Chapter 1

Research Methods and Technical Report Writing

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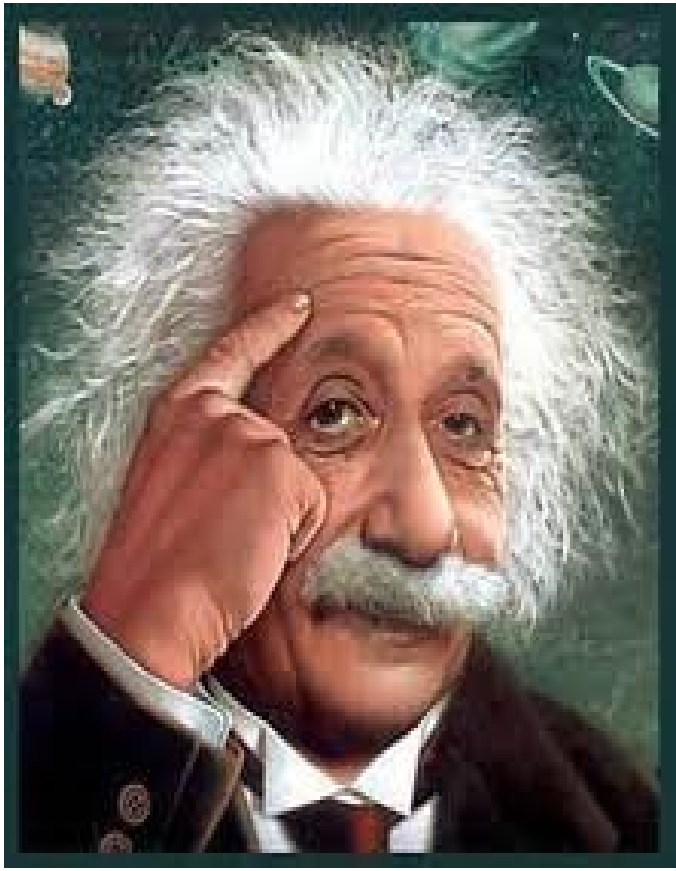
Outline

- Introduction
- Definition of research
- Objectives of Research
- Types of research
- Characteristics of Research
- The Research Process

Research Requires?

- Every thing which is really great and inspiring created by the individual **who can labour in freedom-Einstein**



Introduction

What is research?

Research can be defined as:

- Search for new knowledge (i.e. original contribution of knowledge)
- It is a systematic investigation (i.e., the gathering and analysis of information) to increase our understanding of the phenomenon.
- A scientific and systematic search for relevant information on a specific topic
- It is an art of scientific investigation.

CONT…

- *Research is an Organized and Systematic way of Finding answers to Questions*

Systematic:

- Means there is a definite set of procedures and steps which you will follow. There are certain things in the research process which are always done in order to get the most accurate results.

Organized:

- Means there is a **structured** or method in going about doing research.
- It is a planned procedure, **not a spontaneous one**.
- It is focused and limited **to a specific scope**.

Cont…

- It is actually a voyage of discovery from the known to the unknown.
- Research is an attempt to **search for truth**.
- **Research = Re + Search**

To find out something,

Re’ means again and again

- Therefore, **research means a process of observing the phenomena again and again** from different dimensions and collects the data so as **to draw some conclusions**

Cont…

What research is not?

- **Research is not only information gathering.**
  - ✓ *Gathering information from resources such as books or magazines isn't research.*
- **Research is not transformation of facts from one location to another.**
  - ✓ *Merely transporting facts from one resource to another doesn't constitute research.*
  - ✓ *No contribution to new knowledge*
- **Collecting data**, assembling reference materials, and referring statements properly do not add up to a true research.
  - ✓ *No contribution to new knowledge*

Cont…

- **Scientific research:**
- Refers to the **systematic investigation**, **experimentation**, and **analysis of phenomena** in order to expand ***human knowledge***, ***understanding***, and ***potentially contribute*** to solving real-world problems.

- Employs **systematic observation** and **rational processes** to create new knowledge. It is also based on logical relationships not just beliefs.

- Involves an **explanation of the methods used to collect and analyze data**; explanation to "why the results are meaningful"

Cont…

Objectives of doing a Research

- ***To discover answers*** to questions through the application of scientific procedures,
- ***Original contribution*** of knowledge to mankind
- To **find out the truth** which is hidden which has not been discovered as yet.
- *Is to reduce*, or even ***eliminate uncertainty***
- To gain familiarity with a phenomenon or to **achieve new insights** into (*exploratory research)*

Cont…

- To describe accurately the ***characteristics of a particular individual***, ***situation*** or a ***group*** (***descriptive research)***
- ***To test a hypothesis*** of a causal relationship between variables

MOTIVATION IN RESEARCH

What makes people to undertake research?

- ***Desire to get a research degree*** along with ***its consequential benefits***;
- ***Desire to face the challenge*** in solving the unsolved problems
- ***Desire to get intellectual joy*** of doing some creative work
- ***Desire to be of service to society***.
- ***Desire to get respectability***.

TYPES OF RESEARCH

*Research may be **classified**:*

- ***Based on purpose***

  Basic and applied

- ***Based on source of data***

  Primary and secondary

- ***Based on how it is done***

  Exploratory, Descriptive, Empirical, Qualitative and Quantitative, etc.

Types of research based on purpose

Research could be undertaken to solve:

- *Theoretical problems* – ***basic research***.
- *Practical problems* – ***applied research***.

Excavating Human Behaviors

Basic research

Also known as **pure** or **fundamental** research

Objective of basic research:

- Advancement of knowledge (***formulating or expanding theory***)
- Understanding of ***theoretical relationship*** between **variables**
- Exploratory in nature (***discovery of knowledge***)
- Requires ***rigorous and structured*** type of analysis
- Usually without any ***practical end in mind***
- Research concerning some ***natural phenomenon or relating to pure mathematics*** are examples of fundamental research.

Applied research

Solve specific, practical problems or questions

- ***Aims at finding a solution for an*** immediate problem facing a society or an industrial/ business organization
- Employs methodology that is ***not as rigorous*** **as that of basic research**.
- ***Yields findings*** that can be evaluated in terms of ***local applicability*** and not in terms of ***universal validity***.

The purpose of applied research is testing theories and apply it to real situations.

- ✓ ***Most new research questions originate from theories***
- ✓ ***Researchers of all disciplines use theories to help them describe facts.***
- ✓ ***Theories are strengthened by test results***

Types of research based on *source of data*

Primary and *secondary* research

Primary/ field research *– the collection of data that does not already exist.*

- ***Primary Data:*** data collected from participants through methods such as *telephone, mail, online, and face-to-face (quantitative), and observation studies and focus groups (qualitative)*

Secondary/desk research *– the summary, collection and/or synthesis of existing research*

- ***Secondary Data:*** accessing data through sources such as the internet and library

Types of research based on how it is done

1) Exploratory research is most commonly ***unstructured***, "*informal" research that is undertaken to gain background information* about the general nature of the research problem.

- *It is usually conducted when the researcher does not know much about the problem and needs:*

Additional information or desires new or more recent information.

- ✓ *To define terms*
- ✓ *To clarify problems and hypotheses*
- ✓ *To establish research priorities*

Cont...

- Provides significant insight into a given situation but not usually useful for decision making by itself.
- *Helps to determine the best research design, data collection method and selection of subjects.*

Types of research based on how it is done

2) *Empirical Research:*

- ***It finds a solution empirically*** *(based on* ***observation and experience*** *more than upon theory and abstraction).*
  - ✓ *(i.e. the research bases its findings on direct or indirect observation as its test of reality)*
- Relies on ***experience or observation*** alone, often ***without due regard for system and theory.***
- It is data-based research, coming up with conclusions which are capable of being **verified by** observation or experiment
- *It can be qualitative & quantitative.*
- ***Empirical & theoretical/ conceptual*** *research complements each other in developing an understanding of the phenomena, in predicting future events.*

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3) *Experimental Research*

- An experiment is a research situation where at least *one independent variable*, called the experimental variable, is ***deliberately manipulated or varied*** by the researcher.
- Control group and experimental group
  - ✓ **In a control group, researchers will not manipulate or alter any thing in the process or testing of evaluation**
- Explores ***cause and effect*** relationships.
- *It is common in medical and agricultural sciences.*

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4) Descriptive research

- The main purpose of descriptive research is to ***describe the state of view as it exists at present***.
- *Simply stated, it is a **fact finding** investigation.*

The main characteristic:

- **Researcher has no *control over the variables***; *She/he **can only report what has happened or what is happening***
- *Descriptive research deals with demographic characteristics of the consumer.*
- For *example*, trends in the consumption of soft drink with respect to;
- Socio-economic characteristics such as **age**, **family**, **income**, **education level** etc.

Cont…

The main objectives of descriptive research:

- @ To identify ***present conditions*** and ***point to present needs***.
- @ To study immediate ***status of a phenomenon***.
- @ ***Fact findings***.
- @ To examine the relationships of traits and characteristics ***(trends and patterns***).
- @ To find answers to the questions "*what*, *who and where*".

Research Approaches

Two basic approaches to research

- *Quantitative approach and the Qualitative approach*
- ***Quantitative** methods are identified with the so-called **"hard science"** disciplines, whereas **qualitative** methods related with **social sciences.***

Qualitative

- *Qualitative research involves studies that **do not attempt to quantify their results through statistical summary or analysis.***
- ***Qualitative research** is research undertaken **to gain insights concerning attitudes, beliefs, motivations and behaviors of individuals** to explore a social or human problem*
  - *Phenomena relating to or involving **quality** or **kind**.*
  - *Investigating **the reasons for human behavior** (i.e., why people think or do*
  - *Concerned with **subjective assessment of** **attitudes**, **opinions** **and behavior***
  - The goal of qualitative research is to ***look for meaning***.
  - It typically involves *methods such as **focus groups, in-depth interviews, observation research** and **case studies.***

Quantitative

- The measurement of quantity or amount
- *The **objective of quantitative research** is to develop and employ mathematical models, theories and hypotheses relating to natural phenomena.*
- It tends to *move from the general to the specific*
- The process of ***measurement is central to quantitative*** research, because it provides the fundamental connection between **empirical/ practical observation** and ***mathematical expression of an attribute.***
- This approach typically concentrates on measuring or counting and
- It also involves collecting and analyzing numerical data and **applying statistical tests.**

Qualities of a good research

1. *Good research is systematic*
2. *Good research is logical*
3. *Good research is empirical*
4. *Good research is replicable*

Research Methods versus Methodology

- **Research Method**
  - Methods/techniques that are used for conduction of research
- **Research methodology**
  - *A way to systematically solve research problem.*
  - A science of studying how research is done scientifically.

Distinct characteristics of research processes

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

- Research is initiated or guided by **specific research problem**, **question** or **hypothesis**.
- Research requires **clear articulation of a goal**.
- Research requires **a specific plan for proceeding** (**research design**)
- Research is by its nature **cyclical**.

Steps of the research process

1. GENERATING RESEARCH IDEAS

2. Formulate Research Problem

3. Develop a Hypothesis

4. Design Study to Test Hypothesis

5. Collect Data

6. Analyse and Interpret Results

7. Communicate Results

Cont…

1. Generating research ideas

- Generating ideas comes from **identifying a problem**.
- Problem means ***dispute***, **controversy**, **debate** or **disagreement** that needs to be addressed or answered.
- **Where does one can find problems?**
  - The problems are all around you.
  - It is issue in literature.
- It is the **first step to become a mature researcher.**

2. Formulate the research problem

- **Statement of the problem”**
  - ✓ If you want to solve a problem, **you must know what is the problem**.
    - It is an important step in the research process.
  - ✓ The problem should be ***simple, clear*** and ***complete***

Clearly stated problem is half solved or resolved !

3. Develop hypotheses or Research questions

- **Breaking down the problem** into **sub-problems** called **hypotheses** or **research question**
- It **guides the selection of appropriate research method**, **data collection techniques**, **data analysis techniques**.
- **It should be clearly stated** and **you should be ready to defend or support**

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4. Design the study to test hypotheses or answer research questions

- **Hypotheses or research questions** will **determine the design of the study process**
- The research methodology or method should be selected depending on the research problem and hypotheses.
- First identifying problem, then select method or methodology.

5. Collecting Data

- **Collecting appropriate data helps a researcher (s) to answer the research question or hypothesis accurately**

There are different types of data collection method.

- **Interview**
- Questioners
- Focused group discussion
- Observation
- Use of archival data
- Literature survey

There are two types of data

Primary Data:

- Data that are collected **by the investigator himself** for the purpose of a specific inquiry or study.
- Such ***data are original in character*** and are **mostly generated by surveys** conducted by individuals or research institutions.

Methods of Primary Data Collection:

- Primary data are obtained either through observation or ***through direct communication with respondents*** in one form or another or through personal interviews.

Secondary Data:

- *Those are data that have **already been collected and analyzed** by someone else and which have **passed through the statistical process**.*
  - ✓ ***Such data are primary data for the agency that collected them,** and **become secondary for someone else who uses these data for his own purposes later on**.*
- Secondary data can be ***obtained from journals**, **reports, government publications, publications of professionals and research organizations**.*
- *Secondary data are less expensive to collect both in money and time.*
- While **in case of secondary data** the nature of data collecti on work is merely that of **data compilation**.

Cont…

Methods of collecting primary data in surveys and descriptive researches. Some Important ones are:

I. Observation method,
II. Interview method,
III. Questionnaires ,

I. Observation

- It is the gathering of primary data **by investigator's own direct observation of relevant situations without asking from the respondent**.
- The aim is to gather data or information about the world as it is.
- So the act of studying ***doesn't substantially modify*** the thing you are interested in.
- Observation can produce information **which people are normally unwilling or unable to provide**.

Cont…

Advantage of Observation:

- ***First**, If observation is done accurately, subjective bias will be eliminated,*
- ***Secondly**, the information obtained under observation relates to what is currently happening;*
  - ***It is not complicated by either the past behavior or future intentions or attitudes.***
- ***Thirdly**, this method is **independent of respondents' willingness to respond***

Limitations:

- *Feelings, beliefs and attitudes cannot be observed.*
- *Expensive method*

II. Interview method

- *It is a verbal discussion in a face-to-face manner or communication via some technology like the telephone or computer between an interviewer and a respondent*.
- **Unstructured:** It allows a free flow of communication in the course of the interview or questionnaire administration.
- **Structured:** where the information that needs to be collected from the respondents is already decided.
- **Semi-structured:** restricts certain kinds of communications but allows directional freedom on the discussion of certain topics.

III. Questionnaires

- *This method of data collection is quite popular, particularly in case of big investigations.*
- *The questionnaire is mailed (usually by post) to respondents **who are expected to read, understand and write down the reply** in the space meant for the purpose in the questionnaire itself.*

Type of Question

1. ***Open-ended questions:*** *Type of questions that do not have pre-coded options (answers).*
2. ***Dichotomous questions:*** *Dichotomous questions have two possible answers like yes/no, true/false or agree/disagree responses.*
3. ***Multiple-response questions:*** *Type of questions has many probable answers.*

Cont…

7. Analyze and Interpret Data

- This can be **one of the difficult task in research**, and of course the **crucial one to come up with research findings**.
- The researcher ***analyze using statistical techniques and interprets the newly analyzed data*** and suggests a conclusion.
- Keep in mind that data analysis that suggests **a correlation between two variables can't automatically *be interpreted as suggesting causality between those variables.***

Cont…

- **Depending on whether the research questions are answered or not,** the researcher may be forced to cycle back to an earlier step in the process and begin again with a new research questions formulation.
  - This is **one of the self-correcting mechanisms** associated with the scientific method.
- **Analyze the performance achieved:**
  - using performance measures such as **accuracy, recall, precision, etc.**

Cont…

- ***Interpret***
  - Relate **performance registered** with the algorithms Vs datasets used
  - Show clearly the strength and weakness of the study, algorithms selected
- **Be Careful:**
  - Better to **admit to flaws in your methodology**
  - **Don’t generalize without adequate support**
- **Report everything:**
  - **Procedures followed**, **results achieved and conclusions**
  - So that ***others can replicate the experiment***, and ***build on your conclusions***

8. Communicate Results

- The output should be communicated to the community of fellow researchers and practitioners through.
  - Presentation
  - Journals
  - Thesis
  - Research papers

End of Chapter ! ! !