgetary constraint must be taken into consideration when deciding the sample size.

Parameters of Interest

In determining the sample design, one must consider the question of the specific population parameters, which are of interest. For instance, one may be interested in estimating the proportion of persons with some characteristics in the population, or one may be interested in knowing some average or the other measure concerning the population. There may also be important sub-groups in the population about whom one would like to make estimates. All this has a strong impact upon the sample design that researchers would accept.

Budgetary Constraints

It is vital to take into consideration the specific population parameters, which are of interest, when determining the size of the sample. Cost considerations do have an impact upon the size and type of the sample. Cost considerations, from practical point of view, have a major impact upon the decisions relating to not only the size of the sample, but also to the type of sample. This fact can even lead to the use of a non-probability sample.

Sampling Procedure

Finally, the researcher must decide the type of sample i.e., the techniques to be used in selecting the items for the sample. In fact, this technique or procedure stands for the sample design itself. There are various sample designs, out of which the researcher must select one for his study. He must select that design which, for a given sample size and for a given cost, has a smaller sampling error. It is vital to decide upon the techniques that are used in the item selection of the sample, this is termed as sampling procedure. It is vital that sample should resemble the population, when the sample size is larger, and the method that is used to select the sample utilizes the random process (Chapter 4, n.d.).

The selection of suitable sampling methods are required for successful research. It is of utmost significance to make use of suitable sampling methods that are required for conducting successful research. Different sampling methods are made use of in collecting various kinds of information for research purposes. When conducting research, one or more sampling methods are used for this purpose. One should possess adequate knowledge of the tools, their nature, merits and limitations (Tools of Research, n.d.). Sampling methods may be classified into probability sampling methods and non-probability sampling methods (Alvi, 2016).

Probability Sampling Methods

Probability sampling is also called random sampling or representative sampling. In this case, every member of the population has the non-zero probability of being included in the sample. Some form of random selection is used. The probabilities can be assigned to each unit of the population objectively. The population has to be defined in a systematic and methodical manner in this case. When the population is too general, then these techniques cannot be made use of. In this case, probability sampling can be made use of, as the population is specifically defined and is limited to an infinite number of components (Alvi, 2016). The different types of probability sampling methods have been stated as follows (Alvi, 2016).

Simple Random Sampling - In this type of sampling, each and every element of the population has an equal chance of being included within the sample. The population must contain a finite number of elements that can be itemized or represented. Every element must be mutually exclusive i.e. able to differentiate from one another and does not have any intersecting or corresponding characteristics. The population must be homogenous i.e. every element should contain the same kind of features that meets the defined criteria of the target population.

Systematic Random Sampling – This type of sampling is also used for homogeneous population. It is slightly different from simple random sampling. Unlike simple random sampling, there is not an equal probability of every element of the population to be included. In this type of sampling, the elements are selected at a regular interval. The interval may be in terms of time, space or order. For instance, element appearing after every 30 minutes, or present at a distance of two meters, or every fifth element present on a list. Thus this orderliness, consistency and standardization in selection makes the sampling systematic. The list of components may or may not be required before the research is put into operation. In some cases, it is not even possible to form a list, because of the nature of population.

Stratified Random Sampling – This type of sampling method is used, when population is heterogeneous, i.e. every element of the population is not in accordance to all the features of the predefined principles. Instead the elements differ from one another on the basis of features. So the sub-groups created are homogenous i.e. all the elements within a group have same types of features. The sub-groups are called as strata (single stratum). Common criterions used for stratification are gender, age, ethnicity, and socio-economic status. However, the principle differ on the basis of various research studies. This formation of strata can also be called a small reproduction of the population as each stratum consists of elements

that are different from the elements of other strata on the basis of some features. The sample is randomly selected from each stratum. There are two techniques used in allocating sample from strata, i.e. proportional allocation technique and equal allocation technique. In proportional allocation technique, the sample size of a stratum is made proportional to the number of elements present in the stratum. In equal allocation technique, same number of participants are drawn from each stratum, irrespective of the number of elements.

Cluster Sampling – The group of elements residing in one geographical region is called cluster. Sampling of clusters is called cluster sampling. This sampling technique is used when the elements of the population are spread over a wide geographical area. The population is divided into sub-groups called clusters, on the basis of their geographical distribution. Generally this division of the population is similar to what the standard of division has been used yet. For instance, population spread over a country is clustered up into the cities, population spread over a city is clustered up into the towns and so forth. The clusters ought to be homogenous among them on the characteristic variable of the research. However, for being truthfully representative sample, the selected clusters must capture the heterogeneity of the population. For instance, if in the selection of towns, only small towns are selected and not the larger ones, then the sample is not going to be a true representative of the population.

Multistage Sampling - It is a sampling technique, where two or more probability techniques are combined. It is used when the elements of the population are spread over a widespread geographical region. Obtaining a representative sample with only one aforementioned technique is not possible. It can be described as sampling within the sample. The final unit or element of the population, which is used in research is obtained after sampling at several stages.

Non-Probability Sampling Methods

Non-probability sampling methods are also known as judgmental or non-probability sampling. Every element of the population does not obtain an equal chance of being included in the population. The selection of the respondents is not made on a random basis. The selection of the sample is not made on the basis of subjective judgment of the researcher. The population is not specifically defined in this case. These techniques can be used for both types of populations, the population that is precisely defined and the population that is general. In this case, the sample of the population is selected, in which the elements are infinite in number (Alvi, 2016). The different types of non-probability sampling methods have been stated as follows: (Alvi, 2016).

Volunteer Sampling – In volunteer sampling, the members of the population have to self-select themselves for being the part of the study. It is not the researcher, who approaches the participants, but the participants themselves reach the researcher. The participants generate awareness regarding the investigation, through advertisements, notices and announcements. The ones, who are interested approach the researcher. This type of sampling is inexpensive, less time consuming, helps in gathering large amounts of data in limited time, with small efforts and for selecting the participants, the researcher does not have to make efforts. The limitations in this sampling are, it often encounters problems of generalization, systematic errors, and the individuals, who participate are the ones, who have an interest in the topic and they cannot be representative of the individuals, who are indifferent to it.

Convenient Sampling – It is also called accidental sampling or opportunity sampling. The participants included by the researcher are those, who are convenient to approach. The technique is beneficial, where the target population is defined in terms of comprehensive category. For instance, the target population may be girls and boys, men and women, rich and poor etc. Any member of the population, who is available at the moment is approached. He or she is asked to participate in research and if, they give their consent, the investigation is pursued. This type of sampling is inexpensive, consumes fewer efforts and is less time consuming as the sample is manageable to approach. The limitations are, it is subjected to biases and systematic errors. The categories of the target population are, comprehensive enough to be divisible into infinite number of categories within themselves, which are contrastingly different from one another and cannot at any cost be representative of each other.

Purposive Sampling – Purposive sampling is not a reciprocally exclusive category of the sampling technique, rather many other non-probability techniques are purposive in nature. In fact William M. Trochim divided non-probability techniques into two broader categories: convenient and purposive. Therefore, all the other types of sampling techniques are described under the heading of purposive sampling. In purposive sampling, the sample is approached taking prior objective into consideration. The standards of the elements, who are to be included within the study are predefined. Hence, in this case, only those respondents are included, that are in accordance to the defined conditions.

Quota Sampling - This type of sampling method is used, when population is heterogeneous i.e. every element of the population is not in accordance to all the features of the predefined criteria. Instead the elements differ from one another on the basis of a characteristic. So the sub-groups are formed that are homogenous i.e. all the elements within

a group contains same types of features. The topic and the nature of research communicates on what criterion, quota is to be set. Common criterions used for quota are gender, age, ethnicity, socio-economic background and so forth. There are differences among situations and principles among researchers. The participants are selected non-randomly from each sub-group on the basis of some fixed quota. There is a need to recognize the variables, which makes the target population heterogeneous. Sub-groups are formed on the basis of the identified variable. A quota is set for each sub-group, then the sample is approached on the basis of set quota. This sampling method ensures the presence of every sub-group of the population in the sample. The lists are not required, relating to any of the elements of the population. It is less time consuming and low in cost than stratified random sampling. The major limitation is, this sample is not representative and encounters the problem of generalizability.

Snowball Sampling – It is also called as chain sampling. One element of the population is approached at a time and then the researcher has to refer to the other elements of the population. The researcher makes selection of the individual, who meets the conditions. The first participant is asked to refer the researcher to another person who, meets the same conditions. Now the second participant approached is asked to refer the researcher to another one, in this way, a chain is made. This chain is useful in approaching the type of population, which is not available or present in small quantities. The major limitation is, it is subjected to sampling bias and systematic errors due to network connection.

Matched Sampling – This method is used in experimental researches. The main purpose of this sampling is to take a control group to evaluate the effects of the participation. The selection is made of two groups of elements that resemble on the basis of variety of variables. Intervention is introduced on only one group. The other group is used to compare with the first one to view the impacts of the interventions produced. In this case, first one element is judged to be the part of research and then the other element is explored that resembles the variety of first one, on a number of variables. This method makes it possible to examine, if the intervention has actually proved to be beneficial. The major limitation is, in the selection of the matching element, care must be taken and they must be matched on every possible influencing factor, so that it may be claimed that the changes in the two elements are due to introduced intervention and not on the basis of any other factors.

Genealogy Based Sampling - This sampling method has been used in most cases for obtaining samples from rural areas. This method is primarily used in the selection of the members of the entire families, whether or not they are living in the same house, instead of

the entire households. It provides a rational cross section of the community by age and gender. In this case, first a participant is approached and is convinced to take part in the research. This participant is now asked to refer the researcher to his close relatives, who may be living in other areas. This sampling method is advantageous in obtaining the sample from traditional rural areas, where social and economic differences between the families are not many. The researcher is not required to motivate each respondent to participate in the research, instead one gets the respondents through the references. The major limitation is, there are higher chances of systematic errors within the cases, where the members of the family tend to be similar in comparison to the members, belonging to other families.

Chapter 9. Organization of Data

The quantitative information gathered by the research scholars in any field is never uniform. They always differ from one another, e.g. students in different sections, prices of vegetables and so forth. The data, which is gathered is in an unorganized form in schedules, questionnaires or any other written form. Hence, it is vital for the data to get appropriately organized. It is necessary to make the data suitable for comparison, appreciation and analysis by suitable and proper grouping and arrangement in a condensed form. When organization of data takes place, it is vital to possess information regarding the following steps:

Editing

Data editing is defined as the process involving two major steps. These include, revising and adjusting the data that has been collected. The collected data has to be edited and tabulated in a methodical and systematic manner. Its purpose is to control the quality of the collected data. This task can be carried out either manually or through making use of the computer (Editing in Research Methodology, 2015).

Classification

The classification of the data is another process, which means the process of grouping research data into various classes or sub-classes in accordance to the characteristics is called classification. The classified research information is arranged in a systematic series. The data that is classified in a significant manner facilitates statistical analysis. Classification is the process of arranging things either they are notionally or actually in groups in accordance to their resemblances and give expression to the unity of attributes that may subsist among the diversity of individuals. The grouping of research data in accordance to their resemblances, identity or similarity is called classi-facts. Examples may be, letters in the post office are sorted out in accordance to the cities of destination i.e. Delhi, Jaipur, Agra, Chandigarh etc. Similarly grouping of students may be done in accordance to their age, gender etc. Research data may be classified in accordance to their characteristics, i.e. chronological, geographical, qualitative and quantitative.

Quantitative Classification - In quantitative classification, the data is grouped with reference to the characteristics, which can be measured and numerically described. For example, weight, height, import sales, income, age etc. This type of classification is made in the formation of statistic series.

Frequency Distribution – It is a tabulation of values that one or more variables taken within the sample. It is a tabulation of raw data, obtained by dividing into classes of some size and computing the number of data elements. The horizontal axis from left to right or x axis, indicates the different possible values of some variable. The vertical axis from bottom to top measures the frequency or how many times a particular value occurs.

There are two methods of data classification in accordance to the class intervals:

Inclusive Method – In this method, the upper class limits of the classes are in respective classes. For instance, if the marks of the students are grouped into classes of 5-9, 10-14, 15-19 etc. In the group, 5-9, the first group of students are taken, whose marks are in between 5-9. If the marks are 10, then the student is taken in the next class.

Exclusive Method – In this method, upper limits are excluded. The upper limits of the class interval is the lower limit of the next class. For instance, if the marks are grouped as 5-10, 10-15, 15-20 etc. Then in the first group, the students are included, whose marks are five or more, but under 10.

Presentation

Statistics can be presented in tables, graphs, charts, maps or other diagrammatical forms. The representation of statistics in a diagrammatical form is a proper method of recording the functioning of facts. They indicate clearly and concisely the results obtained. The most symbolic and appealing methods of presentation of statistics should be used, so that the other individuals possess the awareness in terms of the library, without any kind of difficulty.

Interpretations and Generalizations

Generalization is the automating and customising the process, which derives a small scale map from a large scale data. If a hypothesis is tested and upheld several times, then it may be possible for the researcher to arrive at a generalization. The process of generalization lacks formalization. Algorithms are needed to perform the transformations required; the rules that create a linkage between data and specifications to the triggering of the algorithms and the specifications themselves. The representation of an interpretation in the languages of formal logic. If the researcher does not have a hypothesis, he may seek to explain his findings on the basis of some theory, it is termed as interpretation. The process of interpretation may quite frequently trigger off new questions, which may in turn lead to further researches. Plans

are having been worked upon to provide the business with a strategy and appropriate tools to build on demand generalization applications, running as automatically as possible.

Interpretation refers to the task of drawing inferences from the collected facts after an analytical and/or experimental study. In fact, it is a search for a comprehensive meaning of research findings. The task of interpretation has two major aspects i.e., the effort to form continuity in research through connecting the results of a given study with those of another, and the formation of some explanatory concepts. In one sense, interpretation is concerned with relationships within the collected data, partly overlapping analysis. Interpretation also extends beyond the data of the study to include the results of other research, theory and hypotheses. Thus, interpretation is the device through which the factors that seem to explain what has been observed by the researcher within the course of study can be understood in a better way and it also provides a theoretical conception, which can serve as a guide for additional researches (Kothari, 2004).

Reliability and Validity

Reliability and validity are the extent to which the test measures, what it claims to measure. It is vital for the test to be valid for the results to be accurately applied and interpreted. Reliability and validity is not determined by a single statistic, but by a body of research that demonstrates the relationship between the test and the behaviour, it is intended to measure. It is the criterion that is most critical and indicates the degree to which an instrument measures, what it is supposed to measure. Reliability refers to the repeatability of findings. If the study were to be done the second time, it would yield similar results, if the data is reliable. The examiners have to agree that the data is reliable by conducting a pre-test. Reliability also applies to individual measures (Reliability and Validity, n.d.).

When individuals take a vocabulary test twice, their scores on the two occasions should be similar. If so, the test can then be described as reliable. To be reliable, an inventory measuring self-confidence should give the same results, if given twice to the same person within a short period of time. Intelligence Quotient tests should not give different results over time, as intelligence is assumed to be a stable characteristic. Validity refers to the credibility and believability of the research. If data is valid, it must be reliable. If the scores obtained on the test by the students with the class are different then, the test is not likely to predict anything. However, if a test is reliable, that does not mean that it is valid. For example, one can measure strength of grip reliably, but that does not make it a valid measure of intelligence

or even of mechanical ability. Reliability is a necessity, but not a sufficient condition for validity (Reliability and Validity, n.d.).

Chapter 10. Data Analysis and Interpretation

Data analysis is the process of bringing order, structure and significance to the data collected. It is an ambiguous, time consuming, resourceful and an interesting process. Data analysis is referred to as a search for answers about relationships among various classifications of data. Data analysis is considered as an integral part of research in the implementation of a research project. During the initial stage, the data is in a natural form but after it is organized in a meaningful order, it takes the form of the information. The most critical and important supporting pillars of the research are the analysis and the interpretation of data. With the help of interpretation, one is able to achieve a conclusion from the set of gathered data. Interpretation has two major aspects, i.e. creating continuity in the research through connecting the results of the study with those of another and the formation of some relationship with the collected data. Interpretation can be defined as the method through which the factors, which seem to explain what has been observed by the researcher within the course of study, can be better understood. It provides a theoretical conception which can serve as a guide for additional research work (Chapter 4, Presentation, Analysis, n.d.).

Interpretation has acquired significance due to the following factors. It enables the researcher to acquire an in depth knowledge of the principles and standards behind his own findings. The researcher is able to acquire understanding of the findings and the reasons behind the existence. More understanding and knowledge can be obtained with the help of additional research. The researchers are able to obtain proper direction and guidance in relation to the research work (Chapter 4, Presentation, Analysis, n.d.). Gathering, modelling and transforming data with the objective of taking into account meaningful information, suggesting conclusions and supporting decision making.

Purpose of Data Analysis and Interpretation

The main purposes of data analysis have been stated as follows: (Pandey, & Pandey, 2015).

Description - It involves a set of accomplishments and functions that are as indispensable as the first step in the development of most fields. A researcher must be able to categorize a topic about which much information is not available. The researcher must be able to influence others about the purpose and significance of the study and must be able to collect data.

Construction of Measurement Scale - The researcher needs to construct a measurement scale. All numbers generated by measuring instruments can be positioned into

one of four categories: (a) Nominal: The number serves as nothing more than labels. For example, one was not less than two .Similarly two was neither more than one and nor less than three; (b) Ordinal: Such numbers are used to label an ordering along some magnitudes, such as, from less to more, from small to large, from sooner to later; (c) Interval: The interval provides more specific information than ordinal one. By this type of measurement, the researcher can make precise and significant decisions. For example, if A, B and C are of 150 cm, 145 cm and 140 cm height, the researcher can say that A is five cm taller than B and B is five cm taller than C and (d) Ratio Scale: It has two unique characteristics. The intervals between points can be demonstrated to be specifically the same and the scale has a conceptually significant zero point.

Generating Empirical Relationships - Another purpose of analysis of data is recognition of consistencies, uniformities and associations among data. The researcher does not have any idea about the relationship, which will be found from the data collected. If the data were available in specifics and facts, it will be manageable to regulate the relationship. The researcher can develop theories, if he is able to identify the arrangement and order of the data. The pattern may be showing association among variables, which may be done by calculating the correlation among variables or illustrating instruction, direction, precedence or importance. The origin of empirical laws may be made in the form of simple equations, relating one interval or ratio scaled variable to few others through graph methods.

Explanation and Prediction - Normally knowledge and research are connected with the identification of causal relationships and the research activities that are directed to it. But in many fields, the research has not been established to the level, where causal explanation is possible or valid predictions can be made. In such a situation, description and prediction is formed as enabling the values of one set of variables to be derived, given the values of another.

Data Analysis Plan

Data analysis has multiple aspects and approaches, encompassing diverse techniques under a variety of names in different business, science and social science domains. In most of the research proposals, a mixed methods approach is used. In this approach, the qualitative and quantitative techniques are combined. This approach can provide a better understanding of the problem than either approach alone. To ensure that the analysis is undertaken in a systematic manner, it is important to create an analysis plan. The analysis plan comprises of important information regarding the research questions and the various processes that will be implemented within the research study. Designing analysis for use within a project is based

upon the principle that the research aims to obtain understanding of the implementation processes, focusing upon the mechanisms that support or limit those processes; and communicate the understanding of the implementation process to multiple stakeholders, who may render their consequent contributions to the integration of the findings into the current and/or future research (Data, Analysis and Presentation, 2014).

There are two kinds of classification of data, qualitative and quantitative. In the case, of qualitative classification, data is not classified by numerical values and methods. In this case, abstract things like characteristics and attributes play a major role. These may be positive or negative in character. In quantitative classification, the problems under studies are quantified and measured accordingly. Magnitude plays an important role in determining the character of the data. Examples include, age, membership of the library, number of books etc. The variables obey mathematical treatment in the form of averages. It is essential that the analysis and the presentation of findings, be carefully considered to avoid potential interpretations that could lead to inappropriate conclusions and or responses. Focus should be put upon simplicity and interpretability. The reason being, individuals need to understand the information and should be able to interpret it appropriately. Data analysis and data collection processes should be carried out simultaneously (Data, Analysis and Presentation, 2014).

Designing Analysis by Purpose

When designing of the data analysis plan takes place, then it is important to clearly define the objectives of the analysis by identifying the specific issues to be addressed. When designing analysis by purpose, then emphasis should be put upon the following aspects: (Data, Analysis and Presentation, 2014).

Effectiveness – The main purpose of effectiveness is to bring about the modifications of the implementation procedures in order to bring about improvements in the generation of benefits. The major goal of every research project is to generate useful and meaningful findings and the information should be beneficial to the other individuals. The research topic that the researchers have undertaken should prove to be valuable and meaningful to them.

Efficiency – Efficiency refers to the attempts to evaluate the implications of possible modifications to the implementation process in order to increase the benefits in relation to the resources. In the research process, the researcher is required to ensure that in the implementation of various tasks and functions, the traits of competence, efficacy and adeptness are depicted.

Equity – Equity focuses upon distributional issues. This is how the distribution of benefits and resources takes place. In the distribution of resources, it is vital to ensure that all areas and functions are able to generate equal distribution of resources.

Sustainability – Sustainability focuses upon identification of potential inputs. In terms of the availability of these potential inputs, the individuals are able to identify their potential constraints and other possible barriers to medium and long term sustainability.

Quantitative Data Analysis

The analysis of quantitative data is the culmination of a long process of hypothesis formulation, instrument construction and data collection. Data may be interpreted and presented in completely verbal terms. This is especially in the case of observational studies, document analysis and ethnomethodology. Statistical analysis is considered to be of utmost significance. This is through the statistical software known as the Statistical Package for Social Sciences (SPSS). In this case, the various methods adopted include, frequencies, descriptive analysis, tests, standard deviation and measures of central tendency. Analysis is carried between two or more variables. Coefficient of Correlations is used to assess the strength of the relationship between two variables.

Quantitative data analysis will include one or more of the following considerations. These are, frequency distribution and summary statistics, relationships and confounding variables, sub-group analysis, statistical models, generalizing from samples to populations, and trend analysis. Variables in quantitative analysis are identified on their level of measurement. These include, rational, interval, ordinal and nominal. Quantitative research generates large volumes of data that require organizing and summarizing. These operations smooth a better understanding of how the data vary or relate to each other. The data reveals distributions of the values of study variables within a study population. For example, the number of children under six years of age in various households within a given population, daily patient attendance within a medical centre, the birth weights of children born in a particular health facility over a period of time, and educational levels of mothers of children born within a particular medical centre (Data, Analysis and Presentation, 2014).

Analysis of this type of data basically involves the use of techniques to summarize these distributions and evaluate the extent to which they relate to the other variables. For example, in a sample of infants, one may summarize the distribution of birth weights by calculating the frequency of low, normal and high birth weights, categorizing as normal, those in some standard range. If one also calculated the frequency of different education

levels for the mothers of those infants, one could then estimate the strength of a possible relationship between these two variables. The use of frequency distributions for this purpose has various advantages, meaningful for all types of variables, easy to elucidate and understand for the audiences without professional knowledge, and can be presented graphically and in different formats to assist analysis, e.g. tables, bar charts, pie charts, graphs, etc. (Data, Analysis and Presentation, 2014).

In summarizing quantitative data, description of tools are made use of. These include, frequency, mean, median, mode, standard deviation, percentage, and range. The ways that are used to present the data in this analysis, should make the results clear and easy to observe at a glimpse. Tables and charts are the two main ways of presenting the summary of data. The data in this analysis is primarily collected through the survey questionnaire. Therefore, the frequency of each response and the number of non-responses helps in interpretation. Survey results from a sample are an approximation of the results for the whole population and are unlikely to be accurately the same, if the survey were to be repeated. If you have used a probability sampling technique, it is advantageous to calculate the sampling error for the results (Analysing and Reporting Quantitative Data, n.d.).

Cross-tabulations can be used to examine any differences in the results between groups of interest, e.g. males and females. However, one should be careful, not to make too much of small differences in results as these are likely to be due to sampling error. A range of statistical tests, for example Chi-square are available to help one, when looking at the significance of any differences between results. Most software packages will be utilized in order to perform these tests, but it is important that the results are understood and interpreted appropriately. The final report needs to be clear, well-ordered, efficient and rational. The content of the report may vary in accordance to the subject areas. The main sections of the report include, executive summary, introduction, background, methods, findings, conclusions, recommendations and appendices, these include, tables for results and references and the copy of the questionnaire (Analysing and Reporting Quantitative Data, n.d.).

Qualitative Data Analysis

Data analysis is the process of bringing order, structure and meaning to the mass of collected data. Qualitative data analysis is a search for general statements about the relationships among different categories of data. Simple qualitative analysis include, structured, which is like a questionnaire, replicable but may lack richness; unstructured, are not directed by a script, they are rich but not replicable and semi-structured are directed by a

script, but stimulating and interesting matters can be discovered in more depth. These provide a good balance between richness and replicability (Data Analysis, Interpretation and Presentation, n.d.).

There are many ways of qualitative research and it has been argued that there cannot and should not be an unvarying approach to qualitative methods. Similarly, there are few agreed-on canons for qualitative data analysis, in the sense of common ground rules for drawing conclusions and verifying strength. Many qualitative research studies adopt an iterative strategy, collect some data, build initial concepts and hypotheses, test against new data, review concepts and hypotheses, and so forth. This approach implies that data collection and analysis are rooted in a single process and undertaken by the same individuals. However, with the increasing use of qualitative research in epidemiology and health research, objectives are pre-defined, prior to data collection. Qualitative data analysis can be done manually or with registered software like, Atlas-ti deals with large data sets, unstructured coding, mimic paper code and sort. N Vivo handles relatively lesser amount of data, caters for unstructured coding, and find patterns and relationships in codes. Max QDA offers influential tools for analysing interviews, reports, tables, online surveys, videos, audio files, images and bibliographical data sets (Data, Analysis and Presentation, 2014).

There is a considerable range of selection in software for conducting an analysis of qualitative data. Researchers need to feel free to use the most appropriate method of analysis, with or without software that they are contented with. Whatever approach is used, the entire qualitative analysis involves making sense of large amounts of data, identifying significant patterns and communicating the principle of what the data reveals. The three core requirements of qualitative analysis are, detailed description of the techniques and methods used to make the selection of the samples and produce data, judiciously detailed analysis, with emphasis put upon the issues of validity and reliability and triangulation with the other data collection methods (Data, Analysis and Presentation, 2014).

In qualitative studies, validity focuses upon internal validity, with researchers seeking an in-depth understanding that will allow them to counter alternative descriptions for their findings. Qualitative studies often focus on purposive sampling, which tend to take away from the claims for external validity, i.e. generalizability. The term ‘reliability’ is most often associated with quantitative research. In quantitative studies, ‘reliability’ means repeatability and individuality of findings from the precise researchers, and generating those findings. However in qualitative research, reliability implies that from the data collected, the results are trustworthy, dependable and reliable. The strength of qualitative research lies in validity, i.e.

understanding of the truth. Upright and good quality qualitative research, using a selection of data collection methods, should focus upon the centre of what is going on rather than just scanning through the surface (Data, Analysis and Presentation, 2014).

In order to conduct an analysis of the qualitative data, the researcher condenses the large volume of data into quantifiable and analytical units. Data are manipulated and reconfigured in an attempt to discover the patterns and connections, not previously apparent. Complex data is also summarized into charts, graphs, and other illustrations requiring creative interpretative skills. It facilitates, identification of essential features and the systematic description of interrelationships between them. It is a complicated job, the reason being, data is the mix of open-ended questions, interview observations and other social interactions. Two strategies that are frequently adopted are writing and discussing.

Chapter 11. Measures of Central Tendency

Measures of central tendency or statistical averages communicate the point regarding which items have a tendency to get formed into a cluster. Such a measure is considered as the most representative figure for the entire mass of data. Measures of central tendency are also known as statistical averages. Mean, median and mode are the most popular averages. Mean, also known as an arithmetic average, is the most common measure of central tendency and may be defined as the value, which one obtains by dividing the total of the values of various given items in a series by the total number of items (Kothari, 2004). The measures of central tendency have been stated as follows: (Kothari, 2004).

Mean - Mean is the simplest measurement of central tendency and is a commonly used measure. Its primary use consists in summarising the important features of a series and in enabling the data to be compared. It is agreeable to algebraic treatment and is used in additional statistical calculations. It is a moderately constant measure of central tendency. But it undergoes some limitations i.e., it is unjustifiably affected by extreme items, it may not correspond with the actual value of an item within a series, and it may lead to incorrect impressions, especially, when the item values are not given with the average. However, mean is better than the other averages, particularly in economic and social studies, where direct quantitative measurements are possible.

Median - Median is the value of the middle item of series, when it is organized in an ascending or descending order of magnitude. It divides the series into two halves, in one half, all items are less than the median, whereas in the other half, all items are higher than the median. If the values of the items are arranged in the ascending order, for instance, 60, 74, 80, 90, 95, 100, than the value of the 4th item i.e., 88 is the value of the median. Median is a positional average and is used only within the framework of qualitative phenomena, for example, in estimating intelligence, etc., which are often experienced in sociological fields. Median is not suitable, where the items need to be assigned relative importance and weights. It is not frequently used in sampling statistics.

Mode - Mode is the most commonly or frequently occurring value in a series. The mode in a distribution is the item around which there is maximum concentration. In general, mode is the size of the item, which has the maximum frequency. Mode is a positional average and is not affected by the values of extreme items. It is, therefore, valuable in all situations, where one wants to eliminate the effects of variations. Mode is useful in the study of popular sizes. There are certain limitations of mode as well. It is not amenable to algebraic treatment

and sometimes remains indeterminate, when one has two or more model values within a series. It is considered inappropriate in cases, where one wants to give relative significance to the items under consideration.

Geometric Mean – Geometric mean is also considered suitable under certain conditions. It is defined as the nth root of the product of the values of n times within a given series. The most frequently used application of this average is within the determination of the average percent of change i.e., it is often used in the preparation of index numbers or when individuals are dealing with ratios.

Harmonic Mean – Harmonic mean is defined as the reciprocal of the average of reciprocals of the values of items of a series. Harmonic mean is of limited application, particularly in cases, where time and rate are involved. The harmonic mean gives largest weight to the smallest item and smallest weight to the largest item. As such it is used in cases like time and motion study, where time is variable and distance constant.

Chapter 12. Hypothesis Testing

An important consideration in the formulation of a research problem in quantitative research is the construction of a hypothesis. Hypothesis bring precision, transparency and emphasis upon a research problem, but are not indispensable for a study. Though it is possible to conduct research without a hypothesis. Hypothesis mainly arise from a set of 'hunches' that are tested through a study and one can carry out a perfectly valid study without having these hunches or speculations. However, in epidemiological studies, to narrow the field of investigation, it is important to formulate hypothesis. The significance of hypothesis lies in their ability to bring direction, specificity and focus upon the research study (Kumar, 2011).

Characteristics of Hypothesis

The characteristics of hypothesis have been stated as follows:

Clarity - Hypothesis should be clear and precise.

Capability – Hypothesis should be capable of being tested. A hypothesis is testable, if other deductions can be made from it, which in turn can be confirmed or disproved by observation.

Relational Hypothesis – Hypothesis should state the relationships between the variables.

Specificity – Hypothesis should be limited in scope and must be specific.

Manageability – The hypothesis should be understandable and manageable. The formulation of hypothesis should take place in a manner that the researchers are able to adequately understand and manage it in a well-organized manner.

Consistency – The features of steadiness, reliability, uniformity and regularity are considered appropriate within the hypothesis. It should be amenable to testing with a reasonable time.

Explanatory – The hypothesis must explain, what it aims to explain. In other words, it should have empirical reference.

Utility – Hypothesis acts as a guide, prevents blind research, provides direction to research, focuses research, provide connections between related facts and information, serves as a framework for drawing meaningful conclusions and helps in the selection of pertinent factors, once the investigator is able to obtain the direction with the help of hypothesis.

Sources for the Development of Hypothesis

Sources are referred to as the aspects that are required for the development of hypothesis. There are number of areas that are required to be taken into consideration by the researcher, when the formulation of hypothesis takes place. After the researchers have considered the sources for the formulation of hypothesis in accordance to the research study, then it is vital to get it checked from the supervisor. Assistance and consultation of the supervisor are considered essential, when developing hypothesis. A hypothesis may be developed or formulated from scientific theory, findings of previous studies, cultures, analogies, personal experience, pilot study, hunch, creative thinking and imagination of the researcher.

Types of Hypothesis

The types of hypothesis have been stated as follows:

Working Hypothesis – The term 'working' puts emphasis upon the instrumentality of the proposition. It is provisionally adopted to provide explanation to the relationship, between some observed facts for guiding the researcher in conducting an analysis of the research problem. The working hypothesis is capable of being tested and conformed. As the research proceeds further, it gets modified or even abandoned (Research: Hypothesis, n.d.).

Explanatory Hypothesis – Explanatory hypothesis refers to the scope of going into the depth and width with the various possibilities that have been invisible on a large scale. It is a testable explanation of an empirical relationship among variables in a given problem situation, and researchers have argued that hypothesis generation is the process of creating possible, and alternative explanations for a given set of information (Park, 2006).

Descriptive Hypothesis – Descriptive hypothesis are referred to as the propositions that typically state the existence, size, form or distribution of some variable. Examples are private brand purchasers constitute an identifiable market segment. When the statement provides the description of the relationship between the two variables, then it is termed as relational proposition. For examples, families with higher incomes would increase their expenditure on leisure activities. In this proposition, the variables are income and expenditure. There is a positive correlation between these variables.

Null Hypothesis – When a hypothesis is stated negatively, then it is known as null hypothesis. It avoids personal bias of the researcher in the collection of data. This hypothesis states that there is no relationship among the variables. There is no dependency of one variable on another or that there is no significant difference between two measures of the same parameter.

Alternative Hypothesis – An alternative hypothesis is one in which a difference, or an effect between two or more variables is estimated by the researchers. That is, the observed pattern of the data is not due to an unplanned occurrence. This follows from the tenets of science, in which empirical evidence must be found to contradict the null hypothesis, before one can claim support for an alternative hypothesis, i.e. there is in fact a reliable difference or effect in whatever is being studied. The concept of the alternative hypothesis is a central part of formal hypothesis testing. Alternative hypotheses can be non-directional or directional (Research Methods, n.d.). As against the null hypothesis, the alternative hypothesis is formulated, embracing a whole range of values rather than a single point.

False Hypothesis – A hypothesis, which is found to be unsatisfactory, when verified is called a false hypothesis. It does not agree with or explain actual facts. Verification reveals that the hypothesis is false. It is an erroneous hypothesis, a legitimate, but an unsuccessful one. In a statistical hypothesis testing, when errors take place within a hypothesis, then it is termed as false hypothesis.

Barren Hypothesis – A hypothesis from which no consequences can be deducted is called barren hypothesis. A barren hypothesis is one, which does not suggest the deduction of observable data. It cannot be put to test, it cannot be verified. It is the hypothesis that does not have any basis (Research Methodology, 2011).

Conditions for Formulation of Hypothesis

The conditions required for the formulation of hypothesis have been stated as follows:

Clear Theoretical Background – The researcher and the individuals involved in research must possess adequate knowledge of clear theoretical background. The hypothetical, academic and abstract knowledge should be clearly ingrained within their mind-sets, so that they are able to implement the research in an effectual manner.

Logical Background – One has to be logical and rational in their thinking. The notions, perspectives and viewpoints of the researchers should be based upon logical background. Tasks and functions that are an integral part of research work should be consistent, coherent, valid and analytical.

Knowledge of Scientific Methods and Strategies – In the research project, it is vital for the individuals to possess adequate knowledge of the scientific methods and strategies. Knowledge and information regarding various strategies and methods would help the

researcher in generating more accuracy and consistency within the study and would alleviate the occurrence of any types of flaws and inconsistencies.

Productivity of Background Knowledge - A researcher may deduce hypothesis inductively after making observations of behaviour, observing of trends or probable relationships. For instance, on the basis of experience and knowledge of behaviour in school situation, a teacher may attempt to relate the behaviour of students to his own, to his teaching methods, to changes in the school environment and so forth. From these observations, and relationships, the teacher may inductively formulate a hypothesis that attempts to explain in the relationships (Wani, n.d.).

Versatility of Intellect - Hypothesis is also derived from deductive reasoning from a theory. Such hypotheses are called deductive hypotheses. A researcher may begin his study by selecting one of the theories in his own area of interest. After the selection of the particular theory, the researcher proceeds further to derive a hypothesis from his theory (Wani, n.d.).

Analogy with Other Situations - Analogy with other situations enables the researcher to obtain the evidences that he might find beneficial in the formulation of hypothesis and for finding solutions to the problems. Suppose a new situation resembles an old situation with regards to factor 'x'. This will help the researcher to deal with factor 'y' and 'z' (Wani, n.d.).

Conversation and Consultation – Normally conversation and consultation with colleagues and other researchers belonging to different fields, quite often is helpful in the formulation of hypothesis (Wani, n.d.).

Parametric Tests

Testing of hypothesis have two important means, i.e. the study of hypothesis for logical consistency and the study of hypothesis for agreement with fact. Hypothesis is never proved, it is mainly sustained or rejected. A statistical hypothesis test is a method for making statistical decisions using experimental data. It is sometimes called confirmatory data analysis in contrast to exploratory data analysis. Assuming that the null hypothesis is true, the probability of observing the value for a test statistic, i.e. at least as extreme as the value that was actually observed. Parametric tests or standard tests of hypothesis make various kinds of assumptions about the nature of population from which the samples involved in the research study are drawn. The important parametric tests are: (1) *z*-test; (2) *t*-test; (*3) c2-test, and (4) *F*-test. All these tests are based on the assumption of normality i.e., the source of data is considered to be normally distributed. In some cases, the population may not be normally distributed, yet the tests will be applicable on account of the fact that one mostly deals with samples and the sampling distributions closely approach normal distributions (Kothari, 2004).

The statistics, used to infer the truth or the falsity of hypothesis are known as inferential statistics. Independent sample T Tests, ANOVAs, correlations, regression analysis and so forth are the tests that are conducted for analysing the null hypothesis. They are used to compare the mean score of independent groups and to find out the means of more than two groups independently. To test a hypothesis, a process comprises of three phases, constructing a hypothesis, gathering appropriate evidence, and analysing evidence to draw conclusions as to its validity. It is only after analysing the evidence that one can conclude, whether it was true or false. When concluding about a hypothesis, conventionally, statement is made about the correctness or falsity. It is imperative that hypotheses should be formulated clearly, precisely and in a form that is testable. In arriving at a conclusion about the validity of hypothesis, the way evidence is collected is of central significance. It is essential that study design, sample, data collection methods, data analysis and conclusions, and communication of the conclusions be valid, appropriate and free from any bias (Kumar, 2011).

Hypothesis testing begins with an assumption called the hypothesis that one makes about a particular population parameter. Then one collects sample data, procedures, sample statistics, and make use of this information to decide how likely, it is that one's hypothesised parameter is correct. To test the validity of the assumption, one gathers sample data and determine the difference between the hypothesised value and the actual value of the sample mean. Then the judgement is made about whether the difference is significant. The smaller the difference, the greater the likelihood that the hypothesised value for the mean is correct. The larger the difference, the smaller the likelihood. Meta-analysis is an objective and quantitative methodology used for synthesising i.e. combining and summarizing previous research endeavours on a particular subject into an overall global finding. The following are the null hypothesis and the alternative hypothesis.

H_O: There is no relationship (independence) between needing rework and the plant which is kept in the box.

H_1: There is a relationship (dependence) between needing rework and the plant which is kept in the box.

If the null hypothesis cannot be rejected, then the conclusion can be drawn that there is no evidence of a relationship between the two variables. If the null hypothesis is rejected then the conclusion would be that there is evidence of a relationship between the two variables.

Non-Parametric Methods

Non-parametric or distribution free tests or hypothesis make few, if any assumptions about the nature of the population from which the samples are taken. The critical region of the hypothesis test is to set all the outcomes which, if they occur cause the null hypothesis to be rejected in favour of the alternative hypothesis. In most of the situations, the so-called classical or parametric methods of hypothesis testing are employed. The measurements attained on the data are only qualitative, i.e. nominally scaled or in ranks, i.e. ordinarily scaled. The assumptions underlying the use of classical methods cannot be met. The situation requires a study of such features as randomness, trend, symmetry, independence or goodness-of-fit, rather than testing of hypothesis about particular population parameters. For such circumstances, the non-parametric methods of hypothesis testing have been devised.

The non-parametric techniques for analysing quantitative data include:

The Mann-Whitney U Test – A popular non-parametric test to compare outcomes between two independent groups is the Mann-Whitney U test. The Mann-Whitney U test, sometimes called the Mann-Whitney Wilcoxon Test or the Wilcoxon Rank Sum Test, is used to test whether two samples are likely to derive from the same population (i.e., the two populations have the same shape). Some investigators interpret this test as comparing the medians between the two populations. Recall that the parametric test compares the means (H_0: $\mu_1=\mu_2$) between independent groups. It is used, when the researcher is supposed to conduct an analysis of the ranked data. The researcher intermingles the scores of the two groups and then ranks them as if they were all from just one group. The test produces the value (U), which is checked upon in a statistical table (Sullivan, n.d.).

The Kruskal-Wallis One-way Analysis of Variance – A popular non-parametric test to compare outcomes among more than two independent groups is the Kruskal-Wallis test. The Kruskal-Wallis test is used to compare medians among k comparison groups ($k > 2$) and is sometimes described as an ANOVA with the data replaced by their ranks. The null and research hypotheses for the Kruskal-Wallis non-parametric test are stated as follows: H_0: The k population medians are equal versus and H_1: The k population medians are not all equal. The procedure for the test involves pooling the observations from the k samples into one combined sample, keeping track of which sample each observation comes from, and then ranking lowest to highest from 1 to N, where $N = n_1+n_2 + ...+ n_k$. It is used when the researcher has more than two independent groups to compare. The sum of the ranks added together for each of the separate groups are then compared. This analysis produces a value

(H), whose probability of occurrence is checked by the researcher in the appropriate statistical table (Sullivan, n.d.).

The Sign Test – The sign test is a non-parametric test that can be used to test either a claim involving matched pairs of sample data, a claim involving nominal data with two categories, or a claim about the population median against a hypothesized value k. In order to use sign test, first conversion of data values is required to plus and minus signs and then one tests disproportionately for more of either sign (13-2 Sign Test, n.d.). It is used, when the researcher aims to conduct an analysis two related, as opposed to independent samples. The researcher simply lines up the mass of related subjects and then determines, how many times the paired subjects in one group scored higher than those in the other group. If the groups do not differ significantly, the totals of the two groups should be about equal. If there is a marked difference in scoring. The difference may be statistically significant. Probability can be determined by taking into consultation the appropriate statistical table.

The Friedman Two-way Analysis of Variance – This statistic has two applications that can appear different, but are really just two variations of the same statistical question. In one application, the same quantitative variable is measured at two or more different times from the same sample, or from two or more samples that have been matched on one or more important variables. In the other application, two or more comparable quantitative variables are measured from the same sample, usually at the same time. In both applications, Friedman's test is used to compare the distributions of the two or more quantitative variables. Thus, it is applied in the same data situation as an ANOVA for dependent samples except that it is used, when the data are either from a small sample, are importantly non-normally distributed, or the measurement scale of the dependent variable is ordinal, not interval or ratio (Friedman's Two-way Analysis of Variance by Ranks, n.d.).

It is important to remember the null hypothesis, and to differentiate it from the null for the dependent ANOVA. There are two specific versions of the H_0, depending upon whether one characterizes the k conditions as representing a single population under two or more different circumstances, e.g., comparing treated vs. not treated or comparing different treatments, some consider this a representation of two or more different populations or as representing comparable variables measured from a single population (Friedman's Two-way Analysis of Variance by Ranks, n.d.). If more than two related groups are involved, then this test can be used. For example, if the researcher employs four matched groups, then this test can be appropriate.

Chapter 13. Statistical Packages

Processed data is referred to as information. It is a source that enables a person to make a decision or commitment. A system consists of a number of organs or components. These organs or components work in harmony to achieve a purpose. An information system is a group of components that interact to produce information. The three basic components are people, procedures and data. Data has to be manipulated to obtain the information. When information systems make use of computer to obtain the information, then it is known as computerised information systems. To people, procedures and data, two more components are added, i.e. computer and programmes. Information generated can be communicated to any part of the globe through information network. The main statistical packages have been stated as follows:

Hypertext Systems

Hypertext refers to the use of hyperlinks or simply links to present text and static graphics. Many websites are hypertexts to a major extent. Hypermedia refers to the presentation of video, animation, and audio, which are often referred to as dynamic or time based content or as multimedia. Non-web forms of hypertext and hypermedia include CD-ROM and DVD encyclopaedias, such as Microsoft's Encarta, e books, and the online help systems that one finds in software products. It is common for people to use hypertext as a general term that includes hypermedia. For example, when researchers talk about hypertext theory, they refer to theoretical concepts that pertain to both static and multimedia content. In a hypertext system, text, illustrations, graphics, data, programs etc. can be integrated into an electronic document (Farkas, 2004).

Private Branch Exchange Systems

The private branch exchange system is a telephone system within an enterprise that switches calls between the enterprise users on local lines, while permitting the users to share a certain number of external phone lines. Office telephones are connected to more sophisticated private branch exchange (PBX) systems. Such PBX systems allow for the transmission of data as well as voice signals and this makes provision of the medium for the micro-computers to communicate. Voice mailboxes, leave voice messages for one another. Through the means of the video conferencing capabilities, individuals can communicate with each other face to face without travelling.

Text Processing

The systems of text processing are used to formulate, store and print documents. These range from simple text to merging, inserting and integrating text with graphics. These are composed with multiple type fonts, graphic symbols and so forth. The text processing system is used to prepare documents in different formats. This is one of the most useful techniques in organizations and educational institutions and have facilitated the tasks and functions of the individuals. Usually, when multiple fonts are required within the documents and they are to be prepared in an attractive manner, then text processing is made use of by the individuals, who possess adequate knowledge of technology.

Merge Facilities

Merge is another way of combining datasets. Where the append command adds the rows, or observations, while merge adds columns or variables. Thus one should use merge, when there are the same observations across the datasets. A one-to-one merge combines datasets that have identifiers for single observations within a dataset. The many-to-one merge is used, when one has a master dataset that has individual level data and using dataset that contains within individual level data as well as unique individual level identifier from the master data. The one-to-many merge is the opposite of the many-to-one merge. In this case, the master dataset would have within individual level data that one wants to add to the master dataset. In many-to-many merge, the observations are matched within equal values of the specified variables with the corresponding observations matching with one another (Append, Merge, and Collapse in Stata, n.d.). In the case of merge facilities, a file with generalized form of a business letter is merged with a file containing a list of customers with their respective personal data to be inserted into the table.

Automated Document Production

Automated document production is an extension of the form letter. In this case, sections of the document are deleted or replaced with some other matter, or specific connotations are added to meet the individual requirements. In the automated document production process, systems can form the documents required by passing to Active Docs Opus Composition Server's Web Service an XML stream, identifying the templates, data, output formats, and delivery instructions for the documents being produced. Composition Server processes the XML stream, merging the supplied answer data with the requested templates, and then produces the documents to the volumes, formats, and delivery requirements specified. The automated process can be manually and automatically raised, and is the ideal solution, when the source information comes from a line of business system and requires no additional user input (Automated Document Creation, n.d.).

Desktop Publishing (DTP)

Desktop publishing is a computer-based application that is used to produce professional quality page layout for printing the variety of types, styles, sizes, graphics, symbols and so forth. This software can generate layouts and produce typographic quality text and images comparable to traditional typography and printing. Paper spreadsheets are prepared manually and electronic spreadsheets are prepared through computers. The data of a spreadsheet can be used to produce pie charts, bar charts, and line plots. Spreadsheets can be stored as a database. It is the creation of documents, making use of page layout skills on the personal computer. This system is primarily used for creating matter such as reports, posters, notices, pamphlets, advertising matter and so forth.

Database Management Systems (DBMS)

Database Management Systems (DBMS) is a program that is used for processing a database. This is a software for creating and managing databases. This is considered as one of the most effective software that is used to handle the storage, retrieval and updating the data within the computer system. The DBMS provides users and programmers with the systematic way to create, retrieve, update and manage data. Most of the systems include a number of easy to use tools for developing data entry forms, reports and menus. Popular DBMS are, dBase II, III, IV, Sybase, Oracle, Paradox R: Base, MySQL and so forth.

Integrated Packages

An integrated software application is designed to help credit professionals assess and monitor in an accurate manner, the creditworthiness of the clients and optimize the credit policy decisions. Integrated packages are used to create visual displays of data, beyond those that are built into spreadsheet programs. These packages are used to integrate multiple functions into a more elaborate statistical components that would have built in the facilities for performing the standard types of econometric analysis. These create much higher quality graphics with better resolution, more types, colour and three dimensional graphics. This statistical package is also in some cases used for conducting an analysis and exploitation.

Paint and Draw Programs

Paint and draw programs produce logos, symbols, illustrations and the like. In using this program, the individuals are able to make various kinds of images and figures on the computer and paint them. The paint and draw programs are primarily used in the preparation of documents and reports. In educational institutions, when students are learning the basics of computers, then too these programs are emphasised upon to provide knowledge to the students that technology can also prove to be an effective source in implementing artistic

skills of drawing and painting. Working on these programs in most cases is a pleasurable activity for the individuals.

Information Retrieval Programs

In the case of information retrieval programs, a personnel computer can be connected to a database, using telephone lines with a modem. Bibliographic data, stock quotations, Government statistics, legal information and public utility information like air, and rail timings, local engagement, latest news etc. can be heard. These programs can be made use of in a variety of settings. In the present existence, these programs have become freely available for use over the internet. They have been comprehensively used in educational institutions. The main purpose is to permit the students to examine a variety of implementations in terms of various kinds of tasks and functions.

Administrative Assistance Programs

The Administrative Assistant program makes provision of a specialized curriculum in computer applications, office procedures, and business communication. An individual undergoing this program is able to complete it in 27-39 weeks of time period. Upon completion of this program, the individuals are able to acquire the knowledge and hands-on skills that are needed to take one or more certification tests in Microsoft Word, Microsoft Excel, Microsoft PowerPoint, and Microsoft Office. This program also allows the individuals to further develop their skill-sets through an externship for on-the-job training (Administrative Assistant, 2017). In the administrative assistance programs, they provide the menu of services with items like the calculator, calendar, telephone dialler, reminder file, alarm and so forth.

Bio-Medical Data Package (BMDP)

BMDP is a suite of various statistical programs. This statistical package consists of the series of programs that were primarily used for the implementation of parametric and non-parametric statistical analysis. Each program together commands into the paragraphs, comprising sentences. It has own syntax, each is called and run separately. For example, BMDP2V is a program, which performs ANOVA, ANCOVA. It consists of paragraphs, input, variable, group, design, print and end. This software makes available in-depth functionality with all the major statistical analysis. The researcher have been making use of this software in a manageable way. The main benefit of this software has been its high speed.

Internationally Developed Data Analysis and Management Software (IDAMS)

Internationally Developed Data Analysis and Management Software (IDAMS) package is a statistical package, which interfaces with the computerised data system (CDS) or

the Integrated System for Information Service (ISIS). It has univariate and bivariate statistics and multivariate statistical techniques. In addition to these, there are also some recent advanced techniques. It also makes provision of a series of data management programs and a powerful language that is required to bring about transformations within the data. IDAMS was designed for IBM compatible mainframe and micro-computers. When the researchers are involved in the implementation of advanced research process and are required to use univariate, bivariate or multivariate statistical techniques, then IDAMS is made use of.

Micro-stat

Micro-stat is an application software exclusively for statistical analysis. It covers most of the statistical procedures that are used on a frequent basis in academic research. Modern programming languages operate within a computing environment. The three main features of these languages are, interactivity, graphical capability and local expansibility. Micro-stat is a completely conversational software package designed for multidimensional data analysis. It is written in BASIC to be used on an APPLE II micro-computer. On the micro-computer level, it offers the usual facilities of statistical packages such as BMDP, SPSS or SAS. With the rapid growth of micro-computers in the last few years, there has been an increase in the requirement of the statistical software for the systems.

Chapter 14. Types of Data Presentation

The types of data presentation have been stated as follows: (Data Presentation Types, n.d.).

Table – In a table, the data is presented in a tabular form. The table form is usually used for small data sets for comparisons. It has certain advantages and disadvantages. The advantages are, it shows all the data and is regarded as a precise and specific method of presenting the data. The data is organized in a tabular format in a specific manner. The main disadvantage is, it can be difficult to interpret and view the patterns.

Pie Chart – A pie chart shows the data as a percentage of the whole. In this form of presentation, three to seven categories can be used. The main advantage is, it is simple and shows the proportions in a rapid manner. The percentage can be observed in this form in a clear and precise manner. The main disadvantage is, the total represented by the chart is not known.

Bar Chart – A bar chart shows the data in separate columns. It should be used for comparisons between discrete categories. The main advantage is, it clearly shows the scale of the categories. The main disadvantage is, reordering of the bars can bring about changes in interpretation.

Histogram – The presentation of the data in a histogram is in a continuous form, with no gaps between the columns. The use of histograms is in the case of any types of data, where there are not any differences between the categories. The main advantage is, it shows the continuity between different categories of data. The main disadvantage is, the data is in a grouped form, hence, it is difficult to identify individual data.

Box and Whisker – Box and whisker plots show the median and the range of the group of data. It should be used for grouped data that has a spread. The main advantage is, it shows average and spread in one picture. The main disadvantage is, providing explanation to others in terms of this type of data could be difficult.

Scatter Plot – In a scatter plot, the explanation of the data is given in the form of single points. It is used for two sets of numerical data. The main advantages are, it shows all data points including the outliers and it can put focus upon correlation. The main disadvantages are, interpretation can be subjective and correlation does not mean causation.

Line Chart - A line chart is used in plotting the data in order and joins them with a line. It is normally used in the case of data over a period of time. The main advantages are, it shows the entire data in the form of points, is simple and easy to understand and is able to show multiple sets of data. It is essential for the data to be in an ordered form, and within the line chart, the data does not have an order, hence, this is the main disadvantage.

Run Chart – A run chart is the line chart, and in addition, is also referred to as the median for the data. It is used in the case of data over time to look for changes. The main advantage is, it is easy to interpret, with four easy rules to look for. The main disadvantage is, it cannot be used for unordered categories.

Chapter 15. Sociometry

The word, sociometry is derived from the Latin word "socius," meaning social and the Latin word "metrum," meaning measure. As these roots imply, sociometry is a way of measuring the degree of relatedness among individuals. Measurement of relatedness can be beneficial not only in the assessment of behaviour within groups, but also for interventions to bring about positive changes and for determining the extent of changes. For a work group, sociometry can be an influential tool for reducing conflict and improving communication, the reason being, it permits the group to observe itself accurately and to analyse its own dynamics. It is also an influential tool for assessing dynamics and development in groups devoted to scrutiny or preparation (Hoffman, 2000).

A useful working definition of sociometry is that it is a methodology for pursuing the energy vectors of interpersonal relationships within a group. It shows the patterns of how individuals associate with each other, when acting as a group toward a quantified end or goal. It is a mathematical study of psychological properties of populations, the experimental technique of and the results obtained by application of quantitative methods. Sociometry is based upon the fact that individuals make choices in interpersonal relationships. Whenever individuals meet, they are required to make choices, where to sit or stand. There are choices made regarding individuals, their natures, their ways of communications and behavioural traits. The individuals, who are friendly, they tend to be more communicative than the ones, who are isolated (Hoffman, 2000).

Sociometry is referred to as a technique that is used to provide description regarding the social relationships among individuals in groups. It makes an attempt to describe attractions and repulsions between the individuals by asking them to indicate, whom they would select or reject in various situations. The main purpose of this technique is to study the underlying motives of the respondents. The main instruments that have been used in this technique for the purpose of data collection, include the questionnaires and interview techniques. The questionnaire is an instrument that comprises of open-ended questions to elicit proper view and social interaction among groups. By means of open-ended questions, the individuals would be able to interact with each other in a much better way and acquire an understanding of each other's viewpoints and perspectives. In libraries and information centres, socio-metric techniques could be used in the library management and reference services. It is primarily used for identifying experts belonging to various fields and their communication patterns.

A socio-gram is a socio-metric instrument, which diagrammatically indicates the formation and the transformations made about within the group. It is a map of interpersonal relationships and interpersonal lines of communication. Socio-gram takes place, wherever there is a gathering of individuals. The individuals make use of some kind of criterion, when interacting with others. The criterion may be exclusively artistic. The individuals respond to and are attracted to or repelled by certain traits including, system, quality, indication, background and so forth. The other criteria is normally influenced by the situation itself. These include, eating, working, communicating with others and so forth. The socio-metric choices take place among other forms. When understanding these aspects in the present study, focus has been put upon the process of human interactions. There are three major types of socio-grams. These include, the role diagram, the perceptual socio-gram and the more conventional socio-gram of the moment. The techniques required for the administration of the various types of socio-grams are normally the same. They consist of the five basic stages, criterion selection, matrix formation, socio-gram charting, analysis and application (Hollander, n.d.).

Criterion Selection

The criterion for the socio-matrix utilization refers to what one wishes to measure and usually a question arises regarding some aspects of social interaction. Socio-matric criteria is referred to the micro-sociological norms of groups. They primarily put emphasis upon, what are the norms and standards in micro-sociology. The number of criteria upon which groups are constantly forming extend into the millions. The criterion are referred to the qualitative or quantitative standard, which brings the respondents to select or reject other people, with whom, they desire to participate in an activity. Each criterion should present significantly and emotionally meaningful selections of the participants. Encouragement of uprightness and morality can take place by communicating the importance of the socio-metric choices to the participants (Hollander, n.d.).

Selections are commonly made on some basis or criterion. The criterion may be subjective, such as an instinctive feeling of liking or disliking a person on the first impression. The criterion may be more independent and cognizant, such as knowing that a person does or does not have certain skills required for the group task. When members of a group are asked to make a selection among others in the group based on a specific criteria that everyone within the group is permitted to make selections and provide the description of the reasons behind making of the selections. From these selections, a description emerges of the networks inside the group.

Socio-matric Matrix Formation

Socio-matric matrix formation is the data summary sheet, which organizes the selections or rejections presented by each participant in a systematic manner. It is a multicellular chart with two margins, in which the names of the participants are listed. One at the left vertical margin and the other at the top, proceeding horizontally. The responses of each participant is indicated in a cell that intersects with the name of the socio-metric choices. The rejections are plotted in the same manner. For positive selections, + signs are used and for negative selections, - signs are used. It is economical to make use of matrix to locate the socio-metric stars, and the ones, who are rejected and isolated. Socio-metric stars are the individuals, who have made the largest number of positive choices, the ones who are rejected are, who have made the largest number of negative choices and isolates are the ones, who have not received positive or negative choices and they have not made any choices (Hollander, n.d.).

Socio-gram

The development of a socio-gram progresses from the socio-metric matrix. It is a map that represents the socio-geographic positions of each group member and his relationship to every other person within the group. Two commonly used types of socio-grams are classic socio-grams and the target socio-gram, it is the modification of the classical type. A socio-gram needs to be carefully formed. Classic socio-gram is formed on a plan rectangular shaped page. The socio-metric stars are located towards the centre of the page with succeeding graduations moving towards the periphery. Isolates are positioned at the edges of the page. In the target socio-gram, stars are positioned at the inner-most and centre-most circles and concentric circles are pre-established to resemble a central target. Isolates are positioned at the largest or outer circle (Hollander, n.d.).

A drawing, like a map, of those networks is called a socio-gram. The data for the socio-gram may also be displayed as a table or matrix in terms of the selections made by each person. Such a table is called a socio-matrix (Hoffman, 2000). Socio-grams are constructed to identify the leaders and followers. These are the charts that depict the socio-metric choices. A socio-gram is a geometric figure, which indicates each person and his choice or communication pattern through the connecting lines or arrows. The communication pattern among the scientists for the purpose of discussing in terms of the experiment can be represented through a socio-gram. There is a strong relationship between the scientists of the organization and the outside scientists. The results of the study could be used to identify and locate outside experts for the consultation purposes.

Analysis

Conducting an analysis of the socio-gram depends upon what one is hoping to find. One may be searching for pairs, triangles, squares, isolates, stars or chains (interlinking people). Others might be looking at the symbolic reflection of cohesion as represented by mutual selections. Still others might aspire to locate telic, empathic and transference type of relationships. Tele represents a two-way process of action between the individuals. It is the fundamental factor underlying the perceptions of others. Transference is the process of establishing a relationship, in which the primary mechanism of that relationship is projection. Empathy is a one-way projection, in which one person feels into an object, situation or the circumstances of another person. Relationships that are built upon transference or empathic situations do not last for long. They either disintegrate or become telic relationships. Therefore, all the relationships must be composed of these mechanisms that they are not mutually exclusive and indeed may exist together (Hollander, n.d.).

Application

Before implementation of socio-gram into action, one important point to remember is, criteria are frequently applicable to the time of administration and the conditions which surrounded the criteria. If the long gap of time takes place before the application of criterion takes place, then there might be changes and transformations within the choices and they may render the socio-gram inapplicable. The individuals might be added or deleted from the social network, which was utilized during the socio-metric selections and invalidate its implementation. If the participants of the socio-metric investigation aspire to obtain feedback via the socio-gram, then the administrator is required to carefully explain the rationale of the socio-metric procedure. The intrinsic limitations of this tool and total consensus from the participants is desired. Unsuccessfulness on the part of the administrator to respond to the explanations may lead to antagonism, antipathy, distrust, suspicion and embarrassment (Hollander, n.d.).

Chapter 16. Biblio-metrics, Sciento-metrics, Info-metrics and Webo-metrics

Biblio-metrics

Biblio-metrics is a set of methods dedicated to the quantitative analysis of scientific and technical activities. These techniques implement statistical and mathematical tools to measure the data that calculate the researcher's contributions to science and technical development. The data used for biblio-metric studies primarily emerge from information produced by the activity of researcher's communication. These quantitative studies of researcher's communication activities tend to acquire a better understanding of the phenomena of construction, distribution and use of scientific and technical knowledge. Biblio-metrics is considered as a standard tool of science policy and research management within the last decades. All significant gatherings of science indicators rely on publication and citation statistics and other sophisticated biblio-metric techniques. The aim of biblio-metric studies was to measure national research performance in the international framework or to describe the development of a science field with the help of biblio-metric means (Introduction, n.d.).

Biblio-metrics is referred to the application of statistical studies within the library and information centres. This subject has been gaining ground in libraries and information centres, throughout the world. This term was first used by Alan Pritchard in his article, Statistical Bibliography or Biblio-metrics in 1969, published in the journal of documentation. Biblio-metrics can be used with the advantage to achieve productivity counts of literature, comparative studies of the literature generated, areas of study, quantity and quality of research in different branches, areas, regions, periods, types and amounts of publications, scatter and pattern of scatter of literature, impact of literature, identification of peers, bringing about social change and so forth.

Biblio-metric studies may comprehensively be classified into two categories: descriptive studies and behavioural studies:

Descriptive Studies – It describes the characteristic features of documents or literature. These studies bring out the study of the bodies and documents that carry information in the form of presentation, nature of information, quantity of information, time and frequency of studies, origin and geographical scatter of distribution and so forth.

Behavioural Studies – These examine the relationship between various elements, like the authorship, title statement, bibliographic history, frequency of publication, form, place, language, subject, related documents, level of market orientation, content analysis, price, circulation, citations, translations, formats, physical make-up, size, quality of production and production values.

The discovery of the empirical laws of biblio-metrics has led to a series of studies, which can be comprehensively differentiated into two categories. These include, qualitative and quantitative. The kinds of biblio-metric studies include, citations and references, user studies, circulation statistics and document and content analysis. In the beginning of the eighties, biblio-metrics could evolve into a distinctive scientific discipline with an explicit research profile, several sub-fields and the corresponding scientific communication structures, i.e. publication of the international journal, sciento-metrics in 1979 as the first periodical specialised on biblio-metric topics, international conferences since 1983, and the journal research evaluation since 1991. The main reason for these progressions could be observed within the availability of large bibliographic databases in a machine-readable form and the rapid development of computer science and technology. The researchers within the scientific disciplines forms a large and also the most varied interest group in biblio-metrics (Introduction, n.d.).

Biblio-metric Laws

The three laws of biblio-metrics are respectively based upon the number of authors contributing in the discipline or other field, distribution of articles in a set of journals and ranking the word frequency in a particular set of documents. The biblio-metric laws have been stated as follows:

Lotka's Law – Lotka in his classic paper published in 1926 in the Journal of the Washington Academy of Sciences, on the frequency distribution of productivity, presented on analysis of the number of publications listed in the chemical abstracts from 1907 to 1916 with the frequency of the publication of the authors. Lotka's Law, when applied to large bodies of literature over a long period of time, could be precise in general, but not statistically particular. It is often used to estimate the frequency with which authors will appear in an online catalogue (Introduction, n.d.).

Lotka 's Law defines the frequency of publication by the authors in a given field. It states that the number of authors making n contributions is about $1/n^2$ of those making one;

and the proportion of all contributors, that make a single contribution, is about 60 percent. This means that out of all the authors in a given field, 60 percent will have just one publication, and 15 percent will have two publications ($1/2^2$ times 60). Seven percent of the authors will have three publications ($1/3^2$ times .60), and so forth. According to Lotka 's Law of scientific productivity, only six percent of the authors in a field will produce more than 10 articles (Introduction, n.d.).

Influence of Lotka's Law – Lotka's proposition led to the whole gamut of studies on scientific productivity. Such productivity gained momentum during the post second world war period. This in fact has culminated within the rise of the new discipline, called scientometrics. Sciento-metrics is defined as the study of the measurement of scientific and technological progress. Lotka's law suggests the distribution of scientific papers that have the characteristics of reversed distribution, i.e. J shaped, it is skewed, generally the distribution has a long tail and the most general form of distribution is $f(x) = C(x + d)^k$, where c, d and k are constants, f (x) is referred to the number of authors with x papers.

Bradford's Law – Samuel Clement Bradford formulated the law of scattering to provide the description of the distribution of the articles on a particular subject in different periodicals in 1934. This law has received greatest attention within the library literature. Bradford concluded that in a given subject area, the categorization of periodicals can be into three separate groups. Those producing more than four references in a year, those producing between two and four references in a year and those carrying one or fewer references in a year. Bradford's law seems to offer only the sources discernable in the present existence. They aim at leading to reduction in the quantitative disarray of the scientific documentation. Information system and library services to a more orderly state of affairs, capable of being rationally and economically planned and organized.

Bradford's law serves as a general guidelines to the librarians in determining the number of journals in any field. It states that the journals in a given field could be divided into three parts, each containing the same number of articles, a core of journals on the subject, relatively few in number that produces almost one-third of the articles. A second sector comprising the same number of articles as the first, but a greater number of journals, and a third sector, comprising the same number of articles as the second, but a still greater number of journals (Introduction, n.d.).

The mathematical relationship of the number of journals in the centre to the first zone is a constant *n* and to the second zone, the relationship is n^2. Bradford expressed this relationship as 1: *n*: n^2. Bradford framed his law after studying a bibliography of geophysics, covering 326 journals in the field. He discovered that nine journals contained 429 articles, 59 contained 499 articles, and 258 contained 404 articles. Nine journals contributed one-third of the articles, five times nine, or 45, to produce the next third, and five times five times nine, or 225, to produce the last third. As may be seen, Bradford's Law is not statistically perfect. But it is still normally used as a general rule of thumb (Introduction, n.d.).

Zipf's Law – One of the most perplexing phenomenon in biblio-metrics are more comprehensively in quantitative linguistics is Zipf's law. Mathematicians are of the viewpoint that this is a mathematical law. G.K. Zipf was a physiologist from Harvard University, who has worked on the theory of application of his principles of relative frequency in the structure and development of larvage. Zipf's law suggests that the product of the number of occurrences of each word in the body of text and its rank is constant. In r f = c, r is the rank of word type, f is the frequency of occurrence of word type and c is constant. The law represents only an approximation of relationships between ranked and frequency, which is hyperbolic.

Zipf formulated an interesting law in biblio-metrics and quantitative linguistics that he derived from the study of word frequency in a text. Zipf's Law is often used to predict the frequency of words within a text. The Law states that in a relatively lengthy text, if you "list the words occurring within that text in order of decreasing frequency, the rank of a word on that list multiplied by its frequency will equal a constant (Introduction, n.d.).

Studies on Zipf's Law – Zipf's law can be used in an effectual manner in the generation of semi-automatic and automatic indexes. These are useful for an information retrieval system. It makes provision of the measure of productivity within the vocabulary of the author. This technique can be used for making the decisions in terms of the accurate authorship of doubtful and unclear works. This law is also used for the identification of works, more frequently used in various kinds of foreign languages. Zipf's illustrated his law with an analysis of James Joyce's Ulysses. He revealed that the tenth most frequent word occurred 2,653 times, the hundredth most frequent word occurred 265 times, the two hundredth word occurred 133 times, and so forth. Zipf found that the rank of the word

multiplied by the frequency of the word equals a constant that is approximately 26,500. Zipf's Law is not statistically perfect, but it is useful for the indexers (Introduction, n.d.).

Sciento-metrics

Sciento-metrics is the branch of the science. This term was introduced and came into prominence with the formulation of the journal, named 'sciento-metrics' by T. Braunin, 1977. It was originally published in Hungary and currently from Amsterdam. Sciento-metrics is the part of the sociology of science and has application to the making of science policy. It involves quantitative studies of scientific activities, including among others, publication and so overlaps biblio-metrics to some extent. There are two aspects within science of science, i.e. the analytical aspect, which deals with the general laws of the development of science as knowledge systems and a specific social institution. Another is the normative aspect, which deals with the development of practical recommendations for increasing the research efficiency. The principle aim of 'sciento-metrics' is to determine the state and prospect of a subject and its further development. Several sciento-metrics indicators are used for this purpose, and one of the most significant indicators is the number of publications. The changes over the period of time are considered as a measure of research in a given field. These indicators are on the way to become a standard tool of evaluation and analysis in research management of science policy making.

Sciento-metrics are used to measure scientific activities, primarily by producing statistics on scientific publications indexed in databases. They are flexible tools used to study the sociological phenomena associated with scientific communities, to conduct scientific, strategic, technical, technological or competitive monitoring, to design and manage research programs and to evaluate research. They are valuable methods for evaluating research output, positioning studies and conducting anticipation studies in science and technology. Sciento-metric equipment could be used to measure and compare the scientific activities at various levels of aggregation including institutions, sectors, provinces and countries. They could also be used to measure research collaborations, to map scientific networks and to scrutinize the evolution of scientific fields. Sciento-metric indicators provide the policy-makers with the reproducible objective and therefore, supportable information goes beyond the anecdotal (Introduction, n.d.).

Infor-metrics

The field of infor-metrics, took the place of the originally wider specialty biblio-metrics. The term, infor-metrics was adopted by VINITI 12 and stands for a more wide-ranging sub-field of information science, dealing with mathematical statistical analysis of communication processes in science. In distinction to the original definition of biblio-metrics, infor-metrics also deals with electronic media and thus includes subjects, such as the statistical analysis of the scientific text and hypertext systems, library circulations, and information measures in electronic libraries, models for Information Production Processes and quantitative aspects of information retrieval (Introduction, n.d.).

Otto Nacke of West Germany first proposed the term 'infor-metrics' according to Brookes, in 1979. The term's acceptance data since 1987 when, B.C. Brooke recommended during the international conference of biblio-metrics and theoretical aspects of information retrieval in Diepenbeek, Belgium that the term, infor-metrics included in the name of the following conference, scheduled in London, and Canada in 1989. This meeting was thus named, International Conference on Biblio-metrics, Sciento-metrics and Infor-matrics. The name of the third meeting within the series held in Bangalore, 1991 in India, signals the final acceptance of this term. Infor-metrics is the study of the quantitative aspects of information in any form, not just records or bibliographies and in any special group not just scientists. Thus it looks at the quantitative aspects of informal or spoken communication as well as recorded and of information needs and uses of the disadvantaged and not just the intellectual elite individuals (Introduction, n.d.).

Infor-metrics deals with the measurement, hence also the mathematical theory and displaying of all aspects of information and the storage and retrieval of information. It is mathematical meta-information, i.e. a theory of information, scientifically developed with the assistance of mathematical tools. It is clear from the definition of these terms that they are all synonymous and even used interchangeably (Introduction, n.d.). It is another recently used term, which formalises and consolidates the measurement studies, which put emphasis upon the productivity of information. It interprets information technology and complex interactions of information theory, cyber-metrics, and decision theory. Brookes opines that this new term is being used to cover both sciento and biblio-metrics in an impartial manner. It has produced number of distinctively new ideas of its own, but as it implicitly covered both documentary and electronic forms of communication. As a general field of study, this field includes the earlier fields in terms of biblio-metrics and sciento-metrics.

Webo-metrics

Webo-metrics is referred to as gathering the data on the web and measuring aspects of the web. These include websites, web pages, hyperlinks, web search engine results, YouTube video commenter networks, My Space Friend networks and for varied purposes of social sciences. Webo-metrics can conduct an analysis of the online academic communication. It makes provision of answers, such as, why do academic websites interlink, which academic websites interlink, what type of academic interlinking patterns exist and which websites, groups and universities have the most online impact and what are the causes that lead to its influence. Some of the offline phenomenon that have measurable online reflections include, international communication, inter-university collaboration, university-business collaboration, the influence or spread of ideas and perspectives and public opinion regarding science (Thelwall, n.d.).

Webo-metrics in traditional research evaluation can supplement traditional citation influence and non-traditional online influence. It is usually weaker as compared to the citation data, but is useful for research groups that have non-standard types of influences. The Integrated Online Impact Indicator (IOI) combines a range of online sources into one indicator. These include, Google Scholar, Google Books, course reading lists, Google Blogs and PowerPoint Presentations or make a selection between individual separate components. Webo-metrics for new research evaluations. Some of the organizations produce non-academic research and need impact evaluation. They have a target upon the audience but not academic (Thelwall, n.d.).

Web citation analysis count mentions the report on the web; evidence of wider public and media interest, blogs, can be automated and spam is involved to a major extent. Web citation analysis of online PDF and word documents involves the evidence of professional impact, can be automated via Yahoo!, Live Search document type specific queries, i.e. file type: pdf, variable quality documents, and high quality documents can be interesting. Webo-metrics for social science, involves large scale quantitative web measurements for social science research goals. The web contains a wide variety of web and web 2.0 content posted by many different individuals in a variety of formats. The utilization of the webo-metric methods can be in a wide variety of types of influence. This is used for rendering assistance and help to new clients and social scientists (Thelwall, n.d.).

Under this term, it is vital to acquire understanding that in recent years, the number of electronic activities have increased in a strong manner. It also means that the collection of data takes place automatically and one is also able to generate the viewpoint that collecting

data has become a manageable process. Classical info-metric laws deals with the sources, i.e. the objects that are produced and a connecting function F, determining, which items are produced by which sources. Clearly defined sources, item relations are web-sites and their size, web pages and the number of clickable buttons. In some cases, it is also shown that the distribution of hyperlinks between websites is of the Lotka type. This is also application in terms of the distribution of domain names, such as, .edu, .com, .uk and so forth.

Chapter 17. Citation Analysis

Citation analysis is defined as the analysis of citations or references or both which form part of the scholarly apparatus of primary communications. The techniques used for putting items of references in some kind of rank or order, whether they are journals or authors cited. Citation analysis involves counting the number of citations to a particular document for a period of time after its publication, this is sometimes called direct citations. Citation analysis leads to a more sophisticated methods, such as, co-citation, mapping of the literature, bibliographic coupling and co-word analysis. These methods, individually and in combination, strides to find information patterns, by analysing reference and citation patterns as well as word use frequencies, combined with statistical analysis (Introduction, n.d.).

Citations are used in academic works to acknowledge the influence of previous works, or to refer to the authorities. Citations permit the readers to put claims to the test by consulting previous works. Authors often involve earlier works directly, explaining why they agree with, or differ from earlier views. Preferably, sources are primary and recent. In the second phase of this study, citations appended to 935 articles that have been taken and analysed individually. The 935 articles have cited a total of 20579 citations. The number of citations available in a paper depends upon several factors like the type of the field, the size and the citation characteristics of both the discipline and the length of the research papers and so forth (Introduction, n.d.).

Kinds of Citation Analysis

The kinds of citation analysis that have been used on a frequent basis include, co-citation analysis, bibliographic coupling, co-word analysis and direct citation.

Co-citation Analysis – This concept was suggested by H.G. Small and Marshakova in 1973 and later on was developed by Small in collaboration with Griffith and others. These are presented as a form of document coupling which shows the frequency with which two documents are cited together. Citations are often used in biblio-metric analysis, and they are also the basis for the co-citation analysis and bibliographic coupling. In co-citation analysis, the compilation of the data are the counts of the number of times, two documents are jointly cited in later publications. The fact of having been cited together in the same new paper forms a quantifiable connection between the earlier papers, the strength of the connection, depends upon the number of times that pair of documents are cited together. Co-citation analysis can also be based on the authors or journals as units of analysis. Journals can thus be

used for reviewing the organization of a subject literature through co-citation analysis. Co-citation of the published articles connect the journals in which they were published and the journal title then represents the subjects of all the articles included (Introduction, n.d.).

Bibliographic Coupling – In early 1960s, M.M. Kessier of Massachusetts Institute of Technology, introduced the term bibliographic coupling. This research puts emphasis upon the advantage of the coupling units, to be used as a retrieval tool. Each references of the earlier literature identifies a unique conceptual relationship between the reference citations and source citations. It is also known as an ancestor and descendant relationship. In bibliographic coupling, the hypothesis is that two articles which both cite the same earlier published article, have something in common. Analysis of the bibliographic coupling results in clusters of citing documents, when the co-citation analysis groups cited documents. In biblio-metric terminology, the citing articles form a research front, when a cluster of cited documents is called an intellectual base (Introduction, n.d.).

Co-word Analysis – Co-word analysis is based upon the analysis of the co-occurrence of the keywords. The keywords are primarily used to index articles and other documents. This method puts emphasis upon the existence and evolution of networks of problems, the so called problematic networks. The method is useful for mapping the content of research in a given field (Introduction, n.d.).

Direct Citation – This concept has been used by numerous researchers in order to establish a relationship among documents of various types. The latter provided a conceptual framework for understanding the concept of network in overall framework of scientific disciplines.

Significance of Citation Analysis

The significance of citation analysis includes the following: (Introduction, n.d.).

1. Giving credit to related work.
2. Reverence to developers.
3. Classifying methodology, equipment, etc.
4. Modifying one's own work.
5. Modifying the work of others.
6. Providing comprehensive background to the topic.
7. Disapproving the previous paper.
8. Notifying to forthcoming work.
9. Quoting earlier papers that offer associations for one’s notions, concepts or claims.
10. Drawing attention to previous work that is not well known, but ought to be.

11. Identifying an earlier publication from which the author attained the original idea for his or her work.

12. Recognizing original publications in which a notion or concept was discussed.

13. Citing a major figure, because it makes the research work more upright.

14. Citing articles that accept the author's perceptions of the journal's readers and what they are expecting. In other words, to fit the characteristic and status of the journal that the author is submitting the paper to.

15. To lead the reader to further studies in this field.

16. In terms of the preparation of bibliographies.

17. To study the use pattern of different types of documents.

18. To find out the relative use of different languages.

19. To study the use of the literature from different countries.

20. To study the distribution of subjects.

21. To decide the obsolescence rate of documents in different subjects.

22. To determine the interdependence and lineage of subjects.

23. To prepare ranked list of periodicals.

24. To study the rate of collaborative research.

25. In terms of the analysis of scientific journals.

Benefits of Citation Analysis

The benefits of citation analysis have been stated as follows: (Introduction, n.d.).

Citation analysis is used to study the citation connections between scientific papers, technical notes and reviews. For example, it may be used by the periodicals librarian for study of the structure of literature and to classify core journals.

Citation analysis provides pertinent measures of usefulness and relationships of journals, where primary function is to communicate the research results.

Citation analysis helps in the identification of key documents and formation of core lists of journals.

It helps in the grouping of the documents in accordance to the common references and citations.

Provides study of the attributes of literature, including growth rate, obsolescence and citation practices.

Limitations of Citation Analysis

The limitations of citation analysis have been stated as follows: (Introduction, n.d.).

A number of factors combine to limit the different ideals, principles and applications of the information system.

a. They provide only an inadequate and prejudiced record of the working of the information system.

b. Data have to be collected to a large extent by hand although citation indexes published by the institute for scientific can be utilized in some cases.

c. Inadequate research has been conducted into the judiciousness behind citing to enable the undeviating and confident application of data.

A citation study by definition eliminates all those publications that neither cites nor is cited, so as citing trends to be the province of specific subjects and publications, certain specific areas are differentiated against.

Science Citation Index (SCI) is a multi-disciplinary index to the world literature. It processes lakhs of articles and millions of references on an annual basis. Each source article and its connection with the cited article are mapped within this framework.

Chapter 18. Delphi Technique

The Delphi technique is a widely used and accepted method for data collection from the respondents within their domain of proficiency. The technique is designed as group communication process, which aims to achieve a convergence of opinion on a specific issue. The Delphi process has been used in various fields of study, such as, program planning, needs assessment, policy determination and resource utilization, with the purpose of developing a complete range of alternatives, explore and expose the underlying assumptions, as well as correlate judgments on a topic spanning a wide range of disciplines. The Delphi technique is well utilized as a method for consensus building, by making use of a series of questionnaires delivered, and making use of multiple iterations to collect the data from selected respondents. Selection of subjects and respondents, time frame for conducting and completing the study, possibility of low response rates and inadvertently directing feedback from the group of respondents are the areas that need to be considered when designing and putting into practice the Delphi technique (Hsu, & Sandford, 2007).

Delphi is a new technique, which promises the decision maker with concise and directly relevant information. The goals of the Delphi technique are to predict the future, and to evaluate the alternative courses of action. The researchers and the respondents are actually accomplices in the prediction enterprises. The Delphi technique can be used in the achievement of the following objectives. These include, determining or developing a range of possible program alternatives, exploring or exposing the underlying assumptions or information leading to various judgments, seeking information, which may generate a consensus on the part of the respondent groups, correlating informed judgments on a topic covering a wide range of disciplines and educating the respondent groups as to the diverse and interrelated aspects of the subject area (Hsu, & Sandford, 2007).

Delphi is not a procedure intended to challenge statistical or model-based procedures, against which the judgment of human beings are generally shown to be in a deprived state. It is primarily meant to be used in judgment and forecasting situations. In these situations, pure and model-based statistical methods are not considered practical or possible. The reason being, there is lack of appropriate historical, economic or technical data. Thus, some form of human judgmental issue is also considered necessary. It is vital to make effectual use of this input and for this purpose, Delphi technique is considered important (Rowe, & Wright, 1999). Delphi studies deal most exclusively with questions for which answers are not known

and cannot be discovered by any conventional means. It is possible, however to create a synthetic Delphi procedure, making use of the questions for which answers exist, but which are almost not known to the respondents.

Characteristics of the Delphi Technique

The characteristics of the Delphi techniques have been stated as follows: (Hsu, & Sandford, 2007).

The Delphi technique is well suited as a means and method of consensus building by using a series of questionnaires for the purpose of data collection from a panel of selected subjects. Delphi employs multiple iterations that are designed to develop a consensus of opinion, concerning a specific topic.

The feedback process permits and inspires the selected Delphi participants to reconsider their preliminary judgments about the information provided in previous iterations. Thus, in a Delphi study, the results of previous iterations regarding specific statements and/or items can be changed or modified by individual panel members in later iterations based on their ability to review and assess the comments and feedback provided by the other Delphi panellists.

Other noteworthy characteristics intrinsic with using the Delphi technique are the ability to provide anonymity to the respondents, a controlled feedback process, and the appropriateness of a variety of statistical analysis techniques to interpret the data. These characteristics are designed to offset the shortcomings of conventional means of pooling opinions, obtained from a group interaction, i.e., influences of individuals, noise, and group pressure for conventionality.

One of the principal characteristics and advantages of the Delphi process is subject anonymity. It can reduce the effects of dominant individuals, which often is a concern when using group-based processes to collect and synthesize information. Additionally, the issue of confidentiality is facilitated by geographic dispersion of the subjects as well as the use of electronic communication, such as e-mail to solicit and exchange information. As such, certain disadvantages associated with group dynamics, such as operation or pressure to follow or adopt a certain viewpoint can be minimized.

Controlled feedback in the Delphi process is designed to reduce the effects of noise. Noise is that communication, which occurs in a group process, which both misrepresents the

data and deals with the interests of the group and/or individual, rather than focusing upon problem solving. As a result, the information developed from this kind of communication normally consists of prejudice, not related to the purpose of the study. Principally, the controlled feedback process consists of a well-organized summary of the prior iteration, purposefully distributed to the subjects, which permits each respondent to have an opportunity to produce additional insights and more systematically elucidate the information developed by previous iterations. Through the operation of multiple iterations, subjects are expected to become more problem solving oriented, to give their judgements more insightfully, and to minimize the effects of noise.

Finally, the ability to use statistical analysis techniques is a practice, which causes a decline in the prospective of group pressure for conformity. More specifically, statistical analysis can ensure that attitudes produced by each subject of a Delphi study are well represented in the final iteration. The reason being, at the end of the exercise, there may still be a significant spread in individual opinions. That is, each subject would have no stress, either real or perceived, to conform to another participant's responses that may originate from deference to social norms, values, principles, standards, customs, organizational culture, or occupations. The tools of statistical analysis allow for an objective and unbiased analysis and summarization of the collected data.

Conducting a Typical Delphi Study

A Delphi study involves two or more groups of individuals. These include the researchers and the respondents. Researchers make a formal enquiry of the respondents, in terms of their background, occupation, age, gender, ethnicity, religion and caste. The survey questionnaire is formulated by the researchers, whose questions or proposals are conductive to eliciting precise responses as to when, with what probability, or with what degree of benefit certain events or conditions will obtain. When understanding Delphi technique, it is vital to obtain information regarding the rounds within the Delphi study.

In the first round, the Delphi process traditionally begins with an open-ended questionnaire. The open-ended questionnaire serves as the foundation of soliciting precise information about a content area from the Delphi subjects. In the second round, each Delphi participant receives a second questionnaire and is asked to review the items, summarized by the investigators based on the information provided in the first round. In the third round, each Delphi panellist receives a questionnaire that includes the items and ratings, summarized by

the investigators in the previous round and are asked to revise his or her judgments or to identify the reasons for remaining outside the consensus. In the fourth and often final round, the list of remaining items, their ratings, minority opinions, and items achieving consensus are distributed to the panellists. This round makes provision of a final opportunity for participants to revise their judgments (Hsu, & Sandford, 2007).

Limitations within the Delphi Technique

The limitations within the Delphi technique have been stated as follows: (Hsu, & Sandford, 2007).

Potential of Low Response Rates - Due to multiple feedback processes, inherent and integral to the concept and utilization of the Delphi process, the potential exists for low response rates and the determination to maintain vigorous opinion can be a challenge. In the Delphi technique, deprived response rate is enlarged fourfold, because a maximum of four surveys may be sent to the same panellists. If a certain portion of the subjects discontinue their responses during various stages of the Delphi process, the quality of information obtained could be discounted or at least scrutinized. Subject motivation is the key to the successful implementation of a Delphi study and researchers need to contribute an active part in this area to help ensure a high response rate.

Consumption of More Time – The Delphi technique can be time consuming and lengthy. It is iterative and sequential. Optimally speaking, the iteration characteristics of the Delphi process make provision of the opportunities for investigators and subjects to improve the accuracy of the results. In contrast, the same feature also increases the workload of the researchers and the amount of time required to efficaciously complete the data collection process.

Potential of Moulding Opinions – The iteration characteristics of the Delphi technique can potentially enable the researchers to mould the opinions. The subjects in this technique would rate the responses in a different manner after receiving an inaccurate feedback. The Delphi subjects rated the statement above average after receiving feedback. One of the major weaknesses in this technique is, understated pressure from group ratings. Delphi researchers need to be cognizant, exercise caution and implement proper safeguards in dealing with the issue.

Potential of Identifying General Statements vs. Specific Topic Related Information – An assumption concerning the Delphi respondents is, they are equivalent in knowledge and experience. However, this assumption might not be justified. More specifically, the expertise of the Delphi panellists could be distributed in an uneven manner, especially in the field of high technology. The knowledge and information of the panellists are different from each other. Some possess in depth knowledge, whereas others are more knowledgeable concerning different subject areas. Therefore, the subjects, who have less in depth knowledge are unable to state the most important statements, which have been identified by those subjects, who possess in depth knowledge in terms of the target concern.

Chapter 19. Trends in Library and Information Science Research

The trends for selecting the research area in library and information science has been stated as follows: (Pandey, 2014).

Academic Libraries

Libraries are referred to as an integral part of educational institutions. They serve the educational needs of the students and the teachers. The members of the educational institutions are able to access the educational resources and materials. One of the areas that is of utmost significance is, members of the educational institutions are required to bring about improvements in the library services and this has been a continuous demand from the teachers and students. Research in this area is also considered essential to formulate certain ways and sources to cope with the current demands of the individuals in the information age.

Biblio-metrics

Biblio-metrics is an organized set of methods. The main objective of these methods are that they are committed to the quantitative analysis of scientific and technical activities. These techniques put into operation the statistical and mathematical tools to measure the data that determine the contributions of the researcher to science and technical development. The data utilized for biblio-metric studies primarily develop from the information produced through the communication processes of the researcher. Biblio-metrics is referred to the application of statistical studies within the library and information centres. The area of biblio-metrics has been gaining prominence in libraries and information centres throughout the world.

Citation Analysis

Citation analysis is defined as the analysis of citations or references or both, which form part of the academic device of primary communications. The methods used for putting matters of references in some kind of rank or order, whether they are the journals or authors cited. Citation analysis involves counting of the number of citations within a particular document for a certain period of time after it has been published, this in some cases is called direct citations. Citation analysis leads to the initiation of more sophisticated methods. These include, co-citation, mapping of the literature, bibliographic coupling and co-word analysis.

Computer Applications in Libraries

Computer applications are referred to as important devices with the primary purpose to control any system. In libraries, there is an increasing use of computer systems and applications with the main purpose of providing automated and networking services, inspired by the library professionals to research those areas that are necessary to make provision of quality services to the users. Computer technology in the present existence is considered imperative in not only improving the teaching-learning methods, instructional strategies and other academic areas, but also to bring about improvements in other aspects of the educational institutions, such as, administration, management, direction, supervision, organization, clerical job duties and so forth.

Cost Benefit Analysis

Cost benefit analysis is regarded as an important tool for conducting an analysis of the usefulness and effectuality of any system in terms of the costs involved. When one is spending costs into some task or activity, it is important for the individuals to ensure that it proves to be productive. Cost benefit analysis is considered as one of the important areas for the management of the libraries. Bringing about progresses in areas, bringing in new materials, resources, equipment, technology, infrastructure, books, articles, documents require cost benefit analysis. Though this area is of utmost significance, but one point to be noted is, it is not being taken for research by the library and information science research scholars on a frequent basis.

Digital Library

Digital libraries make use of the advanced and innovative techniques and methods to render the library services information and communication technology environment of the present existence. In the present existence, there is research going on in studying about the technology involved in the formation of digital libraries. The primary focus of research centres is upon finding the initiatives that cause the digitization of the libraries and the related aspects. Digitization of libraries has proven to be effectual for the individuals. They are able to access thesis, journals, articles and other information online. The titles that have been found related to this area includes, digitization and open access initiatives: A study of special libraries in the national capital region; trends and development of digital libraries in scientific and research institutions in Delhi: a comparative study and design and development of digital database of homoeopathic information resources in India: a plan proposal.

Information Handling and Management

It is important to study and conduct research upon the systems in terms of information handling and management. Libraries are also considered as depositories of information and management. The members of the educational institutions, as well as the other individuals are required to handle and manage the infrastructure, equipment and technology with care. In some cases, individuals misplace the reading materials or lack the knowledge in terms of information handling and management. Therefore, it is vital for the individuals to possess the desired skills and abilities to handle and manage the information, infrastructure, equipment and technology with carefulness and precision.

Information Sources and Services

Information needs to be scanned, stored and presented in such a manner that it should be manageable for the individuals to make use of it in an appropriate manner. In the libraries, there are numerous sources of information, these include, books, articles, journals, newspapers, magazines, computers, thesis, projects and other documents. The individuals, pursuing masters and doctoral programs are required to make use of these sources in their research. Whether they are working on a research paper, a project or thesis. These sources make provision of adequate information to them. Services are referred to the assistance that one obtains from the staff members of the library. Their primary job duties is to help the individuals to find the materials or in making use of technology. When the individuals need to obtain any information regarding the library or in the implementation of certain functions, then they approach the staff members.

Information and Communication Technology

Information and Communication Technology (ICT) has influenced each and every sphere of human activity. In every field, the implementation of various tasks and functions take place with the help of ICT. In the field of education, research is an imperative area. In order to conduct research, especially relating to enhancement of libraries, the field of information and communication technology is considered indispensable. In order to acquire complete knowledge and understanding of this field of ICT, individuals need to research this area appropriately. This area is considered important to acquire awareness of the effects of ICT as well as to know about new prospect for handling library activities using ICT.

Intellectual Property Rights Issues

Intellectual Property Rights (IPR) are the set of rights associated with formations of the human mind. An output of the human mind may be recognized with intellectual property rights. These are like any other property, and the law permits the owner to use the same to

economically benefit from the intellectual work. Generally IPR covers laws related to copyrights, patents and trademarks. While there are variations in laws in different countries, they follow the international legal instruments. The establishment of the World Intellectual Property Organization (WIPO) has established the significance of IPR for the economic growth of nations in the knowledge economy (Intellectual Property Rights, 2015). Lawful features of information with special reference to India, which reflects the IPR matters in digital libraries. Research is required in this area to know about the Intellectual Property Rights Issues related to digital libraries and ways to manage them.

Internet Applications in Library

Internet is regarded as the prominent source of information. It is helpful and available at any point of time. When individuals have to search information relating to various subjects and areas. In the improvement of the libraries in educational institutions, the role of internet is regarded as significant and it is performing its role in a well-organized manner. A great deal of research is going on, relating to the applications of the internet in the present world activities of the library. Internet can help the individuals to look for various advanced and innovative techniques and methods that are necessary in bringing about improvements in the library services.

Open Access and E-Journals

In educational institutions at all levels and especially in colleges and universities, open access and e-journals have become an important topic for research. Some of the topics covered under this area are, open sources movement in India with special reference to digital library software: a study; use of electronic Journals in Agriculture Libraries by the Agricultural Scientists in Delhi; Electronic Journals: a study of UGC Info-net E-Journals Consortium with special reference to University Libraries in Delhi: a study; Use of E-Journals by users of ICMR labs in Delhi; Use of E-Journals in the field of chemistry by the faculty members and research scholars in the university libraries in Delhi: a study; Use of resources in the field of geography by the users in selected university libraries in Delhi; Electronic resources: A survey of current practices in university libraries in Delhi and electronic resources in Physics in selected libraries in Delhi. Open Access resources are becoming popular because of their unrestricted access. Research in this area is important to find better service conditions for the users.

Performance Appraisal

Performance appraisal plays an important part in accessing the working abilities of the individuals within the educational institutions. The main purpose of performance appraisal

systems is to assess the skills and abilities of the employees, identify the weak areas and implement measures to make improvements. The performance appraisal systems have proven to be helpful in enhancing the functioning and performance of the individuals. Research in this area is considered important to ensure better service conditions for the library professionals, so that they are able to perform their job duties in a well-organized manner and may give maximum output for their routine work.

Public Libraries

Public libraries contribute an important part in the dissemination of information to the individuals of the community as well. Apart from the students, professors and the staff members of the educational institutions, the individuals living in the community also have the right to access the libraries, use computers, issue books, or just utilize the library for reading purposes. In this way, the libraries are rendering a significant contribution to the improvement of lifelong learning of the individuals. The community individuals, when have access to the library facilities are able to enrich their learning and generate awareness relating to various areas.

Thesaurus

Thesaurus is referred to as a reference work that lists the words grouped together in accordance to the similarity of meaning containing synonyms and sometimes antonyms. Thesaurus is not the complete list of all the synonyms for a particular word. The entries are also planned for comprehending the differences between similar words and choosing the right word. In the case of thesaurus, there have been initiation of two topics, out of which first one is regarding creation of Bilingual Thesaurus of LIS: A pragmatic and thematic approach and the other is 'Thesaurus of LIS in Gujarati'. It indicates that there is a slow speed for taking thesaurus as a theme of Ph.D. research.

User Studies

Users are regarded as one of the most important components of the library system. The reason being, without the users, the collecting, processing and managing the information would not be useful. Within the library, bringing in new books, articles, journals and other documents, making improvements in technology and putting into practice advanced and innovative strategies and methods have the major objective of enhancing learning and understanding of the users. In higher educational institutions, when individuals are pursuing masters or doctoral programs, then these strategies would certainly prove to be helpful and beneficial to them. New sources would enable them to frame their reports, and projects in a well-organized manner.

The Role of University Grants Commission in Promoting Libraries in India

The appointment of University Education Commission under the chairmanship of Dr. S. Radhakrishnan was the most important task of the Government of India towards the development of higher education. It is only after the appointment of this commission that the concrete process of development of the university libraries took place in India. The commission made recommendations that are related to annual grants, open access system, working hours, organization of the library, recruitment of staff members, and providing adequate materials and resources. However, meaningful steps for the staff development of the libraries was taken up only after the establishment of UGC on December 28, 1953. UGC has appointed various systems for the review and improvement of the library system in India. The library committee recommended the appointment of another committee to look into the standards of teaching and learning, and examination and research in library schools. The committee also observed that the status and salary of the library staff should be the same as that of teaching and research staff. UGC accepted all the recommendations of the library committee. As a result, a staff formula for the university and college libraries was formulated and the status and salary of the library staff was made at par with the academic staff (Devi, & Singh, 2006).

Chapter 20. Research Evaluation

Evaluation is a methodical area that is closely related to but distinguishable from more traditional social research. Evaluation utilizes many of the research methodologies, used in traditional social research. It takes place within organizational and political framework and for this purpose, it requires group skills, management capability, political dexterousness, sensitivity to multiple stakeholders and other skills that social research does not depend upon to a much greater extent. In this case, the concept of evaluation has been introduced and in addition, there have also been initiation of some of the major terms and issues that are used in this field. Evaluation is the systematic assessment of the worth or merit of some object. There are number of evaluations that do not necessarily result in an assessment of value or quality. Evaluation is referred to as a methodical acquisition and assessment of information to make provision of useful feedback regarding some objects (Trochim, 2006).

Goals of Evaluation

The standard goal of most of the evaluations is to provide valuable feedback to a variety of audiences including sponsors, donors, client groups, administrators, staff, and other pertinent constituencies. Most often, feedback is perceived as worthwhile, if it assists in decision making. The relationship between an evaluation and its influence is not a simple one, studies that seem critical, in some cases, fail to influence the short term decisions, and studies that initially do not have any influence can have a delayed influence when more agreeable conditions arise. Despite this, there is a comprehensive consensus that the major goal of evaluation should be to have an impact upon the decision making processes or policy formulation through the provision of empirically driven feedback (Trochim, 2006).

Evaluation Strategies

Evaluation strategies are referred to comprehensive, and all-encompassing viewpoints on evaluation. They incorporate the most general groups or camps of evaluators, although, at its best, evaluation work borrows eclectically from the viewpoints of all these camps (Trochim, 2006). Four major groups of evaluation strategies have been stated as follows: (Trochim, 2006).

Scientific-experimental Models – These are perhaps the most historically dominant evaluation strategies. The values and methods contained within the scientific-experimental models are derived from the sciences, especially the social sciences, they prioritize on the suitability of impartiality, accurateness, precision, objectivity and the validity of the information generated. Included under the scientific-experimental models would be the tradition of experimental and quasi-experimental designs; objectives based research that is originated from education; econometrically-oriented viewpoints including cost-effectiveness and cost-benefit analysis; and the recent articulation of theory-driven evaluation.

Management-oriented Systems Models - Two of the most common of these are PERT**,** the Program Evaluation and Review Technique, and CPM, the Critical Path Method. Both have been broadly used in business and government. It would also be legitimate to include the logical framework or log frame model developed at the U.S. Agency for International Development and general systems theory and operations research approaches in this category. Two management-oriented systems models were originated by the evaluators: the UTOS model, where U stands for Units, T for Treatments, O for Observing Observations and S for Settings; and the CIPP model, where C stands for context, I for input, the first P for process and the second P for product. These management-oriented systems models put emphasis upon the comprehensiveness in evaluation, placing evaluation within a larger context of organizational activities.

Qualitative or Anthropological Models - The third class of strategies are the qualitative or anthropological models. They focus upon the significance of observation, they need to maintain the phenomenological quality of the evaluation framework, and the value of subjective human understanding within the evaluation process. Included in this category are the approaches known in evaluation, as naturalistic or 'Fourth Generation' evaluation. The various qualitative schools, critical theory and art criticism approaches and, the grounded theory approach of Glaser and Strauss are included among others.

Participant-oriented Models – These models puts emphasis upon the central importance of the evaluation participants, especially the clients and users of the program or technology. Client-centred and stakeholder approaches are the examples of participant-oriented models, as are consumer-oriented evaluation systems.

Types of Evaluation

There are many different types of evaluations depending upon the object being evaluated and the purpose of evaluation. Perhaps the most important basic distinction in evaluation types is the one between formative and summative evaluation. Formative evaluations reinforce or progress the object being evaluated, they help form it by examining the delivery of the program or technology, the quality of its implementation, and the assessment of the organizational framework, personnel, procedures, inputs, and so forth. Summative evaluations, in contrast, examine the effects or outcomes of some object, they summarize it by describing, what happens subsequent to delivery of the program or technology, evaluating whether the object can be stated to have caused the outcome, determining the inclusive impact of the causal factor beyond only the instantaneous target outcomes, and, assessing the relative costs associated with the object (Trochim, 2006).

Formative evaluation includes several evaluation types: (Trochim, 2006).

Needs assessment determines the category of the individuals, who are in need of the program. How major the need is, and what practices, strategies and methods need to be put into practice in order to meet the needs.

Evaluation assessment determines whether an evaluation is practicable and how stakeholders can assist in structuring its efficacy and usefulness.

Structured conceptualization helps the stakeholders describe the program or technology, the target population, and the possible outcomes.

Implementation evaluation monitors the commitment and trustworthiness of the program or technology delivery.

Process evaluation scrutinizes the process of delivering the program or technology, including, alternative delivery procedures.

Summative evaluation can be sub-divided into the following types: (Trochim, 2006).

Outcome evaluations examine whether the program or technology caused noticeable effects on explicitly defined target outcomes.

Impact evaluation is comprehensive and measures the general or net effects, intended or unintended of the program or technology as a whole.

Cost-effectiveness and cost-benefit analysis report questions of effectiveness by regulating consequences in terms of their expenses and principles.

Secondary analysis reconsiders the existing data to report new questions or use methods that have not been implemented earlier.

Meta-analysis incorporates the outcome assessments from multiple studies to arrive at an inclusive or summary judgement on an evaluation question.

Evaluation Questions and Methods

Numerous kinds of questions arise within the mind-sets of the evaluators and they make use of variety of methods to address them. These are considered within the framework of formative and summative evaluation (Trochim, 2006).

In formative research, the major questions and methodologies are: (Trochim, 2006).

What is the definition and scope of the problem or issue, or what's the question?

Formulating and conceptualizing methods might be used, including brainstorming, focus groups, nominal group techniques, Delphi methods, brain-writing, stakeholder analysis, synectics, lateral thinking, input-output analysis, and concept mapping.

Where is the problem and how big or serious it is?

The most common method used here is "needs assessment" which can include, analysis of existing data sources, sample surveys, interviews of constituent populations, qualitative research, expert testimony, and focus groups.

How should the program or technology be delivered to address the problem?

Some of the methods that are applicable in this case include, detailing methodologies like simulation techniques, or multivariate methods like multi-attribute utility theory or exploratory causal modelling, decision making methods, and project planning and implementation methods like preparation of flow charts, PERT/CPM, and project scheduling.

How well is the program or technology delivered?

Qualitative and quantitative monitoring techniques, the use of management information systems, and implementation assessment would be appropriate methodologies in this case.

The questions and methods stated under summative evaluation include: (Trochim, 2006).

What type of evaluation is feasible?

Evaluation assessment can be used here, as well as standard methods required for the selection of a suitable evaluation design.

What was the effectiveness of the program or technology?

One would make a selection from observational and correlational methods for demonstrating whether the desired effects occurred, and quasi-experimental and experimental designs for determining, whether observed effects can rationally be recognized to the intervention and not to the other sources.

What is the net impact of the program?

Econometric methods for assessing the cost effectiveness and cost benefits would apply here, along with qualitative methods that enable individuals to summarize the complete range of projected and unintentional influences.

The evaluation methods are required to get enhanced, rationalized and on needs to adapt these methods to the changing conditions. This means that methodological research and development needs to have a major place in the task of evaluation.

Chapter 21. Writing Reports and Thesis

Report is a document in which the problem is given in some detail. The effectiveness of the report to a major extent depends upon the clarity and completeness of the contents and presentation. Report writing is termed as functional writing. Accuracy and clarity of content and information are the major aspects that the researchers have to take into account, when working on a research report. Writing reports and thesis include four stages, preparation, arrangement, writing and revision.

Preparation

In reports and thesis, the first and the foremost step is preparation. In this case, the researchers are required to prepare the material and content that would comprise an integral part of the reports. These need to be in accordance to the main variables within the topic of research. In order to prepare the material, they are required to obtain information from a number of sources, including, books, articles, internet and so forth. Upon implementation of extensive research, the information collected have to be adequately organized. The chapterization plan, bibliography and appendices, have to be prepared in an appropriate manner in accordance to the format and structure, before, they become part of the main report. In preparation, the main areas include, language and its use, sentences, understandable jargon, grammar, spelling, style, and sense ending.

Arrangement

The next important step is arrangement of information and data. After the matter is composed, it should be read once again to detect the errors that might have occurred in composing. This is known as proof reading. A proof reader uses the same symbols used by the editor to instruct the corrections. A proof reader takes care of typographical errors, punctuation marks, numbering, pagination, wrong typefaces, missing letters and so forth. In arrangement, it is vital to take into consideration, preliminary text and reference material. The main aspects that need to be taken into consideration is, the information and data collected should be placed in a proper format. It is essential to ensure that the information that is required to be put in the introduction chapter, should be put appropriately; information that is required to be put in the literature review chapter, should be put correctly and so forth.

Writing

The researcher finally has to put all the information collected in writing. The information primarily comprises of the data and other materials that he has collected from books, articles, internet or other documents. The layout of the report or the thesis has to be in accordance to the preliminary pages, main text and the end matter. In the preliminary pages, the report or the thesis should carry out the title, date, acknowledgements, table of contents, list of tables, list of graphs, or charts, given in the report. When writing a report or a thesis, the researchers need to take into consideration, number of factors, these include, sentence structure, grammar, punctuation, information and so forth. The researcher should carefully check the title, sub-title, name, references, notes, sectional headings, typography, illustrations, appendices, quotations, numbers, dates, proper names, pagination, continuity of text and so forth. In most cases, writing also involves preparation of charts or graphs into the reports or thesis. The researchers have to be careful that sentences are not repeated and information and sentences should be meaningful and understandable.

Revision

Revision of the report is essential, it helps to identify the flaws and inconsistencies that have taken place in a report. In the revision process, editing is an essential step in improving the quality of the report in terms of presentation, grammar, typography, format, balance of contents etc. Errors from a number of sources occur into reports and thesis, hence, the researchers should work towards correction of errors and making improvements. In revision, the researchers are required to review the entire report, the chapters, content, material, information, bibliography, appendices, structure and format. In the review process, they ensure that sentences are not repeated, they are properly structured, information is adequately organized and there are not any kinds of grammatical errors. The edited report should be concise, forceful, clear and complete.

Chapters of the Reports and Thesis

The chapters that comprise the reports and thesis should be stated as follows:

Introduction

It should contain a clear statement of objectives of the research, an explanation of the methodology adopted and information regarding the research area. The scope of study along with various limitations should also be stated within this section. The main purpose of

introduction is to provide adequate information to the readers regarding the research topic and what are the measures that have been formulated in the implementation of research.

Literature Review

After the introduction, the second chapter is the literature review. Literature review mainly comprises of opinions of various authors regarding the variables that have been used in the research study. The main body should be presented in a logical sequence and broken down into readily identifiable units. The literature review is the second chapter in the report or the thesis and one is able to acquire adequate understanding of various authors, who have worked in the similar research area. The authors included are both national as well as international.

Methodology

The main purpose of this chapter is to provide the necessary information regarding the procedures that have been used in the collection of data. Methodology is usually the third chapter of the thesis. In this chapter, the methods are stated that are used in the collection of data, tools used for the collection, kind of data, sample design, the data that is tested for validity and reliability, strengths and limitations of the research study and problems faced during the study.

Data Analysis and Interpretation

After the data has been collected and organized in a proper form, the fourth chapter is formulated, which is termed as data analysis and interpretation. In this chapter, the researcher illustrates the data in the form of graphs, charts, tables and provide explanation regarding, how the data has been collected, analysed and interpreted. The data has to be classified and tabulated with the scientific methods to obtain the results. After the tabulation of data, much is dependent upon the results interpreted. The results are normally presented with the help of graphs, and pictorial materials. The discussions should be creative, critical and revealing. Analysis contains the texts with tables and figures formed in an appropriate manner. Whether the data is quantitative or qualitative in nature, and whether it has been analysed through SPSS or any other techniques are reported in a proper format in this chapter.

Summary of Findings

The next chapter would contain the summary of findings and recommendations for future research. The findings are produced as a result of analysis and then they are summarised. These depict the outcomes of the analysis of data. The recommendations primarily focus upon the suggestions for future research. When research would be conducted in future regarding similar area of study, then what kinds of measures and procedures should be implemented.

Conclusion

The conclusion is an integral part of the thesis. Within the conclusion, if there are any kinds of particular suggestions or recommendations, then they are required to be added. Towards the end of the main text, the researcher should again put down the results of the research study, clearly and precisely. Indeed, it is known as the final summing up. The main purpose of conclusion is to provide assumption and supposition of the entire thesis.

In the writing of the report and thesis, the steps that need to be taken into consideration usually comprise of the preliminary section, introduction, statement of problem, significance of the problem, purpose, statement of hypothesis, assumptions, limitations and definitions, review of the literature, description of the research design, sources of data, sampling procedures, data collection methods, statistical treatment, data analysis and summary and conclusions.

Chapter 22. Aging and Obsolescence

Age is related to the date of publication or origin and obsolescence is referred to no longer useful or reliable documents. The concept of aging and obsolescence signifies that documents, articles, reports, projects and pamphlets also have a certain age and are useful and consistent for a certain period of time. For instance, certain documents, articles, research papers, projects, thesis and reports may have a long life span. They may be applicable and in use for a long period of time from the date of publication or origin. These may include, masters or doctoral thesis, Government documents, reports and articles relating to the budgets of previous years and so forth. On the other hand, pamphlets, leaflets, brochures, and guides are examples of documents that have a short life span. Age is referred to the difference between the date of publication or origin to that of its actual use.

The concept of half-life has been borrowed from the field of nuclear physics to illustrate the journal obsolescence. The citation half-life provides a quantitative measure of the rate at which the scientific papers become obsolete. Citation half-life is related to the growth and development of the literature. There have been emergence of the conflicting views on obsolescence. While all the biblio-metric studies make an attempt to find the utility of publications, the technique of obsolescence has been specifically used in the confirmation or rejection of the idea that the document use or value declines with age.

Functions of Aging and Obsolescence

The functions of aging and obsolescence include, bringing about enhancements within the knowledge of the aging mechanisms; justifying an appropriate and robust aging management for non-replaceable organizations; mechanical performance comprises of conservative and deterministic methods; anticipating the potential and exceptional maintenance of useable constituents; implementing outlooks for limiting the solicitation of equipment; strengthening the watching of particular equipment and maintaining one's qualifications during the conditions of misfortunes (Vaucher, 2017).

Chapter 23. Organization of Reports and Thesis

Research reports are considered as a major component of the research study. The research work gets completed only with the presentation and writing of the report. The purpose of the research is not adequately fulfilled, unless the findings are made known to others. Research results must consistently enter the general store of knowledge. These are the primary aspects that are important in the organization of reports and thesis. It is the final step in the research study and requires a set of skills that are different from the ones that are required in the previous stages of research. The researcher has to implement this task with utmost care and requires assistance and help from his supervisors and experts (Kothari, 2004).

In the reference section, bibliography, appendix and indexes etc. are included. Bibliography is considered as an imperative part of the thesis. It comprises of the list of authors, books, articles, journals, reports and other information that has been incorporated within the thesis. It needs to be prepared adequately and should be easy to locate. Indices make the information usually accessible to the readers. Footnotes are given either at the bottom of each page to which these refer or at the source material, from which a technique or an expression has been borrowed. Sometimes, it is also explanatory. Indices may be one or more, depending upon, how the readers are likely to lookup information. Some books give both subject and an author index, while others give specialised indices. References can be name-date style, numbered style, parenthetical number style and super script numbers.

Endnotes are put at the end of the thesis. The page numbers of the text to which the endnotes refer should appear at the top of each page of the notes. At the beginning of the notes of each chapter, both the number and the title of the chapter should be stated. Each footnote or endnote must begin on a new line, indented the same as paragraphs within the text. All notes are single-spaced, with double-spacing between them. Each note should end with a period. Notes should be numbered consecutively, starting with one for each chapter. In most cases, the use of Roman numerals are made. Either of two styles may be followed in numbering footnotes. The simpler one is to use numerals on the line, followed by a period. The older style is to use superscript numbers, like footnote numbers within the text, without punctuation. For endnotes, use numerals on the line, followed by a period (General Guidelines 2006).

Footnote or endnote numbers within the text, normally appear after punctuation marks rather than before them. They have the main purpose of providing information about the author or the source that has been used within the text. They facilitate the understanding of the readers. The note number, giving the source of the quotation normally appears at the end of the quotation. At the end of every thesis or dissertation, a brief biography of the author is prepared and is put on the last page of the document. The normal length is one paragraph, but it should not be more than one page. Numbering is required for the page. The biography does not appear in the table of contents (General Guidelines 2006).

Types of Reports

The research reports vary in length and type. The background of the potential audience, their total research situation and their technical background and knowledge are crucial factors in the types of reports. The reports may be either short or long. Short reports have a brief statements in terms of the authorization of the study, problem, summary, conclusions and recommendations. The long report may be a technical report or popular report. The technical report is prepared for the specialists, who have developed an interest in understanding the technical procedure and terminology used within the research project. The reports are required to be prepared in technical language. Tables, charts, diagrams, figures and illustrations are common in reports.

Technical Report – In the technical report, main emphasis has been put upon the methods employed, assumptions made within the course of study, and the detailed presentation of the findings, including their limitations and supporting data. The format of the technical report comprises of summary of results, nature of the research study, methods employed, data analysis and the presentation of findings, conclusions, bibliography, technical appendices and index. This order gives a general idea of the nature of a technical report. The order of the presentation may not essentially be the same in all the technical reports. This, in other words, means that the presentation may vary in different types of reports. Even the different sections outlined above will not always be the same, nor will all these sections appear in any specific report. It should, however be remembered that even in a technical report, simple presentation and ready obtainability of the findings remain an important consideration. It is appropriate to consider the liberal use of charts and diagrams (Kothari, 2004).

Popular Report - The popular report is the one which puts emphasis upon uncomplicatedness and desirability. The simplification should be sought through strong writing, minimization of technical, particularly mathematical, details and the liberal use of

charts and diagrams. Good quality layout along with large print, many sub-headings, appealing figures and diagrams are another characteristic features of the popular report. Besides, in such a report, emphasis is put upon the practical aspects and policy implications. The main aspects of the popular report includes, findings and their implications, recommendations for actions, objectives of the study, methods employed, results, and technical appendices. There can be several variations in terms of the format, in which a popular report can be prepared. The only important thing about such a report is that it puts emphasis upon simplicity and policy implications from the operational point of view, avoiding the technical details of all sorts to a large extent (Kothari, 2004).

Oral Presentation

At times the oral presentation of the results are considered effectual, especially in the cases, where the policy recommendations are directed by project results. The worth of this approach lies in the fact that it makes provision of the prospect for the decisions in terms of give and take, which normally leads to a better understanding of the findings and their implications. The main disadvantage of this presentation is the lack of any permanent record in terms of the research details and it may be possible that the findings may weaken before any action is put into operation. In order to overcome this effort, a written report may be circulated before the oral presentation and is referred to on a regular basis during discussion (Kothari, 2004).

Oral presentation is operative when supplemented by various visual devices. The use of technology is helpful in this kind of presentation. Use of slides, wall charts and blackboards is quite co-operative in contributing to precision and lucidity, and in leading to a decline in boredom. Distributing a broad outline, with a few important tables and charts relating to the research results, makes the listeners attentive, who have a ready outline on which their thinking is focused upon. This quite often happens within the academic institutions, where the researcher discusses his research findings and policy implications with others either in a seminar, workshop, presentation, conference or in a group discussion. Thus, research results can be described in more than one ways, but the usual practice adopted, in academic institutions especially, is that of writing the technical report and then preparing various research papers to be discussed at various forums in one form or the other. But in practical field and with having problems in policy implications, the practice followed is that of writing a popular report (Kothari, 2004).

Chapter 24. The Role of Computer Technology in Research

Problem solving is an activity that has been prevalent since ancient times. The development of electronic devices, especially computers, has given additional stimulus to this activity. Problems which could not be solved earlier due to complete amount of computations involved can now be undertaken with the assistance of computers precisely and speedily. Computer is certainly one of the most resourceful and useful developments of the modern technological age. In the present existence, individuals use computers in almost every walk of life. The computers are not just used by the individuals in providing solutions to the problems and in carrying out of tasks and functions, but also for leisure purposes. Their sole purpose is to do mathematical calculations at high speed and they are also utilized in philosophy, psychology, mathematics and linguistics to produce the desired output. The erudition in computer technology has been valuable in all areas and fields. Indeed, the progression in computers is surprising. To the researcher, the use of computers is to scrutinize the complex data that has made complicated research designs practical. Electronic computers have now become an essential aspect of the researchers in the physical and behavioural sciences as well as in humanities (Kothari, 2004).

The Significance of Computer Technology

In the present existence in all fields, the use of computers have become prominent. They are used to carry out various kinds of tasks and functions and are regarded as an imperative means of communication. Computer is a machine capable of receiving, storing, manipulating and yielding information, such as numbers, words, and pictures. The computer can be a digital computer or an analogue computer. A digital computer is the one, which functions fundamentally by counting by making use of information, including letters and symbols, in a coded form. On the other hand, the analogue computer operates by measuring rather than counting (Kothari, 2004).

Digital computer handles information as strings of binary numbers i.e., zeros and ones, with the help of the counting process. Analogue computer transforms varying quantities such as, temperature and pressure into the corresponding electrical voltages and then performs identified functions on the given signals. Thus, analogue computers are used for certain focussed engineering and scientific applications. Most computers are digital, so much so that the word ‘computer’ is commonly accepted as being synonymous with the term ‘digital computer’. Over the time period of four decades, computer technology has undergone

a significant change. The present day micro-computer is far more influential and costs less, as compared to the world's first electronic computer i.e. Electronic Numerical Integrator and Calculator (ENIAC) established in 1946. The micro-computer works faster, is more reliable and has a large memory (Kothari, 2004).

The Computer System

All the computer systems can be described as containing some kind of input devices, the CPU and some kind of output devices. The function of the input-output devices is to get information into, and out of the CPU. The input devices interpret the characters into binary, comprehensible by the CPU, and the output devices retranslate them back into the familiar character i.e., in a human readable form. In other words, the purpose of the input-output devices is to act as translating devices between the external world and the internal world of the CPU i.e., they act as an interface between man and the machine. CPU has three segments i.e. internal storage, control unit, and arithmetic logical unit (Kothari, 2004).

When a computer program or data is input into the CPU, it is in fact input into the internal storage of the CPU. The control unit serves to direct the sequence of computer system operation. Its function extends to the input and output devices as well and does not just remain confined to the sequence of operation within the CPU. The arithmetic logical unit is concerned with performing the arithmetic operations and logical comparisons designated into the computer program. In terms of inclusive sequence of events, a computer program is input into the internal storage and then transmitted to the control unit, where it becomes the basis for overall sequencing and control of computer system operations. Data that is input into the internal storage of the CPU is available for processing by the arithmetic logical unit, which transports the results of the calculations and comparisons back to the internal storage. After the designated calculations and comparisons have been accomplished, output is obtained from the internal storage of the CPU (Kothari, 2004).

Important concepts in the context of computers have been stated as follows: (Kothari, 2004).

Hardware – All the physical components such as, CPU, input-output devices, storage devices etc. of a computer are co-operatively called hardware.

Software – It comprises of the computer programs written by the user, which allow the computers to execute the instructions.

Firmware – It is that software that is integrated by the manufacturer into the electronic circulatory of the computer.

System Software – It is the software that communicates the point to the computer in terms of the implementation of the functions. It is also known as operating software and is normally supplied by the computer manufacturer.

Application software - It is that program which communicates to the computer how to perform particular tasks such as, preparation of company pay roll or inventory management. This software is either written by the user himself or is supplied by the software houses, the organizations, whose business is to get engaged into manufacturing and selling of software.

Integrated Circuit (IC) - It is a complete electronic circuit fabricated on a single piece of pure silicon. Silicon is the most commonly used semi-conductor, a material which is neither a good conductor of electricity nor a deprived one. An IC may be small scale, medium scale or a large scale depending upon the number of electronic components fabricated on the chip.

Memory Chips - These ICs form the secondary memory or storage of the computer. They hold data and instructions, not needed instantaneously by the main memory contained in the CPU.

Two-state Devices - The transistors on an IC chip take only two states, they are either on or off, conducting or non-conducting. The on-state is represented by one and the off-state by zero. These two binary digits are called bits. A string of eight bits is termed as byte and a group of bits constitute a word. A chip is called eight bit, 16 bit, 32 bit and so forth, depending upon the number of bits contained in its standard word.

Characteristics

The characteristics of computers have been stated as follows: (What is Computer? n.d.).

Speed - A computer is a fast electronic machine. It can perform large amounts of work in few seconds and is efficient and accurate in the performance of tasks and functions. Where human beings are involved in the implementation of particular work for the entire day, computer does the same in a short amount of time. In the present world, computers can perform 100 million computations in one second. The speed of computers are measured in terms of micro seconds, Nano seconds and even in Pico seconds. Where one second = 10^{-6} micro second = 10^{-9} Nano second = 10^{-12} Pico second. Computers can perform calculations in just few seconds as compared to human beings, who would take a longer amount of time to do so. This has led to many scientific projects, which were earlier difficult to carry out.

Accuracy - The computer is precise and proficient in the implementation of mathematical calculations and logical operations. The results generated are 100% accurate.

The cause of errors may be due to incorrect feeding of the data or due to wrong settings of the programmers. In the case of data analysis, Statistical Package for Social Sciences is made use of. This software is effective in the production of desired outcomes, which occurs as a result of appropriate feeding of the data.

Diligence – The computer has the capacity to operate for long hours, without taking any rest. Being a machine, a computer does not experience the human qualities of tiredness and lack of concentration. Even after working for long hours, the work and outcomes generated are accurate and precise. Even if numerous calculations have to be performed, it will perform the two millionth with just the same precision and the speed as the first.

Versatility - Versatility is referred to the resourcefulness, usefulness, and flexibility of the computer. It is one of the most magnificent features about the computer that have enriched the lives and workings of the individuals. The computer has the capacity to perform multiple jobs at a time. One is able to perform mathematical calculations, prepare reports, do research on the internet, simultaneously. Computers are used in the data processing jobs to a major extent, these include, weather forecasting, ticket reservation, multimedia designing, animations, accountancy and so forth.

High Memory - Computer has more memory or storage capacity as compared to human beings. It can store millions of data, information and instructions, which can be retrieved and recalled even after a number of years. In a computer, when an article or report or document is prepared, then if it is saved, it can be read even after months. This is not possible in case of human beings, they may not recall the incidents that have occurred months or years ago.

Automation – Computers are automatic in operation. The individuals are required to possess the desired skills and abilities that are needed to operate a computer in an appropriate manner. The individuals working on a computer, especially when they are implementing data analysis are required to feed the data in an appropriate manner. Upon feeding of the data, it is vital to give the command, regarding the descriptives, frequencies or the tests that the researchers need to implement. The computer software has the primary function of operating the data in accordance to the instructions.

Superiority of Manufacture - Computer hardware is manufactured using the best quality materials by the processor of superior quality. It has supremacy of manufacture as compared to the other machines. The superiority of manufacturing of computer is of utmost significance in terms of the implementation of tasks and functions. When the manufacturing

processes of the computer are carried out in an appropriate manner, then the computer will be operative in carrying out the research procedures.

Reduce the Paper Work – Making use of computer leads to a decline in paper work. The individuals are less likely to frame the documents and reports manually and tend to make use of a computer to a major extent. The usage of a computer leads to efficiency in the performance of tasks. In solving mathematical problems, which individuals find difficult, computers are made use of and they are less time consuming. The individuals are able to carry out numerous tasks using computers in lesser duration of time.

Relationship between Computers and Research

There is a strong correlation between research and the usage of computer technology. In order to carry out research in an efficient manner, it is indispensable to make use of technology. Computer technology is regarded as one of the most effectual sources that are used to generate knowledge and information regarding numerous aspects. Information is obtained on the internet regarding all the subjects and fields. Research is of numerous kinds, it includes, working on a research paper, project, report, article or a thesis. The extent of research may vary in accordance to the subject area and length of the document. Some may require extensive research, whereas, some may require less research. Books, articles, documents, projects, reports and computers are considered as important areas that are made use of to implement research.

Computers are regarded as imperative, when individuals have to work on a report or a thesis or a paper. They help them to find answers to the questions immediately. In higher educational institutions, in the pursuance of masters and doctoral programs, students are in some cases, engaged in part time or full time jobs, hence, they experience lack of time to devote towards their project. In other words, they do not find time to visit the library or collect books, hence, computers are regarded as primary sources that are used to complete the project in lesser duration of time. The internet enables the individuals to access numerous articles, papers, reports and projects. Computers are vital in conducting data analysis in terms of large research projects. Researchers are normally concerned with huge storage of data, their faster retrieval, when required and processing of data with the assistance of various techniques.

The statistical techniques can be carried out, making use of computers in an effectual manner. Means, standard deviations, correlation coefficients, t-tests, analysis of variance, analysis of co-variance, multiple regression, factor analysis, and various non-parametric analysis are the statistical techniques that are put into operation through the use of computers.

In the present existence, not only in India, but throughout the world, computers are utilised to prepare presentations, articles, reports and projects. The storage facility that the computer provides is of enormous help to the researcher, for he can make use of stored data, whenever he needs it. Numerous data can be processed and analysed with greater ease and speed. The results that are obtained are accurate and reliable. The important steps that the researchers need to be aware of include, data organising and coding, storing the data in a computer, selection of appropriate statistical measures and techniques, selection of appropriate software package and implementation of the computer program.

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