

Research Methodology

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MEANING OF RESEARCH

- Research is an academic activity and as such the term should be used in a technical sense.
- The systematic investigation into and study of materials and sources in order to establish facts and reach new conclusions.
- Research is "creative and systematic work undertaken to increase the stock of knowledge".
- To **study** a subject in detail, especially in order to discover new information or reach a new understanding

OBJECTIVES OF RESEARCH

- The purpose of research is to discover answers to questions through the application of scientific procedures. The main aim of research is to find out the truth which is hidden and which has not been discovered as yet. Though each research study has its own specific purpose, we may think of research objectives as falling into a number of following broad groupings:

1. To gain familiarity with a phenomenon or to achieve new insights into it (studies with this object in view are termed as *exploratory* or *formulative* research studies)
2. To portray accurately the characteristics of a particular individual, situation or a group (studies with this object in view are known as *descriptive* research studies);
3. To determine the frequency with which something occurs or with which it is associated with something else (studies with this object in view are known as *diagnostic* research studies);

MOTIVATION IN RESEARCH

- What makes people to undertake research? This is a question of fundamental importance. The possible motives for doing research may be either one or more of the following:
 1. Desire to get a research degree along with its consequential benefits;
 2. Desire to face the challenge in solving the unsolved problems, i.e., concern over practical problems initiates research;
 3. Desire to get intellectual joy of doing some creative work;
 4. Desire to be of service to society;
 5. Desire to get respectability.
- However, this is not an exhaustive list of factors motivating people to undertake research studies. Many more factors such as directives of government, employment conditions, curiosity about new things, desire to understand causal relationships, social thinking and awakening, and the like may as well motivate (or at times compel) people to perform research op

TYPES OF RESEARCH

1. The basic types of research are as follows:
Descriptive vs. Analytical: Descriptive research includes surveys and fact-finding enquiries of different kinds. The major purpose of descriptive research is description of the state of affairs as it exists at present. The main characteristic of this method is that the researcher has no control over the variables; he can only report what has happened or what is happening.

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

1. *Applied vs. Fundamental: Research* can either be applied (or action) research or fundamental (to basic or pure) research. *Applied research* aims at finding a solution for an immediate problem facing a society or an industrial/business organization, whereas *fundamental research* is mainly concerned with generalizations and with the formulation of a theory.

TYPES OF RESEARCH

3. *Quantitative vs. Qualitative:* Quantitative research is based on the measurement of quantity or amount. It is applicable to phenomena that can be expressed in terms of quantity.
4. Qualitative research, on the other hand, is concerned with qualitative phenomenon, i.e., phenomena relating to or involving quality or kind. For instance, when we are interested in investigating the reasons for human behavior.
5. *Conceptual vs. Empirical:* Conceptual research is that related to some abstract idea(s) or theory. It is generally used by philosophers and thinkers to develop new concepts or to reinterpret existing ones. On the other hand, empirical research relies on experience or observation alone, often without due regard for system and theory. It is data-based research.

Research Approaches

- The above description of the types of research brings to light the fact that there are two basic approaches to research, viz., *quantitative approach* and the *qualitative approach*.
- The former involves the generation of data in quantitative form which can be subjected to rigorous quantitative analysis in a formal and rigid fashion. This approach can be further sub-classified into *inferential*, *experimental* and *simulation approaches* to research.
- The purpose of *inferential approach* to research is to form a data base from which to infer characteristics or relationships of population. This usually means survey research where a sample of population is studied (questioned or observed) to determine its characteristics, and it is then inferred that the population has the same characteristics.

Research Approaches

- *Experimental approach* is characterized by much greater control over the research environment and in this case some variables are manipulated to observe their effect on other variables.
- *Simulation approach* involves the construction of an artificial environment within which relevant information and data can be generated.
- *Qualitative approach* to research is concerned with subjective assessment of attitudes, opinions and behavior. Research in such a situation is a function of researcher's insights and impressions. Such an approach to research generates results either in non-quantitative form or in the form which are not subjected to rigorous quantitative analysis. Generally, the techniques of focus group interviews, projective techniques and depth interviews are used.

Significance of Research

- famous Hudson: “All progress is born of inquiry. Doubt is often better than overconfidence, for it leads to inquiry, and inquiry leads to invention”.
- *The role of research in several fields of applied economics, whether related to business or to the economy as a whole, has greatly increased in modern times.*
- *Research has its special significance in solving various operational and planning problems of business and industry.*

Significance of Research

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

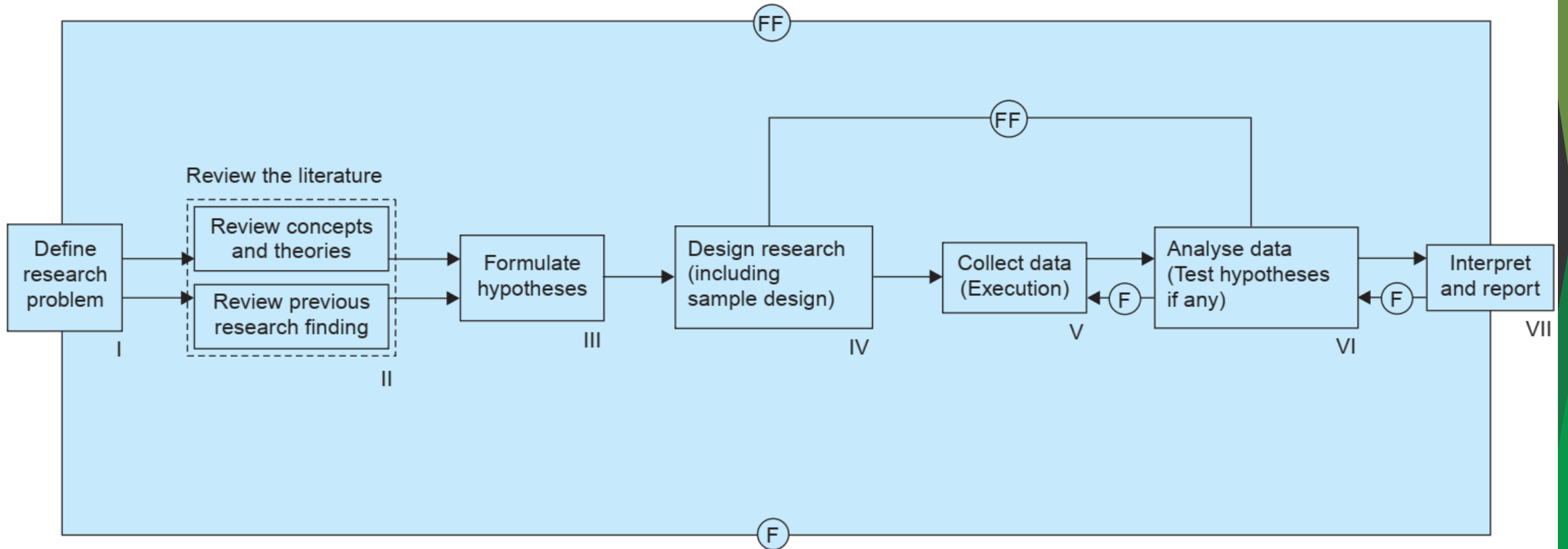
Research Methods versus Methodology

- *Research methods or techniques**, thus, refer to the methods the researchers use in performing research operations.
- *Research methodology* is a way to systematically solve the research problem. It may be understood as a science of studying how research is done scientifically.
- Karl Pearson writes, “The scientific method is one and same in the branches (of science) and that method is the method of all logically trained minds ... the unity of all sciences consists alone in its methods, not its material; the man who classifies facts of any kind whatever, who sees their mutual relation and describes their sequences, is applying the Scientific Method and is a man of science.”

Importance of Knowing How Research is Done

- In fact, importance of knowing the methodology of research or how research is done stems from the following considerations:
- (i) The knowledge of methodology provides good training specially to the new research worker and enables him to do better research. It helps him to develop disciplined thinking or a 'bent of mind' to observe the field objectively. Hence, those aspiring for careerism in research must develop the skill of using research techniques and must thoroughly understand the logic behind them.
- (ii) Knowledge of how to do research will inculcate the ability to evaluate and use research results with reasonable confidence. In other words, we can state that the knowledge of research methodology is helpful in various fields such as government or business administration, community development and social work where persons are increasingly called upon to evaluate and use research results for action.
- (iii) When one knows how research is done, then one may have the satisfaction of acquiring a new intellectual tool which can become a way of looking at the world and of judging every day experience. Accordingly, it enables use to make intelligent decisions concerning problems facing us in practical life at different points of time. Thus, the knowledge of research methodology provides tools to look at things in life objectively.
- (iv) In this scientific age, all of us are in many ways consumers of research results and we can use them intelligently provided we are able to judge the adequacy of the methods by which they have been obtained. The knowledge of methodology helps the consumer of research results to evaluate them and enables him to take rational decisions.

Research Process



Where (F) = feed back (Helps in controlling the sub-system to which it is transmitted)
(FF) = feed forward (Serves the vital function of providing criteria for evaluation)

- However, the following order concerning various steps provides a useful procedural guideline regarding the research process:
- (1) formulating the research problem;
- (2) extensive literature survey;
- (3) developing the hypothesis;
- (4) preparing the research design;
- (5) determining sample design;
- (6) collecting the data;
- (7) execution of the project;
- (8) analysis of data;
- (9) hypothesis testing;
- (10) generalizations and interpretation,
- and (11) preparation of the report or presentation of the results, i.e., formal write-up of conclusions reached.

The best way of understanding the problem is to discuss it with one's own colleagues or with those having some expertise in the matter.

Analysis of data



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Hypothesis-testing:

- After analysing the data as stated above, the researcher is in a position to test the hypotheses, if any, he had formulated earlier. Do the facts support the hypotheses or they happen to be contrary?

Preparation of the report or the thesis:

- Finally, the researcher has to prepare the report of what has been done by him. Writing of report must be done with great care keeping in view the following:
 1. The layout of the report should be as follows: (i) the preliminary pages; (ii) the main text, and (iii) the end matter.

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

Preparation of the report or the thesis:

- *The main text of the report* should have the following parts:
 - (a) *Introduction*: It should contain a clear statement of the objective of the research and an explanation of the methodology adopted in accomplishing the research. The scope of the study along with various limitations should as well be stated in this part.
 - (b) *Summary of findings*: After introduction there would appear a statement of findings and recommendations in non-technical language. If the findings are extensive, they should be summarised.
 - (c) *Main report*: The main body of the report should be presented in logical sequence and broken-down into readily identifiable sections.
 - (d) *Conclusion*: Towards the end of the main text, researcher should again put down the results of his research clearly and precisely. In fact, it is the final summing up.

Preparation of the report or the thesis:

- *At the end of the report*, appendices should be enlisted in respect of all technical data. Bibliography, i.e., list of books, journals, reports, etc., consulted, should also be given in the end. Index should also be given specially in a published research report.
- **2.** Report should be written in a concise and objective style in simple language avoiding vague expressions such as ‘it seems,’ ‘there may be’, and the like.
 - 3.** Charts and illustrations in the main report should be used only if they present the information more clearly and forcibly.
 - 4.** Calculated ‘confidence limits’ must be mentioned and the various constraints experienced in conducting research operations may as well be stated.

Criteria of a Good Research:

- Whatever may be the types of research works and studies, one thing that is important is that they all meet on the common ground of scientific method employed by them. One expects scientific research to satisfy the following criteria:
 1. The purpose of the research should be clearly defined and common concepts be used.
 2. The research procedure used should be described in sufficient detail to permit another researcher to repeat the research for further advancement, keeping the continuity of what has already been attained.
 3. The procedural design of the research should be carefully planned to yield results that are as objective as possible.

Criteria of a Good Research:

4. The researcher should report with complete frankness, flaws in procedural design and estimate their effects upon the findings.
5. The analysis of data should be sufficiently adequate to reveal its significance and the methods of analysis used should be appropriate. The validity and reliability of the data should be checked carefully.
6. Conclusions should be confined to those justified by the data of the research and limited to those for which the data provide an adequate basis.
7. Greater confidence in research is warranted if the researcher is experienced, has a good reputation in research and is a person of integrity.

In other words, we can state the qualities of a good research as under:

1. *Good research is systematic:* It means that research is structured with specified steps to be taken in a specified sequence in accordance with the well defined set of rules. Systematic characteristic of the research does not rule out creative thinking but it certainly does reject the use of guessing and intuition in arriving at conclusions.
2. *Good research is logical:* This implies that research is guided by the rules of logical reasoning and the logical process of induction and deduction are of great value in carrying out 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 in the context of decision making.

In other words, we can state the qualities of a good research as under:

3. *Good research is empirical:* 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.
4. *Good research is replicable:* This characteristic allows research results to be verified by replicating the study and thereby building a sound basis for decisions.

Writing from Research



Finding a Topic

- 2a Relating Your Personal Ideas to a Scholarly Problem
 - Connecting Personal Experience to Scholarly Topics
 - Considering Your Subject to Discover Ideas and to Focus on the Issues
- 2b Talking with Others to Refine the Topic
 - Personal Interviews and Discussions
 - Online Discussion Groups
- 2c Using Online Searches to Refine Your Topic
 - Using an Online Subject Directory
 - Using an Internet Keyword Search

Organizing Ideas and Setting Goals



Gathering Sources Online

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Academic sources



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2. A review on organic rankine cycle (ORC) system applications for solar energy-Hozan
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4. A review on bioethanol on NO_x and PM emissions of SI engine-Ravin
5. A review on low temperature combustion strategies of CI engine-Sivan
6. A review on effect of piston bowl geometry on RCCI engine-Solin
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8. A review on biodiesel production using solar energy-Saman
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Conducting Field Research



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Writing the Introduction, Body, and Conclusion



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