

Review Article

Research methodology and design: A powerful tool for scientific data

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ABSTRACT:

Research is an integral part of any academic and non-academic learning, innovations, and developmental activities. An inherent feature of human being is to add something new, to expand the knowledge by his forethought, serendipity or scientific and systematic acquisition of the facts and figures. Research is a process of enquiry and investigation; it is systematic, methodical and ethical; research can help solve practical problems and increase knowledge. This paper looks at the various research methodologies and research methods that are commonly used by researchers in the field of information systems.

Keywords: research methods, methodology, review article, research design

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INTRODUCTION

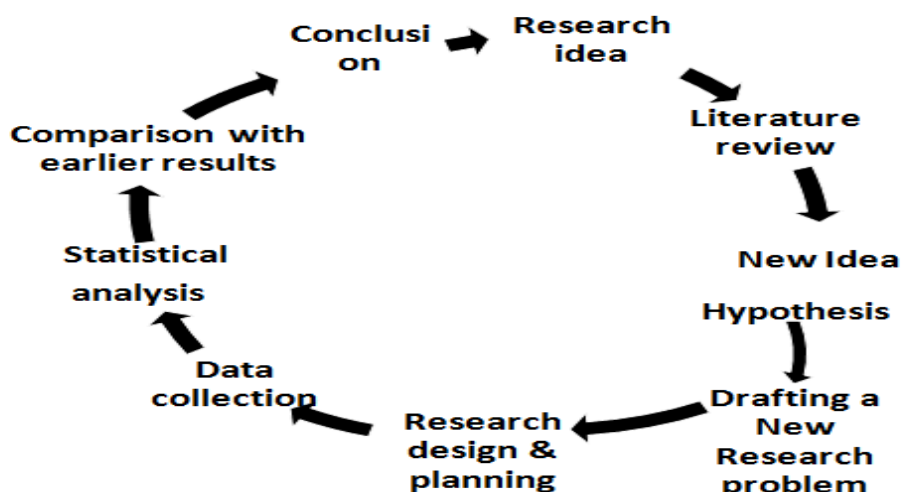
Research is defined as a systematic, controlled, empirical and critical investigation of hypothetical propositions about the natural phenomenon¹.

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

RESEARCH IS A CYCLIC PROCESS²

- ▶ It consists of number of closely related activities that overlap continuously rather than following a strictly prescribed sequence.
- ▶ Due to cyclic nature of research: It is difficult to determine where to start and when to stop.
- ▶ Cyclic mechanism: part of “built-in error correction” machinery.

Figure 1: The flowchart below well illustrates the research process



LITERATURE REVIEW³

A literature review is an examination of the research that has been conducted in a particular field of study.

Hart (1998)³ defined the literature review as the selection of available documents (both published and unpublished) on the topic, which contain information, ideas, data and evidence.

A Literature Review provides the meaningful context of the project within the universe of already existing research. “Meaningful context” can elevate the research from disconnected observations or number-crunching to the level of significance in the field of investigation.

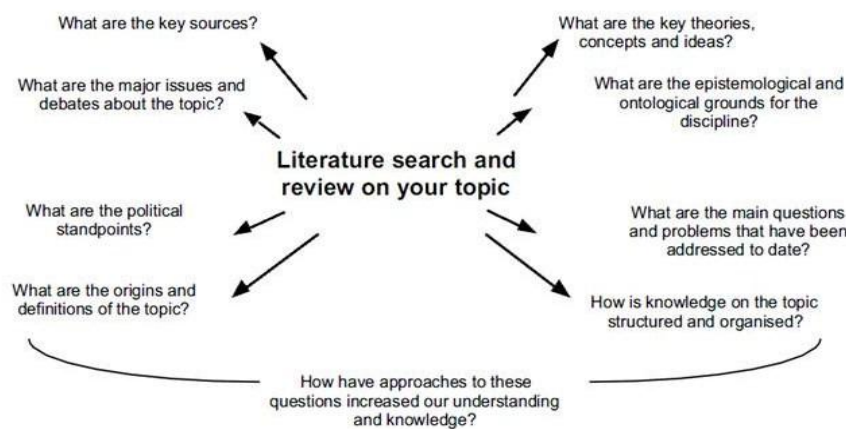
The Literature Review can help to understand the structure of the problem. It also places the research in a historical context, showing that the researcher is familiar with the most recent innovations in the field.

WHAT IS THE PURPOSE OF A LITERATURE REVIEW?⁴

- To demonstrate one’s scholarly ability to identify relevant information and to outline existing knowledge.
- To identify the ‘gap’ in the research that the study is attempting to address, positioning your work in the context of previous research and creating a ‘research space’ for the work.
- To evaluate and synthesise the information in line with the concepts of the research.
- To produce a rationale or justification for the study.

WHETHER OR NOT WRITING A SECTION OR CHAPTER CALLED “LITERATURE REVIEW,” IT IS USUALLY EXPECTED TO PRESENT THE RESEARCH WITH KNOWLEDGE OF EXISTING RESEARCH.⁵

Figure2: Questions literature review can answer



Some of the questions the review of the literature can answer

Source: Hart, C. (1998) *Doing a literature review: Releasing the social science research imagination*, Thousand Oaks, Sage, p. 14.

SOURCES

- Associated journals
- Internet
(www.pubmed.com)
(www.scopus.com)
(www.sciencedirect.com)
- Cochrane library

HOW???

- Start searching professional journals.
- Begin with the most recent articles that are available.
- Keep track of relevant articles in a bibliography.
- Don’t be discouraged if work on the topic is already underway.

WHY???

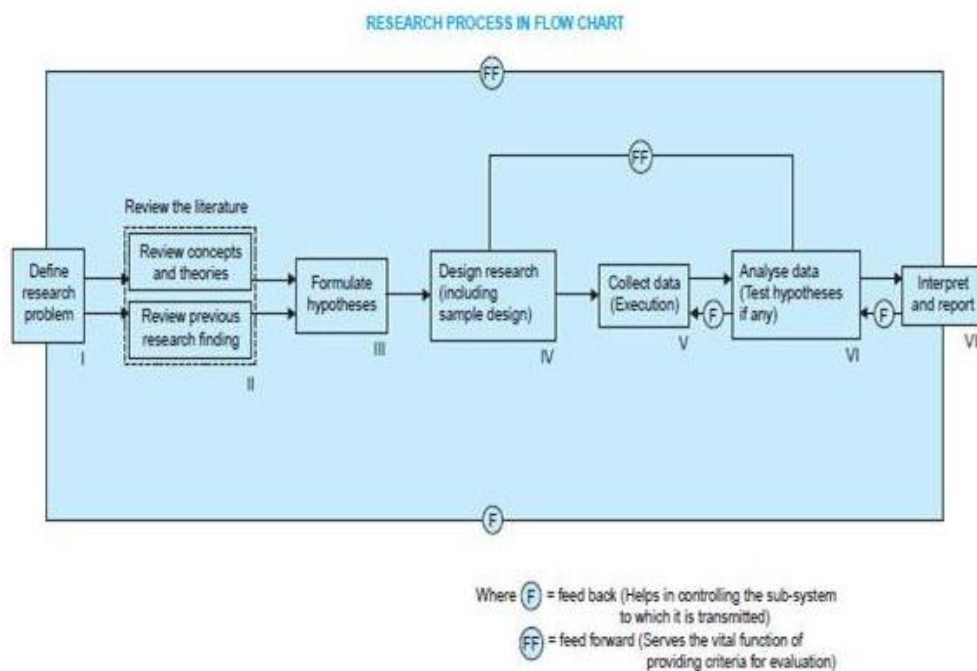
- To know what related research is already underway.
- To decide the best methodology.
- To compare the results and support for the data interpretations.

REVIEW PITFALLS

- ▶ Reading Non peer reviewed articles
- Check the sources.
- ▶ Many trade magazines/ Company claimant pamphlets are not peer reviewed.

RESEARCH PROCESS⁵

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

Figure 3: Flowchart showing research process

The chart indicates that the research process consists of a number of closely related activities, as shown through I to VII. But these activities overlap continuously rather than following a strictly prescribed sequence. At times, the first step determines the nature of the last step to be undertaken. If subsequent procedures have not been taken into account in the early stages, serious difficulties may arise which may even prevent the completion of the study. One should remember that the various steps involved in a research process are not mutually exclusive; nor are they separate and distinct. They do not necessarily follow each other in any specific order and the researcher has to be constantly anticipating at each step in the research process the requirements of the subsequent steps.

However, the following order concerning various steps provides a useful procedural guideline regarding the research process ⁶:

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. Generalisations and interpretation

11. Preparation of the report or presentation of the results i.e., formal write-up of conclusions reached.

Research purposes may be grouped into four categories, viz.

- (i) Exploration
- (ii) Description
- (iii) Diagnosis
- (iv) Experimentation.

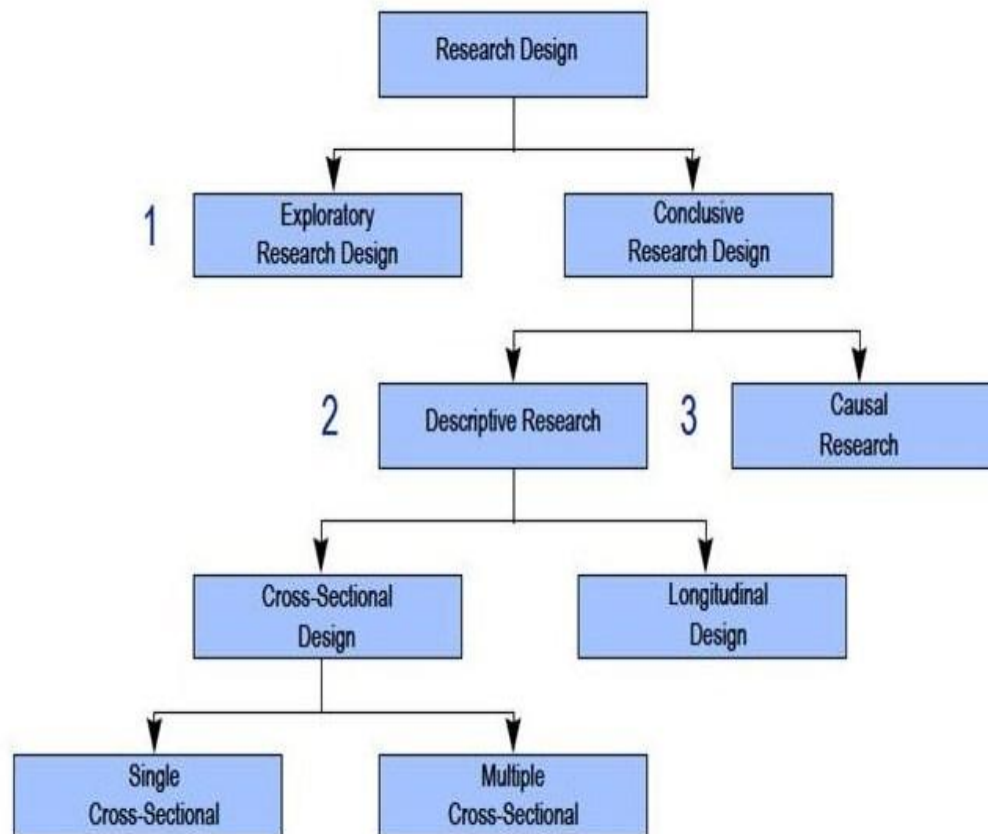
There are several research designs, such as, experimental and non-experimental hypothesis testing.

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

RESEARCH DESIGN⁷ DEFINITION

Babbie and Mount (2002) said science is an enterprise dedicated to “finding out”. Research design addresses the planning of scientific enquiry, designing a strategy for finding out something specific. The design is the complete strategy of tackling the central problem.

CLASSIFICATION OF RESEARCH DESIGN (FIGURE 4)⁸



VARIOUS TYPES OF RESEARCH DESIGN ARE AS FOLLOWS

Historical Research Design- The purpose is to collect, verify, synthesize evidence to establish facts that defend or refute the hypothesis. It uses primary sources, secondary sources, and lots of qualitative data sources such as logs, diaries, official records, reports, etc. Its limitation is that the sources must be both authentic and valid.

Case and Field Research Design- Also called *Ethnographic* research, it uses direct observation to give a complete snapshot of a case that is being studied. It is useful when not much is known about a phenomenon. It uses few subjects.

Descriptive or Survey Research Design- It attempts to describe and explain conditions of the present by using many subjects and questionnaires to fully describe a phenomenon. **Survey research design /survey methodology is one of the most popular design for dissertation research.**

Correlational or Prospective Research Design- It attempts to explore relationships to make predictions.

It uses one set of subjects with two or more variables for each.

Causal Comparative or Ex Post Facto Research Design- This research design attempts to explore cause and affect relationships, where causes already exist and cannot be manipulated. It uses what already exists and looks backward to explain why.

Developmental or Time Series Research Design- Data are collected at certain points in time going forward. There is an emphasis on time patterns and longitudinal growth or change.

Experimental Research Design- This design is most appropriate in controlled settings such as laboratories. The design assumes *random assignment* of subjects and random assignment to groups. It attempts to explore cause and affect relationships where causes can be manipulated to produce different kinds of effects. Because of the requirement of random assignment, this design can be difficult to execute in the real world (non laboratory) setting.

Quasi Experimental Research Design- This research design approximates the experimental design but does not have a control group.

Table 1. Comparison of quantitative and qualitative research approaches

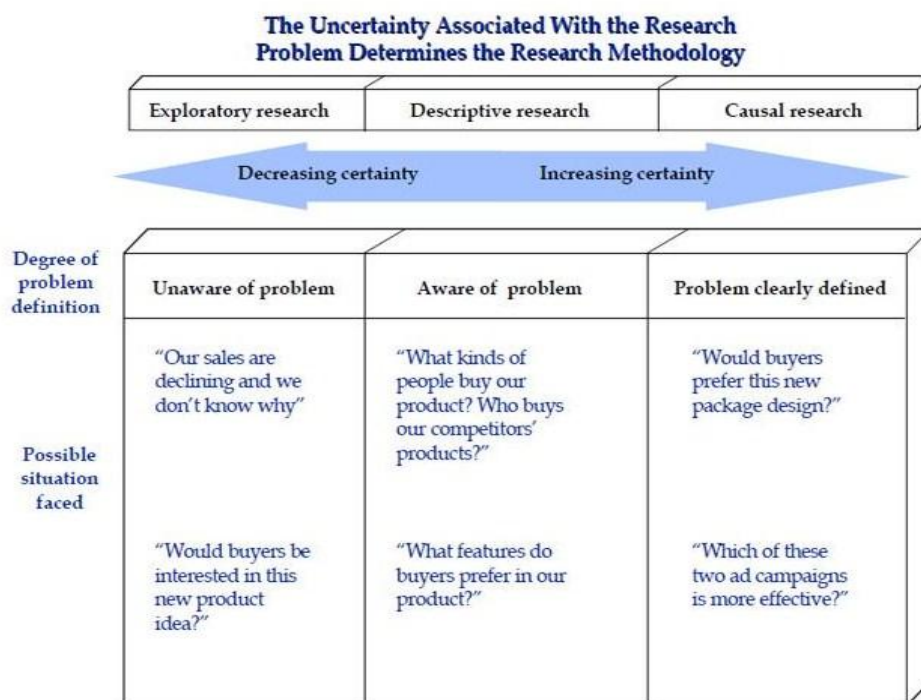
	Quantitative	Qualitative
General framework	Seek to confirm hypotheses about phenomena Instruments use more rigid style of eliciting and categorizing responses to questions Use highly structured methods such as questionnaires, surveys, and structured observation	Seek to explore phenomena Instruments use more flexible, iterative style of eliciting and categorizing responses to questions Use semi-structured methods such as in-depth interviews, focus groups, and participant observation
Analytical objectives	To quantify variation To predict causal relationships To describe characteristics of a population	To describe variation To describe and explain relationships To describe individual experiences To describe group norms
Question format	Closed-ended	Open-ended
Data format	Numerical (obtained by assigning numerical values to responses)	Textual (obtained from audiotapes, videotapes, and field notes)
Flexibility in study design	Study design is stable from beginning to end Participant responses do not influence or determine how and which questions researchers ask next Study design is subject to statistical assumptions and conditions	Some aspects of the study are flexible (for example, the addition, exclusion, or wording of particular interview questions) Participant responses affect how and which questions researchers ask next Study design is iterative, that is, data collection and research questions are adjusted according to what is learned

Table 2: Comparison of basic research designs

Table 4.2 A Comparison of Basic Research Designs

	Exploratory	Descriptive	Causal
Objective:	Discovery of ideas and insights	Describe market characteristics or functions	Determine cause and effect relationships
Characteristics:	Flexible Versatile Often the front end of total research design	Marked by the prior formulation of specific hypotheses Preplanned and structured design	Manipulation of one or more independent variables Control of other mediating variables
Methods:	Expert surveys Pilot surveys Case studies Secondary data Qualitative research	Secondary data Surveys Panels Observational and other data	Experiments

Figure 5: Uncertainty associated with the research problem determines the research methodology



CRITERIA FOR GOOD RESEARCH

- The purpose clearly defined and common concepts be used.
- repeatability of the research procedure.
- procedural design of the research should be carefully planned
- The researcher should report with complete frankness, flaws in procedural design and estimate their effects upon the findings.
- 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.
- 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.

CONCLUSION

The task of defining a research problem and conducting a research , very often, follows a sequential pattern results in a well defined research

that is not only meaningful from an operational point of view, but is equally capable of paving the way for the development of working hypotheses and for means of solving the problem itself.

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