Unit 2: Research Process Model

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Contents

Main objective

1. The process of doing research, and
2. To understand the components that make up the research process.

The 6Ps of Research

- So far we've looked at the purpose of research (the reasons people do research) and the products of research (outcomes from research projects).
- In this chapter we'll start to look at another of the 6Ps of research — the **process**.

1. Purpose,
2. Products,
3. Process,
4. Participants,
5. Paradigm and
6. Presentation

Model of Research Process

Figure below gives an overview of the research process and its components:

1. Personal experiences and motivation
2. Literature review
3. Research question
4. Conceptual framework
5. Strategies
6. Data generation methods
7. Data analysis

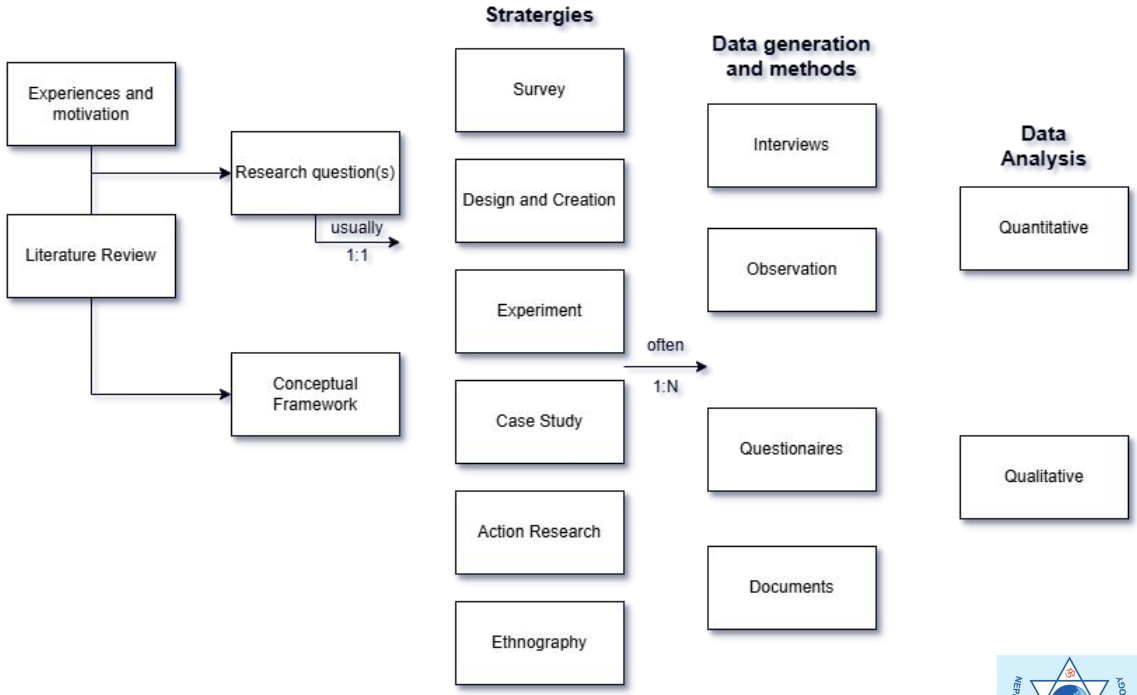

Figure: Model of research process

Before we begin

Finding and Choosing Research Topics

- Until now we have seen that there are many different reasons for doing research (Purpose), and many different possible outcomes (Outcomes).
- But how do we get started? That is, how do we find research topics?

Sources of research ideas:

- Suggestions from staff in your department. In some departments, staff circulate suggested research topics or project ideas.
- Recent conference and journal papers, especially the sections (often found near the end of a paper) discussing where further research is needed.
- Current events reported in the media. Sometimes a phenomenon is noticed in popular culture before it is taken up by academics. For example, Internet gambling or the use of text messaging by teenagers.

Before we begin

Selecting a topic

- Having found some potential research topics, you have to choose one.
- This involves identifying the topic that best meets the two criteria:
  - enjoyability (for you), and
  - feasibility (as a piece of academic research).

Ask yourself, ‘Will I enjoy working on that topic?’ If the answer is, ‘Not really’, then find another topic.

Before we begin

To check for feasibility, ask yourself the following questions:

- Is the research likely to offer something new?
- Can the research be carried out in the time available?
- Do you have the necessary resources?
- Can you approach the topic without too much bias?
- Will the research be safe and ethical?

Model of Research Process

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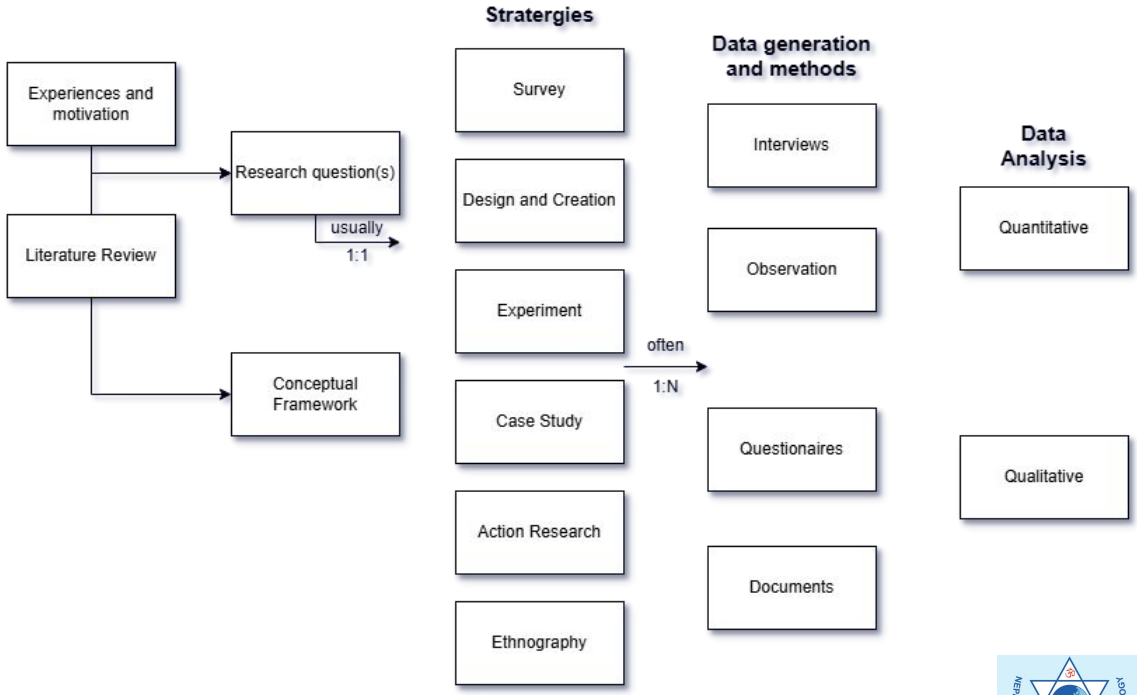

Figure: Model of research process

Personal experiences and motivation

- As we saw in Chapter 1, people do research for a variety of reasons.
- You need to think about why you are doing research.
- Thinking about your motivation, as well as your Personal experiences, likes, dislikes, strengths, weaknesses and so on will help you think about possible research questions that you could address.

Note: why you are doing the research can also help keep you going through the difficult, boring or frustrating times — there will be some, guaranteed!

Literature review

- All academic researchers have to review the literature in their chosen area of study: the books, journal articles and conference papers that have already been written on the topic or have previously been produced.
- By studying the literature you can find out what has been done before, and **what topics remain to be addressed**.
- This helps you to decide upon a viable research question that has not already been fully addressed.
- The literature review should help provide the conceptual framework for your research.

Research question

- To get going on research you need a research question or set of questions.
- As we saw in the previous section, you can find a question by thinking about:
  - **Yourself**: what motivates you, the kind of research you would like to do and the kind of knowledge outcome you would like to achieve.
  - **What others propose**: suggestions in the literature of where more research is needed, and calls for papers for conferences and journals on a particular topic.

Conceptual framework

1. A conceptual framework is how you structure your thinking about your research topic and the process undertaken.
2. A conceptual framework is like a blueprint for your research. It helps you to make clear such things as:
    a. the different factors that comprise your topic;
    b. your way of thinking about the topic
    c. your way of tackling your research question(s) (that is, the combination of **strategies** and **methods** you adopt - often called your *research methodology*);
    d. your approach to analysing any generated data (for example, quantitative analysis, which uses mathematics and statistics, or qualitative analysis, which uses thematic approaches)

Strategies

A strategy is your overall approach to answering your research question. In this course we look at six strategies:

1. Survey,
2. Design and creation,
3. Experiment,
4. Case study,
5. Action research, and
6. Ethnography

Strategies: Survey

- Survey focuses on obtaining the same kinds of data from a large group of people (or events), in a standardized and systematic way.
- You then look for patterns in the data using statistics so that you can generalize to a larger population than the group you targeted.

Strategies: Design and creation

- Design and creation focuses on developing new IT products, or artifacts.
- Often the new IT product is a computer-based system, but it can also be some element of the development process such as a new construct, model or method.

Strategies: Experiment

- Experiment: focuses on investigating cause and effect relationships, testing hypotheses and seeking to prove or disprove a causal link between a factor and an observed outcome.
- There is ‘before’ and ‘after’ measurement, and all factors that might affect the results are carefully excluded from the study, other than the one factor that is thought will cause the ‘after’ result

Strategies: Case study

- Case study: focuses on one instance of the ‘thing’ that is to be investigated: an organization, a department, an information system, a discussion forum, a systems developer, a development project, a decision and so on.
- The aim is to obtain a rich, detailed insight into the ‘life’ of that case and its complex relationships and processes.

Strategies: Action research

- Action research focuses on research into action.
- The researchers plan to do something in a real-world situation, do it, and then reflect on what happened or was learnt, and then begin another cycle of plan-act-reflect.

Strategies: Ethnography

- Ethnography focuses on understanding the culture and ways of seeing of a particular group of people.
- The researcher spends time in the field, taking part in the life of the people there, rather than being a detached observer.

Data generation methods

- A data generation method is the means by which you produce empirical (field) data or evidence.
- Data can be either quantitative or qualitative:
  - Quantitative data is numeric data, for example, number of website hits, number of employees, annual turnover, last year's profit.
  - Qualitative data is all other types of data: words, images, sounds and so on.
- In this course we look at four data generation methods:
  - interviews,
  - observations,
  - questionnaires, and
  - documents.

Data analysis

- After you have generated some data, by using your chosen research strategy and one or more data generation methods, you need to analyse the data, looking for relationships or themes.
  - **Quantitative data analysis** uses mathematical approaches such as statistics to examine and interpret the data.
  - **Qualitative data analysis** looks for themes and categories within the words people use or the images they create.

Literature Review

After this study you should be able to explain:

- the purpose of a literature review;
- the range of available literature resources;
- how the Internet can be used during a literature review;
- how to do a literature review.

Literature Review: Purpose

A literature review normally has two purpose:

1. Finding a Research Idea & Understanding the Topic**
    - What you do: Read journals, books, and articles to discover:
    - What has already been studied?
    - Which experts or theories are important?
    - Where are the gaps (missing research)?

    Example:

    You want to study "online learning challenges”.

    You find that many papers discuss internet issues but few study student motivation.

    This helps you pick a research question: "How does low motivation affect online learning?"

Literature Review: Purpose

A literature review normally has two purpose:

2. Supporting Your Research (Like a Lawyer in Court)

   What you do: Keep collecting evidence (even while writing) to prove:

   - Your topic matters (e.g., online learning is growing, so studying it is useful).
   - Your work is new (e.g., no one has studied motivation in rural areas yet).
   - You add knowledge (e.g., your findings suggest gamification

   Example:

   Like a lawyer citing past cases, you reference studies to show:

   Previous research (Smith, 2020) focused on cities, but rural students face unique issues.

   My survey proves motivational apps improve grades—a finding not yet published.

Literature Review: literature resources

- There is a wide range of sources you can use in a literature review.
- Some of them are considered to be more worthy than others in academic research.
- Some of the literature resources are:
  - Books
  - Manuals
  - Journals
  - Conference and workshop proceedings
  - Newspapers, magazines, radio and television
  - Art exhibition catalogues
  - Gateways
  - Internet

Literature Review: literature resources: Books

- Textbooks can be useful as introductory sources.
- They explain a field and the main approaches or theories used within it, and they give guidance on particular methods or techniques.
- However, these books are aimed at students on taught courses, not at academic researchers, which is what you should be aspiring to be, so they are only rarely cited in a literature review.
- Instead, you should look at the list of references the textbook author has used, and follow up and cite those that are relevant to your chosen area.

Literature Review: literature resources: Manuals

- Manuals can be a valuable source of information, particularly for design and creation projects where you will often need to use the relevant technical manuals to use particular software packages or computer systems.
- However, useful as they are, they are not refereed academic works giving insight into current thinking in the field.
- They are not often cited in a literature review.

Literature Review: literature resources: Journals

- Academic journal articles are where you should find information on the current thinking and research in your area of interest.
- Your final literature review will probably contain mostly journal articles.
- They can be difficult to read at first, so you might find it best to gain an understanding of the area through books before exploring journal articles for the latest developments.
- Also useful when you first start are journal articles that are themselves a survey of the literature on a particular topic.

Literature Review: literature resources: Conference and workshop proceedings

- Often researchers will present their work initially via a paper at a conference or workshop before writing and submitting a more detailed journal article.
- Conference and workshop proceedings are therefore where you are likely to find the most up-to-date theories as well as suggestions for further research.

Literature Review: literature resources: Newspapers, magazines, radio and television

- Newspapers, magazines and broadcast programmes can be a valuable resource for up-to-date information.
- Some carry authoritative articles by expert journalists, for example the Financial Times or Wall Street Journal, the Economist or Time magazines, and the BBC or CNN.
- However, many press and broadcasting organizations are biased politically or geographically, and the articles and programmes are not subject to peer review.
- They can therefore be useful for finding a way into a subject, but you should not normally use them much in your literature review.

Literature Review: literature resources: Art exhibition catalogues

- Those researching into computers and art find art exhibition catalogues useful.
- Such catalogues often also contain critical reviews by art critics, who analyse the work and place it in a broader historical context.
- Remember, however, that such essays are not peer reviewed as in most academic research — they reflect the personal, subjective views of the artist or art critic.

Literature Review: literature resources: Multimedia literature

- The meaning of ‘literature review’ is now being stretched to go beyond textual material to include such things as images, films, photographs and animations, sound clips and software.
- For those researchers using a design and creation strategy, in particular, it is often important to review such multimedia sources.

Literature Review: literature resources: Gateways

- Academic gateways (also called portals) are websites that provide links to other websites on particular subjects.
- Since the links provided have been chosen by academics in the relevant subject area, they are useful places to look for better quality information than much that is on the web.

Literature Review: literature resources: Internet

- The Internet is a very useful resource to researchers.
- As noted above, gateways and online databases and catalogues are an important tool in searching for relevant publications.
- They have speeded up the whole business of literature searching and made it more convenient — often you can access them from home, at a time suitable for you rather than within your library's normal opening hours.
- Search engines such as Google (www.google.com) or Alta Vista (www.altavista.com) can also help you find web-based material.
    - There are also meta-search engines —they use a number of other search engines and sort the combined results, for example, MetaCrawler (www.metacrawler.com).
    - Many search engines are all-purpose — they index everything they find on the web.
    - Others undertake more restricted searches. For example, Google Scholar (scholar.google.com) searches only for online academic publications.

Literature Review: Conducting literature review

- Conducting a literature review can be broken down into seven different activities:
  a. Searching
  b. Obtaining
  c. Assessing
  d. Reading
  e. Critically evaluating
  f. Recording
  g. Writing a critical review
- (SOA-RCR-W)

Literature Review: Conducting literature review

1. Searching- Look for relevant books, articles, and research papers on your topic. 100

Example: Searching "effects of social media on teens" in Google Scholar.

2. Obtaining - Get copies of the useful sources you find.

Example: Downloading PDFs or borrowing books from the library. 20

3. Assessing - Quickly check if each source is actually relevant to your research. 15

Example: Skimming abstracts to see if articles match your topic.

4. Reading - Carefully go through the selected materials.

Example: Highlighting key points in research papers.

5. Critically Evaluating - Judge how good and useful each source is. 6 past 5-8 years

Example: Asking "Is this study reliable? Are there flaws in their methods?"

6. Recording - Take notes and organize the important information.

Example: Making a table comparing different researchers' findings.

7. Writing a Critical Review - Put it all together in your own words, showing what's known and where gaps exist, i.e., **Research Gap**. Conference/journal (Q3 or Q1)

Example: Writing a chapter that summarizes and analyzes all the studies you found.

Kishor - Coding//Simulation

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sanjeev - Writing Academic paper

megha - Writing Academically

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Citation and its types

- Citations are used to show your reader(s) where the information in your paper was originally published.
- Citations are important because they show your reader(s):
  a. when the information was published
  b. who the author of the information is
  c. which journal or group published the information
  d. which version the information was published in (usually just for literature)
- There are different citation styles, each with specific formatting rules. The most common types are:
  a. **In-text Citation** – Brief references within the body of the text.
  b. **Bibliography/Reference List** – A detailed list of all sources at the end of the document.

Major Citation Styles with Examples

1. **APA (American Psychological Association)**

Used in social sciences, psychology, and education.

- In-text Citation (Parenthetical):
  - (Author's Last Name, Year)
  - Example: (Smith, 2020)
- Reference List Entry (Book):
  - Smith, J. (2020). *Psychology of Learning*. Penguin Books.

Major Citation Styles with Examples

2. **MLA (Modern Language Association)**

Commonly used in humanities, literature, and arts.

- In-text Citation:
  - (Author's Last Name Page Number)
  - Example: (Smith 45)
- Works Cited Entry (Book):
  - Smith, John. *Psychology of Learning*. Penguin Books, 2020.

Major Citation Styles with Examples

3. Chicago/Turabian Style

Used in history, business, and fine arts. It has two formats:

- Notes-Bibliography (Humanities): Uses footnotes/endnotes.
- Author-Date (Sciences & Social Sciences): Similar to APA.

Example (Notes-Bibliography):

- Footnote:
  - John Smith, *Psychology of Learning* (New York: Penguin Books, 2020), 45.
- Bibliography Entry:
  - Smith, John. *Psychology of Learning*. New York: Penguin Books, 2020.

Major Citation Styles with Examples

4. IEEE (Institute of Electrical and Electronics Engineers)

Used in engineering and computer science.

- In-text Citation:
  - [1]
- Reference List Entry:
  - [1] J. Smith, *Psychology of Learning*. New York: Penguin Books, 2020.

Major Citation Styles with Examples

5. Harvard Style

Common in business and social sciences.

- In-text Citation:
  - (Smith 2020, p. 45)
- Reference List Entry:
  - Smith, J. (2020) *Psychology of Learning*. New York: Penguin Books.

Plagiarism

- Plagiarism is the act of using someone else's words, ideas, or work without giving proper credit, presenting them as your own.
- It is considered a serious ethical violation in academics, journalism, and professional writing.

Types of Plagiarism

1. Direct Plagiarism – Copying text word-for-word without quotation marks or citation.
2. Self-Plagiarism – Reusing your own previously published work without permission.
3. Paraphrasing Plagiarism – Rewriting someone else's ideas without proper attribution.
4. Mosaic Plagiarism – Mixing copied phrases with original text without citation.
5. Accidental Plagiarism – Unintentional failure to cite sources correctly.

Plagiarism

How to Avoid Plagiarism?

- ✔ Cite Sources – Use proper citations (APA, MLA, Chicago, etc.).
- ✔ Use Quotation Marks – When copying exact words.
- ✔ Paraphrase Correctly – Rewrite in your own words + citation.
- ✔ Use Plagiarism Checkers – Tools like Turnitin, Grammarly, or Copyscape.

Strategies

Strategies

1. Survey
2. Design and Creation
3. Experiment
4. Case Study
5. Action Research and
6. Ethnography

Strategies-Survey

Planning and Designing Surveys

The planning and conducting of surveys can be broken down into six different activities under the following headings:

1. data requirements,
2. data generation method,
3. sampling frame,
4. sampling technique,
5. response rate and non-responses,
6. sample size.

Data requirements

You need to decide what data you wish to generate (see the case study below). The data could be on topics directly associated with your research question(s), or it could be only indirectly related, such as demographic data about your respondents (the peo- ple who provide you with data), for example, their age and gender. As you normally only get one opportunity with your respondents in a questionnaire- or interview-based survey, it's important to think carefully beforehand about all the data you wish to generate - you probably will not get a second chance to go back and ask about things you forgot the first time. This means thinking ahead about how you might analyse your data, patterns you might look for, and interpretations that might arise for which you will need additional data.

Strategies-Survey

1. Data Requirements
   - You need to decide what data you wish to generate.
   - The data could be on topics directly associated with your research question(s), or it could be only indirectly related, such as demographic data about your respondents (the people who provide you with data), for example, their age and gender.
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   - This means thinking ahead about how you might analyse your data, patterns you might look for, and interpretations that might arise for which you will need additional data.

Strategies-Survey

2. Data Generation Method
   - Survey research strategy is often assumed to be based on questionnaires, it can also use other data generation methods such as interviews, documents and observations.
   - You therefore have to decide which data generation method you will use.
   - For one survey usually just one method is chosen.

Note: Whichever method you choose, you will then have to decide exactly how it will generate the data. If you choose a survey via questionnaire, you must design the questionnaire (Later), for interviews you need to plan the interview format (Later), and for observation you need to design observation schedules (Later). If choose a document survey, the relevant documents might already exist, or you might need to create them yourself (Later), and you need to decide exactly what you are looking for in the documents.

Strategies-Survey

3. Sampling Frame
    - Sample frame (or sampling frame) is the actual list of individuals or items from which a sample is drawn for a study. It represents the *target population* you want to generalize your results to.

    Why is a Sample Frame Important?
    - Ensures the sample accurately represents the population.
    - Helps avoid bias (e.g., excluding certain groups).
    - A poor frame leads to inaccurate conclusions.

Strategies-Survey

4. Sampling Techniques

- Sampling is the process of selecting a subset of individuals from a larger population for research.
- There are two main types:
  - Probability Sampling (Random Selection)
  - Non-Probability Sampling (Non-Random Selection)

Strategies-Survey

Probability Sampling (Random Selection)

- Every member has a known chance of being selected.

1.1 Simple Random Sampling

- Method: Randomly pick participants (like a lottery).
- Example: Selecting 50 students out of 500 by drawing names from a hat.

1.2 Systematic Sampling

- Method: Select every *nth* individual from a list.
- Example: Choosing every 10th customer from a store's 1000 daily visitors.

Strategies-Survey

1.3 Stratified Sampling

- Method: Divide the population into groups (strata) and randomly sample from each.
- Example: Surveying 100 employees by randomly selecting 20 each from 5 departments (HR, Sales, IT, etc.).

1.4 Cluster Sampling

- Method: Divide the population into clusters, randomly select some clusters, and survey all within them.
- Example: Picking 5 schools out of 50 in a city and surveying all students in those schools.

Strategies-Survey

Non-Probability Sampling (Non-Random Selection)

- Selection is based on convenience or judgment.

2.1 Purposive (Judgmental) Sampling

- Method: Researcher selects participants based on specific criteria.
- Example: Interviewing only doctors for a study on medical practices.

2.2 Snowball Sampling

- Method: Existing participants refer others (used for hard-to-reach groups).
- Example: Studying homeless individuals by asking one person to introduce others.

Strategies-Survey

2.3 Self-Selection Sampling

- Method: Volunteers choose to participate.
- Example: Online surveys where people opt-in to respond.

2.4 Convenience Sampling

- Method: Selecting easily available participants.
- Example: Surveying shoppers at a mall because they’re accessible.

Strategies-Survey

5. Response Rate and non-responses

- The response rate is the percentage of people who complete a survey or study out of the total number contacted.
- Formula:

$$\text{Response Rate} = \left(\frac{\text{Number of Completed Responses}}{\text{Total Sample Size}} \right) \times 100$$

Example:

- If you send a survey to 200 people and 150 respond, the response rate is:

$$\left(\frac{150}{200} \right) \times 100 = 75\%$$

Strategies-Survey

- Non-response occurs when selected participants do not complete the survey, leading to potential bias.
- Types of Non-Response:
    1. Refusal – Participant declines to participate.
       (Example: A customer says "No" when asked to fill out a feedback form.)
    2. Non-Contact – Researcher cannot reach the participant.
       (Example: Phone calls go unanswered, or emails bounce back.)
    3. Partial Response – Participant starts but doesn't finish.
       (Example: Someone abandons an online survey halfway.)

Strategies-Survey

6. Sample Size

- Sample size refers to the number of participants or observations included in a study. It determines how accurately your results represent the entire population.

Why Sample Size Matters

- Too Small → Results may be unreliable or biased.
- Too Large → Wastes time and resources unnecessarily.
- Just Right → Balances accuracy and practicality.

Example:
If you want to know the average height of students in a university (population: 10,000), surveying:

- 5 students → Too small (high risk of error).
- 1,000 students → More reliable (if properly selected).

Strategies-Design and Creation

- Design and creation research follows a problem-solving approach using an iterative cycle (repeating steps for improvement).

- The 5 key stages are:

  1. Awareness (Identifying the Problem)
     - Recognize a need or issue to solve.
     - *Example:* A UX designer notices that users struggle to find the "checkout" button on an e-commerce app.

  2. Suggestion (Brainstorming Solutions)
     - Generate ideas to address the problem.
     - *Example:* The team suggests:
       - Moving the button to a more visible location.
       - Changing its color for better contrast.

Strategies-Design and Creation

3. Development (Creating a Prototype)
   - Turn ideas into a tangible prototype.
   - *Example:* The designer creates two app versions:
     - Version A: Bright red checkout button at the top.
     - Version B: Floating button at the bottom.

4. Evaluation (Testing & Feedback)
   - Test the prototype with real users and gather data.
   - *Example:* User testing shows:
     - Version A gets 20% more clicks.
     - Users complain Version B blocks content.

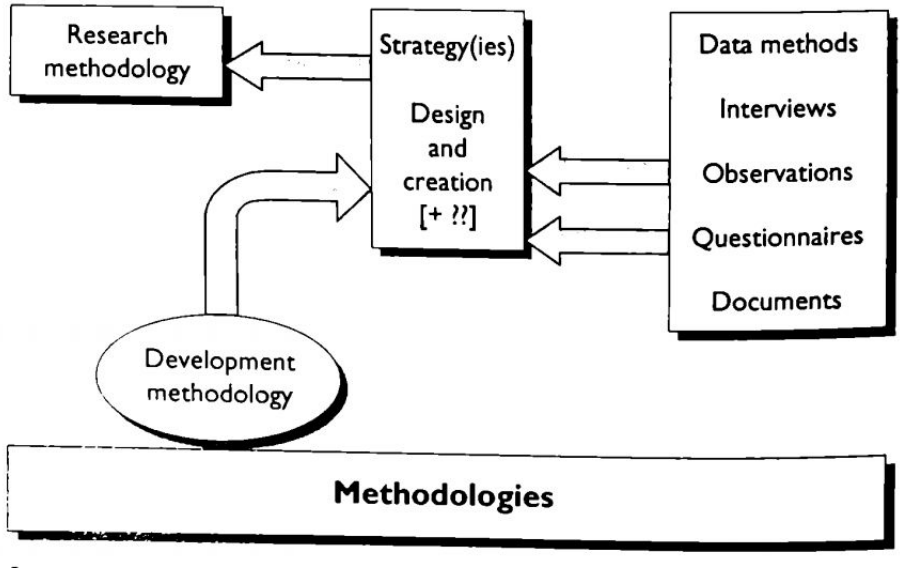
Strategies-Design and Creation

5. Conclusion (Implementing the Solution)
   - Refine and finalize the best solution.
   - *Example:* The team implements Version A and monitors long-term user engagement.

Strategies-Design and Creation

Systems development methodology

- Many computing research projects involve the development of a computer-based product. In your research report, you must explain and document you worked through the stages of analysis, design, implementation and testing, that is, your systems development method or methodology (both terms are used). This is not to be confused with your research methodology -the combination of research strategies and data generation methods that you use in your research project (see Figure below).



Research Methodology and Development Methodology

Strategies-Experiment

Planning and Conducting Experiments

When designing an experiment you have to think about:

- the **hypothesis** to be tested,
- the variables to be controlled and measured, and
- internal and external validity.

There are also different kinds of experiments: true experiments, quasi experiments and uncontrolled trials.

Strategies-Experiment

Hypotheses

- An experiment is based on a hypothesis to be tested.
- A hypothesis is a statement that has not yet been tested empirically (that is, by gathering field data) but for which it is possible to devise empirical tests that will provide clear evidence to support it or reject it.
- It is written as a kind of **prediction**, for example:
    - When factor A occurs B will happen.
    - An increase in D causes a decrease in C.
    - Water will freeze when the temperature drops to 32 degrees Fahrenheit (0 degrees centigrade).

Note: A hypothesis must be testable and it must always be possible to disprove, or falsify, the hypothesis.

Strategies-Experiment

Independent and dependent variables

- The independent variable affects one or more dependent variables: its size, number, length or whatever exists independently and is not affected by the other variable.
- A dependent variable changes as a result of changes to the independent variable.
- An experiment will be based on manipulation of the independent variable to observe the changes in the dependent variable(s).

For example, the introduction of a new teaching and learning approach might lead to improved examination results. This could be investigated via an experiment, where the independent variable is the new approach and the dependent variable is the exam results.

Strategies-Experiment

Controls

- The aim of a research strategy based on experiments is to show that one factor only causes an observed change.
- The researcher therefore tries to control all the variables, either all at once or in a sequence of experiments so that in the end just one factor remains as the only viable cause of the observed change.

For example, in the experiment mentioned above, to examine the link between a new teaching approach and examination results, it would be necessary for the examination and the marker to be exactly the same as before the introduction of the new approach, otherwise it is possible that an easier examination or a more generous marker caused the improved results.

Strategies-Experiment

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Strategies-Experiment

Observation and measurement

The experiment strategy involves observations, making measurements of the dependent variables and observing change. Typical things which are observed and measured include:

- project data, for example, number of person-hours, cost, time to completion;
- self-report responses (for example, the subjects of the experiment complete a questionnaire about their feelings or how they rate a concept);
- behavioural counts - the number of times a certain kind of behaviour occurs (for example, number of times someone asks for help or accesses an online help system);
- number of bugs in a piece of code;
- time to process a file of data.

Strategies-Experiment

Internal validity

- Internal validity means that the changes you observe in your experiment are truly caused by the thing you're testing (the *independent variable*), and not by other outside factors.
- For example, if you test whether a new teaching method improves students' grades, you want to be sure that any improvement is because of the method—not because the students got smarter over time, or because they practiced the test before.

Common Threats to Internal Validity

- Different Groups at the Start
  - If your experimental group and control group were not similar before the experiment, any differences later might not be because of your changes.
- People Dropping Out (Experimental Mortality)
  - If some participants quit, the remaining group might be biased.
  - *Example:* In a tech study, only the least skilled workers stay—so results don't reflect the w
    group.

Strategies-Experiment

Common Threats to Internal Validity

- Outside Events (History)
  - Something unexpected happens during the experiment that affects results.
  - *Example:* You measure stress before and after a new work system, but a company layoff happens in between—so stress may be from job fears, not the system.
- Natural Changes Over Time (Maturation)
  - People change naturally (e.g., kids grow smarter, adults get tired or bored with repeated tests).
  - *Example:* Testing kids at age 4 and 6—they improve naturally, not necessarily because of your experiment.
- Faulty Measuring Tools (Instrumentation)
  - If your measurement tool (survey, machine, observer) changes or is unreliable, results may be wrong.
  - *Example:* Interviewers get better (or lazier) over time, affecting responses.

Strategies-Experiment

Common Threats to Internal Validity

- People Reacting to Being Studied (Reactivity)
  - Participants might act differently just because they know they're being watched.
  - *Example:* Employees work harder during a productivity study, not because of a new policy but because they want to impress.
- Experimenter Influence
  - The researcher's behavior (unintentionally) affects results.
  - *Example:* A teacher gives subtle hints to students in an experiment, leading to better performance.

Strategies-Experiment

External validity

- External validity means your experiment's results can be applied to other people, places, or situations—not just the specific conditions of your study. In other words, can your findings be *generalized* to the real world?
- For example, if a study finds that a new teaching method helps college students learn better, does it also work for high school students, working adults, or online learners? If not, the study has low external validity.

Common Threats to External Validity

1. Using Unusual or Limited Participants
    - *Example:* Testing only college students when you want to apply results to all adults.
    - *Problem:* Students are often younger, more educated, and less experienced than the general population.

Strategies-Experiment

Common Threats to External Validity

1. Using Unusual or Limited Participants
    - *Example:* Testing only college students when you want to apply results to all adults.
    - *Problem:* Students are often younger, more educated, and less experienced than the general population.
2. Too Few Participants
    - Small samples may not show true effects, making results unreliable for larger groups.
3. Non-Representative Samples
    - If participants don't match the real-world group you're studying, results won't generalize.
    - *Example:* Using only volunteer participants (who may be more motivated or sociable than average).
4. Artificial or Unrealistic Test Conditions
    - *Example:* Testing a new software tool in a controlled lab instead of a real workplace.
    - *Problem:* People might behave differently in experiments than in everyday life.

Strategies-Case study

- A case study is like doing a deep dive into one specific example (a "case") to understand it as fully as possible. Instead of studying many things briefly, the researcher focuses on one situation in great detail.

Key Features/Characteristics of a Case Study:

1. Depth Over Breadth
    - The goal is to gather as much detail as possible about one case (e.g., a person, a company, a school, an event).
    - Example: Instead of surveying 100 companies about workplace culture, you study one company in depth to really understand how it works.
2. Natural Setting (Real-Life Context)
    - The case is studied where it naturally happens, not in a lab or controlled environment.
    - Example: If studying a hospital's workflow, you observe actual doctors and nurses in the hospital, not in a simulation.
    - The researcher tries not to interfere—they observe things as they normally are.

Strategies-Case study

3. Holistic Approach (Seeing the Big Picture)
    - Instead of isolating single factors (like "Does salary affect productivity?"), the researcher looks at how everything connects.
    - Example: Studying a struggling school? You'd look at teaching methods, student behavior, funding, leadership, and community support—not just one factor.
4. Multiple Sources & Methods
    - The researcher gathers data from many places to get a full picture.
    - Example: If studying a business team, you might:
        - Interview employees, managers, and customers.
        - Observe meetings and daily work.
        - Read reports, emails, or meeting notes.
        - Use surveys if helpful.
    - Both numbers (quantitative) and descriptions (qualitative) data can be used.

Strategies-Case study

Example:

Imagine researching why a famous startup failed. A case study would involve:

- Interviewing founders, employees, and investors.
- Studying their business plans, financial records, and customer feedback.
- Observing their company culture (if possible).
- Putting all this together to explain not just what went wrong, but how and why.

Strategies-Case study

Types of Case Studies

Case studies can be used for different purposes. There are three main types:

1. Exploratory Case Study
   - Purpose: To explore a topic when little is known about it. Helps figure out what questions to ask in future research.
   - Example: You want to study why some remote workers are more productive. Since there's not much research, you first study one company in-depth to identify key issues (e.g., work environment, manager support, tech tools). Later, you use these findings to design a bigger survey.
   - Like: Scouting a new area before making a map.

2. Descriptive Case Study
   - Purpose: To give a detailed, story-like account of a situation or event.
   - Example: Studying how a school implemented a new anti-bullying program—what happened, how teachers and students reacted, and what challenges arose.
   - Like: Writing a documentary about a real-life event.

Strategies-Case study

Types of Case Studies

3. Explanatory Case Study

- Purpose: To explain why something happened, often by linking real-world events to theories.
- Example: A company's sales dropped suddenly. Instead of just describing the drop, you investigate why—poor leadership? Market changes? Failed marketing? You compare findings to business theories to see which explanation fits best.
- Like: Being a detective who not only describes a crime scene but also figures out the motives and causes.

Simple Summary

- Exploratory: "What should we even study?" (Early-stage research).
- Descriptive: "What happened?" (Tells a detailed story).
- Explanatory: "Why did it happen?" (Digs into causes and theories).

Strategies-Action research

Action research is a hands-on approach where researchers work with people (like employees, teachers, or community members) to solve real-world problems while also learning from the process.

Key Features of Action Research:

1. Focused on Real Problems
    - It tackles actual issues people face in their daily work/lives (not just theories or lab experiments).
    - Example: A teacher tests new ways to reduce student stress in their classroom instead of just studying stress in a lab.
2. An iterative cycle of Plan → Act → Reflect
    - Researchers:
        - Plan a change (e.g., a new teaching method).
        - Try it out in real life.
        - Reflect on what worked/didn't.
        - Adjust and repeat the cycle to improve.
    - Like tweaking a recipe after each try to make it better.

Strategies-Action research

3. An emphasis on change
    - The point isn't just to observe—it's to make things better.
    - Example: A manager collaborates with employees to reduce overtime stress, then measures if the changes helped.
4. Collaboration with Practitioners
    - The people affected by the problem (e.g., nurses, students, workers) help design and test solutions.
    - Example: A hospital researches patient wait times by working *with* nurses and admins, not just observing them.
5. Multiple Data-generation method
    - Collects both numbers (quantitative) and stories/observations (qualitative).
    - Tools: Surveys, interviews, notes, meeting records, etc.
6. Action outcomes plus research outcomes
    - Practical outcomes: Did the problem improve? (e.g., shorter wait times).
    - Research outcomes: What did we learn? (e.g., why certain solutions failed).
    - Success isn't just about fixing the problem—even failures teach us something!

Strategies-Action research

F, M, and A in Action Research

Peter Checkland, a well-known researcher in information systems (IS), developed a way to structure action research using three key ideas: F, M, and A. These help researchers organize their work clearly—so it's not just guesswork, but a thoughtful process.

1. F = Framework (The Guiding Ideas)

- What it is: The theory or big ideas behind the research.
- Example: If you're improving a hospital's workflow, your *F* might be "efficiency theories" or "team communication models."
- Why it matters: It's like the "textbook knowledge" that guides your actions.

Strategies-Action research

2. M = Methodology (The Step-by-Step Plan)

- What it is: The specific method or tools you use to solve the problem, based on *F*.
- Example: If your *F* is "systems thinking," your *M* could be Checkland's Soft Systems Methodology (SSM)—a way to analyze and fix messy real-world problems.
- Why it matters: It's your "game plan" for turning theory into action.

3. A = Area of Application (The Real-World Problem)

- What it is: The actual situation you're trying to improve (e.g., a slow hospital, a chaotic school).
- Example: Using SSM (*M*) to redesign a hospital's patient intake process (*A*) based on systems theory (*F*).
- Why it matters: This is where theory meets reality—you test ideas, learn, and adjust.

Strategies-Ethnography

Ethnography is like being a "culture detective." It means studying how people live, behave, and think in a specific group or place—whether it's a workplace, a university, or even an online community.

How We All "Do" Ethnography Without Realizing It

- Example 1: Starting university? You had to figure out:
  - How do students dress?
  - What's the "right" way to act in class?
  - What weird slang do professors use?
- Example 2: Starting a new job? You learn:
  - Who eats lunch together?
  - What's the boss's pet peeve?
  - What's the "real" way to get things done (even if it's not the official rule)?

We all do this when entering a new culture—but ethnographers do it systematically for research.

Strategies-Ethnography

How Academic Ethnography is Different

An ethnographer doesn’t just "pick things up" naturally. They:

1. Observe & Record: Take notes, interviews, photos, or videos.
2. Reflect: Ask, *"How did I learn this? Did my presence change things?"*
3. Compare: Link findings to past research (*"This matches what other studies say about office culture…"*).
4. Write It Up: Share discoveries in reports, books, or articles.

Strategies-Ethnography

Characteristics of Ethnography

1. You Live It to Learn It
    - Researchers don't just watch from afar - they participate in daily life
    - Example: To study firefighters, you'd ride along on calls, eat at the firehouse, wear the gear
2. Real World, Not Lab World
    - Studies happen where life actually occurs (homes, workplaces, streets)
    - The goal is to be like a "fly on the wall" - not disturbing normal behavior
3. You Are the Research Tool
    - Use your eyes, ears, and notebook to collect:
        - Conversations (interviews)
        - Daily activities (observations)
        - Diaries, photos, official records
    - Take tons of notes about everything - even your own feelings

Strategies-Ethnography

Characteristics of Ethnography

4. Show Their World Through Their Eyes
    - The best test? If the people you studied say:
      "Yes! That's exactly how it is for us!"
    - Example: If studying teachers, your report should make teachers nod in recognition
5. The Whole Picture, Not Just Pieces
    - Don't just focus on one thing (like pay or schedules)
    - Show how everything connects:
        - Work relationships + family life + money + traditions
    - Like painting a full landscape, not just a single tree

Example:

An ethnographer studying a restaurant would:

- Work shifts as a waiter (participate)
- Note how cooks and servers really communicate (not just official rules)
- Show how pay, customer moods, and kitchen stress all affect each other

Data Generation methods

Data generation methods:

1. Interviews
2. Observation
3. Questionnaire
4. Documents

Data Generation methods-Interviews

What is a Research Interview?

- An interview in research is a special type of conversation where one person (the researcher) asks questions to get information from another person.
- Unlike a normal chat where topics flow freely, an interview is planned—the researcher decides what to talk about and guides the discussion.

Key Features of Interviews:

1. Structured & Planned
    - The researcher prepares questions in advance.
    - Topics aren't random; the interviewer controls the flow.
2. Researcher Leads the Conversation
    - The interviewer asks most of the questions.
    - The interviewee knows it's for research and agrees to participate.
3. Open & Honest
    - Interviews aren't secret—both sides know it's for research.
    - Answers are usually "on the record" (can be used in the study) unless the interviewee says something is "off the record."

Data Generation methods-Interviews

When Are Interviews Useful?

Interviews work well when researchers want to:

- Get detailed answers (not just yes/no).
- Ask flexible questions (order can change based on the person).
- Understand feelings, experiences, or sensitive topics (things people might not write in a survey).
- Study complex issues that need deeper discussion.

How Are Interviews Used in Research?

- Case Studies & Ethnography (studying people in real-life settings).
- Surveys (instead of written questionnaires, or to add depth).
- Design & Testing (getting user feedback before and after creating something).

Data Generation methods-Interviews

Interviews in research come in three main types, depending on how flexible or controlled the questions are:

1. Structured Interviews

- Like a spoken questionnaire – You ask the exact same questions to every person in the same way.
- No extra chatting – You stick to the script, don't add your opinions, and just record answers.
- Good for surveys where you need consistent data (like yes/no answers or ratings).
- Example: A phone survey where you read questions word-for-word.

2. Semi-Structured Interviews

- A mix of planned and free-flowing – You have key questions, but can change order or ask follow-ups.
- More like a conversation – The interviewee can add their own thoughts, and you explore interesting points.
- Good for deeper understanding (e.g., opinions, experiences).
- Example: A job interview where you have set topics but adjust based on answers.

Data Generation methods-Interviews

3. Unstructured Interviews

- Very open & natural – You just introduce a topic and let the person talk freely.
- No strict questions – You listen more, interrupt less, and let them share stories or ideas.
- Good for exploring personal experiences (e.g., life stories, emotions).
- Example: A documentary filmmaker asking, "Tell me about your childhood," and letting the person lead.

Data Generation methods-Interviews

Steps in Interview

1. Interview Preparation

- Plan your questions – Know what you want to ask.
- Research the person/company – Check their job, company news, or reports.
- Why?
    - Helps you ask better questions.
    - Makes you look professional (so they trust you).
    - Helps spot if they give wrong info.
- Send questions early (if needed) – Gives them time to prepare.
- Practice with a friend – Get comfortable before the real thing.

Data Generation methods-Interviews

Steps in Interview

2. Scheduling the Interview

- Ask for their time – Tell them:
  - Why you're interviewing them.
  - How long it'll take (don't guess—better to finish early!).
- Don't book too many in one day – More than 3 is tiring.
- Keep it short – 1-2 hours max (longer? Split into parts).
- Pick a comfy place – Their office, a quiet café, or their home.

3. Recording the Interview

- Never rely on memory! Use:
  - Notes (minimum) – Write key points + body language.
  - Audio recording – Best for accuracy (ask permission first!).
  - Video – Shows body language but may feel awkward.
- Write notes right after – Memory fades fast!

Data Generation methods-Interviews

Steps in Interview

4. Seating & Equipment Setup

- Sit at a 90° angle – Feels friendly, not like an interrogation.
- Test your gear – Check mics, batteries, and backups.
- Small talk while setting up – Avoid awkward silence.
- Turn off your phone!

Data Generation methods-Interviews

Steps in Interview

5. Conducting the Interview

- Start friendly
  a. Introduce yourself.
  b. Explain the purpose.
  c. Ask easy warm-up questions (e.g., "Tell me about your job.").
- Ask good questions
  a. Use open questions (start with *What, How, Why*).
  b. Avoid yes/no or confusing double questions.
  c. Save sensitive topics for later.
- Listen well
  a. Nod, keep eye contact, and pause to let them think.
  b. Use silence – Don’t rush to fill gaps.
- End politely
  a. "Anything else you’d like to add?"
  b. Thank them!

Data Generation methods-Interviews

Steps in Interview

6. Transcribing (Writing It All Down)

- Type out recordings – Takes ~5 hours per 1 hour of audio!
- Add notes – Include body language, tone, and your thoughts.
- Label everything – Name, date, and line numbers for easy checking.

7. Checking Facts & Analyzing

- Let interviewees review – Confirm quotes are correct.
- Compare with other sources – Check if answers match reports/other interviews.
- Look for patterns – What topics keep coming up?

Data Generation methods-Observation

Observation is a way for researchers to watch and record what people actually do (instead of just asking them). It's not just about seeing—it can also involve:

- Listening (to words, tone of voice)
- Touching (e.g., checking the comfort of a chair)
- Smelling (e.g., noticing if a room gets stuffy)
- Tasting (e.g., trying the snacks served in a meeting)

Why Use Observation?

- People don't always do what they say they do.
- Helps study real behavior (e.g., how workers use computers, how students learn in class).
- Can even study objects (e.g., how a machine or software works).

Data Generation methods-Observation

Two Main Types of Observation:

1. Systematic Observation
    - Like a scientist – You plan exactly what to watch and record (e.g., counting how many times people check their phones in a meeting).
    - Good for clear, measurable data.
2. Participant Observation
    - You join the group you're studying (e.g., working in a store to see how employees really treat customers).
    - Good for understanding hidden habits or culture.

Data Generation methods-Observation

Steps to Conduct Systematic Observation

1. Define Your Research Goal
   - Ask: *"What specific behavior or situation do I need to observe?"*
     (Example: "How often do nurses wash their hands in a hospital?" or "How do shoppers react to a new store layout?")

2. Choose What to Observe
   - Decide the focus: Actions, words, body language, interactions, etc.
   - Set clear categories:
     (Example: For a classroom study, note: "Teacher questions," "Student participation," "Distractions.")

3. Pick a Recording Method
   - Checklist/Tally Sheet (counts how often something happens).
   - Notes/Diary (describes events in detail).
   - Audio/Video (captures exact behavior but needs permission).

Data Generation methods-Observation

4. Plan the Timing
   - When? (e.g., during meetings, rush hour, or specific events).
   - How long? (Short bursts or continuous? Repeat sessions for accuracy).

5. Stay Unbiased
   - Don’t interfere – Be a "fly on the wall."
   - Avoid assumptions – Record only what you *see*, not what you *think* it means.

6. Test Your Method
   - Do a practice observation to fix flaws in your checklist or approach.

7. Conduct the Observation
   - Stick to your plan – Follow your categories/timing.
   - Note context (e.g., "Room was noisy," "Participant seemed tired").

Data Generation methods-Observation

8. Review & Analyze Data

- Count behaviors (if using tallies).
- Look for patterns (e.g., "Handwashing increased after lunch").

9. Compare with Other Data

- Check if observations match surveys/interviews *(e.g., Do people say they wash hands often, but observations show otherwise?)*.

Data Generation methods-Observation

Steps to Conduct Systematic Observation

1. Choose Your Research Focus
   - *Example*: "How do street vendors manage daily sales?" or "What's the work culture in a startup?"

2. Gain Access & Build Trust
   - Get permission (if needed).
   - Blend in—dress/act like the group. *(Example: Work as a cashier to study retail staff.)*

3. Take Notes Secretly (Ethically!)
   - Use a small notebook or voice memos (if allowed).
   - Write immediately after to avoid forgetting.

Data Generation methods-Observation

4. Observe & Participate

- Do what the group does (e.g., attend meetings, work shifts).
- Watch for:
  - Actions: What people *actually* do vs. what they *say*.
  - Routines: Daily habits, unwritten rules.
  - Social dynamics: Who leads? Who's ignored?

5. Ask Subtle Questions

- Use casual chats to clarify what you see.
  Example: "Why do we always stack boxes this way?"

6. Record Emotions & Context

- Note body language, moods, conflicts, or surprises.
- *Example*: "Team laughed during breaks but argued over deadlines."

Data Generation methods-Observation

7. Leave & Analyze Data

- Compare notes for patterns (e.g., "Workers cut corners when the boss is absent").
- Stay honest—don’t let your presence change the group’s behavior.

Data Generation methods-Questionnaire

A questionnaire is a fixed set of questions given to people to collect data. Researchers use the answers to find patterns and make conclusions.

Key Points:

1. How It Works:
   - People answer the same questions in the same order.
   - Can be self-filled (e.g., online forms) or researcher-led (like a structured interview).
2. Best For:
   - Gathering quick, simple info from many people.
   - Getting standardized answers (e.g., yes/no, ratings).
   - When respondents can read and understand questions easily.
3. Challenges:
   - Must be clear and unbiased—questions should mean the same thing to everyone.
   - Takes time and money to print, send, and collect responses.
4. Not Just a List of Questions!
   - Requires careful design to get useful, accurate data.

Example: A customer feedback form with ratings (1-5) is a questionnaire.

Data Generation methods-Questionnaire

How to Design a Good Questionnaire

1. Start with Your Research Goal
   - Ask: *"What do I need to find out?"*
   - Example: If studying customer satisfaction, focus on *service speed, friendliness, product quality*.

2. Keep Questions Simple & Clear
   - Bad: *"Do you agree that our company's multifaceted operational deliverables enhance user experiences?"*
   - Good: *"How satisfied are you with our service? (Very satisfied/Satisfied/Neutral/Unsatisfied)"*

3. Use Mix of Question Types
   - Closed-ended (Easy to analyze):
     - Yes/No: *"Did our staff help you today?"*
     - Multiple choice: *"How did you hear about us? (Social media/Friend/Advertisement)"*
     - Rating scales (1-5 or 😊→😞).
     - Open-ended (For deeper insights):
       i. *"What could we improve?"*

Data Generation methods-Questionnaire

4. Avoid Bias

- Leading: *"Don't you love our new product?"*
- Neutral: *"How do you feel about our new product?"*

5. Logical Order

1. Easy/warm-up questions first (e.g., age, gender).
2. Main questions next.
3. Sensitive/personal questions last (if needed).

6. Test Before Sending!

- Try it on 5 people to catch confusing questions.

7. Keep It Short

- Aim for 5-10 minutes max—people abandon long surveys!

Data Generation methods-Documents

Documents are written, visual, or digital materials that researchers use as data sources (instead of only interviews or surveys).

Two Main Types:

1. Found Documents
    - Already exist before the research.
    - Examples:
        - *Company records* (reports, emails, meeting notes).
        - *Public records* (birth certificates, voter lists).
        - *Everyday items* (receipts, bus tickets, graffiti).
2. Researcher-Generated Documents
    - Created *for* the research.
    - Examples:
        - *Field notes* (written during observations).
        - *Photos/videos* (taken by the researcher).
        - *Diagrams/models* (e.g., software designs).

Data Generation methods-Documents

Steps to Document-Based Research

1. Obtaining Access to Documents
   - Ask permission (for private/company documents).
   - Public documents (e.g., reports, census data) are freely available.
   - Ethical rule: Don’t use personal/secret documents without consent.

2. Using Secondary Data & Archives
   - Secondary data = Info collected by others (e.g., old surveys, government stats).
   - Research archives = Libraries/online databases (e.g., Harvard Dataverse, UK Data Archive).
   - Pros: Saves time! Cons: Might not fit your exact needs.

Data Generation methods-Documents

3. Evaluating Documents

Ask:

- Is it trustworthy? (Who made it? Why?).
- Is it biased? (e.g., a company’s annual report hides problems).
- Is it relevant? (Does it answer your research question?).

4. Analyzing Documents

- Read/watch/listen carefully.
- Look for patterns (e.g., repeated words in emails).
- Compare different documents (e.g., official rules vs. employee notes).
- Summarize key points (e.g., "Meeting minutes show budget cuts were rushed").

Data Analysis

Data Analysis

1. Quantitative Data Analysis
2. Qualitative Data Analysis

Quantitative Data Analysis

Learn about:

- What are different kinds of Quantitative data
- How to prepare your quantitative data for analysis
- Using visual aids for quantitative data analysis
- Using visual aids for quantitative data analysis

Quantitative Data Analysis

Quantitative data means data, or evidence, based on numbers. It is the main type of data generated by experiments and surveys, although it can be generated by other research strategies too.

Examples of numeric data include:

a. number of people expressing satisfaction with an organization's IT help-desk;
b. a company's annual turnover for each of the last 5 years;
c. time in seconds to process a data file;
d. number of characters in a computer animation;
e. number of people accessing the Internet for more than 20 hours per week;
f. number of hot links on a website.

- The idea of data analysis is to look for **patterns** in the data and draw conclusions.
- There is a wide range of established techniques for analysing quantitative data.
- A simple
- analysis would use tables, charts or graphs — these enable the researcher or reader to see some patterns

Quantitative Data Analysis

Quantitative data comes in different "flavors" depending on what the numbers represent. Here's a simple breakdown:

1. Nominal Data (Label Data)

- What it is: Numbers used as labels for categories (no math meaning).
- Example:
  - Gender: `1 = Male`, `2 = Female` (you can't calculate an "average gender").
  - Colors: `1 = Red`, `2 = Blue`, `3 = Green`.
- Analysis: Just count how many are in each category (e.g., "50% chose Blue").

2. Ordinal Data (Ranked Data)

- What it is: Numbers show order, but gaps between them aren't equal.
- Example:
  - Exam ranks: `1st`, `2nd`, `3rd` (we know who's better, but not by how much).
  - Survey ratings: `1 = Disagree`, `5 = Agree` (is "5" *twice* as good as "2.5"? No idea!).
- Analysis: Compare rankings (e.g., "More people agreed than disagreed").

Quantitative Data Analysis

3. Interval Data (Evenly Spaced Data)

- What it is: Numbers with equal gaps, but no true "zero".
- Example:
  - Temperature (°C): `20°C vs. 30°C` (10° difference), but `0°C` doesn't mean "no heat".
  - Years: `2000 to 2010` is the same length as `1990 to 2000`.
- Analysis: Add/subtract (e.g., "Average temperature rose 5°C"), but no ratios (30°C isn't "1.5× hotter" than 20°C).

4. Ratio Data (True Zero Data)

- What it is: Numbers with equal gaps + a true zero (you can do all math!).
- Example:
  - Height: `0 cm` = no height. `10 cm` is *twice* as tall as `5 cm`.
  - Salary: `$0` = no income. `$100K` is *double* `$50K`.
- Analysis: All calculations work (+, −, ×, ÷).

Quantitative Data Analysis

Two More Types

- Discrete Data: Whole numbers only (e.g., "2 children", not "2.5 children").
- Continuous Data: Can be split infinitely (e.g., "Weight: 70.5 kg" or "70.523 kg").

Visual Aids for Quantitative Data Analysis

- The simplest form of analysis uses tables and charts to present the data in a visual way that allows you to explore it and ‘see’ values and patterns in it.
- Typically, we use tables and charts to show specific values, highest and lowest values of a variable, frequencies, proportions, distributions, and trends, as the following examples show

Visual Aids for Quantitative Data Analysis—Tables

- Tables are suitable for use with all types of data and are easily produced using word processing software.
- For example, Figure 2.3 shows the actual values obtained for 'Number of people allocated to each systems development project team.
- You could use another table to plot the frequency of project team sizes—see Figure 2.4

Project	No. allocated
Robin	2
Swallow	3
Swan	5
Eagle	2
Osprey	3
Sparrow	0
Finch	1
Mallard	1
Pelican	13
Rose	4
Daisy	5

Project	No. allocated
Lily	5
Iris	9
Spider	2
Ant	5
Bear	2
Lynx	10
Wolf	5
Coyote	4
Deer	2
Fox	8
Tiger	9

Figure 2.3: Number of people allocated to systems development projects

No. of people allocated	No. of projects
0–3	10
4–7	7
8–11	4
> 11	1

Figure 2.4: Frequency of project team size

Visual Aids for Quantitative Data Analysis—Bar charts

- Bar charts are often used for displaying frequencies. For example, the data in Figure 2.4 is displayed in a bar chart in Figure 2.5.
- More complex bar charts are also possible. For example, Figure 2.6 shows the number of days lost through sickness for three teams.
- However, the more data you try to show in one chart, the harder it can be for the reader to understand it. Be careful not to overload the reader.

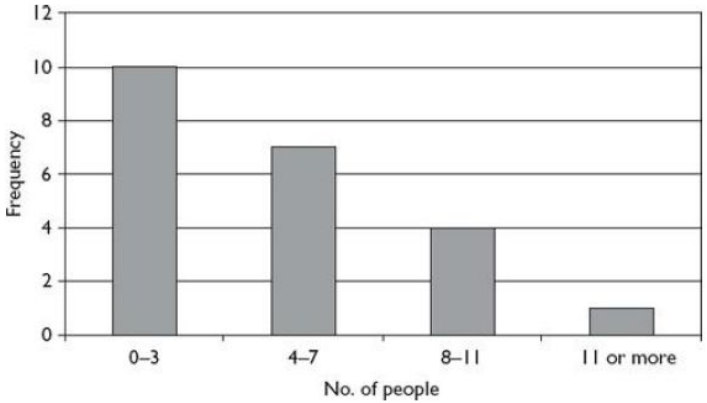

Figure 2.5: Allocation to project teams

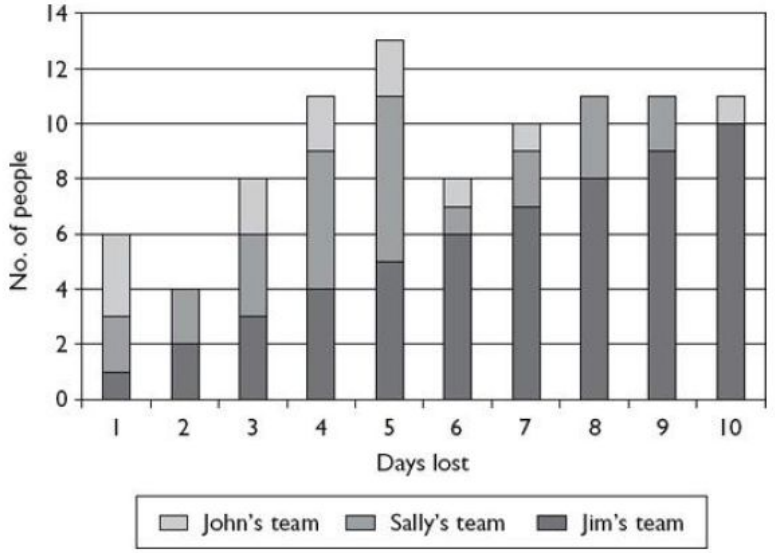

Figure 2.6: Days lost through sickness

Visual Aids for Quantitative Data Analysis—Pie charts

- Pie charts are good for showing proportions, as in Figure 2.7. For ease of reading, usually you should have not more than seven segments.

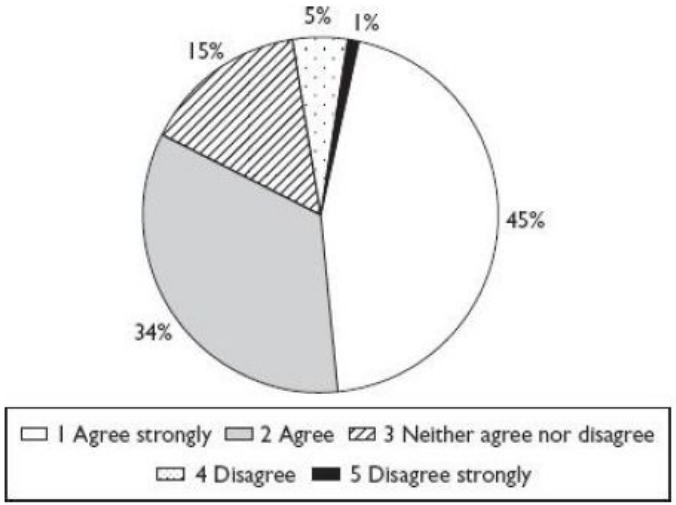

Figure 2.7: Percentage of people agreeing that a web presence is essential

Visual Aids for Quantitative Data Analysis—Scatter graph

- A scatter graph can be used to show a relationship between two variables.
- You plot your data as points on a graph, where the x-axis represents the values of one variable, and the y-axis represents the values of the other variable.

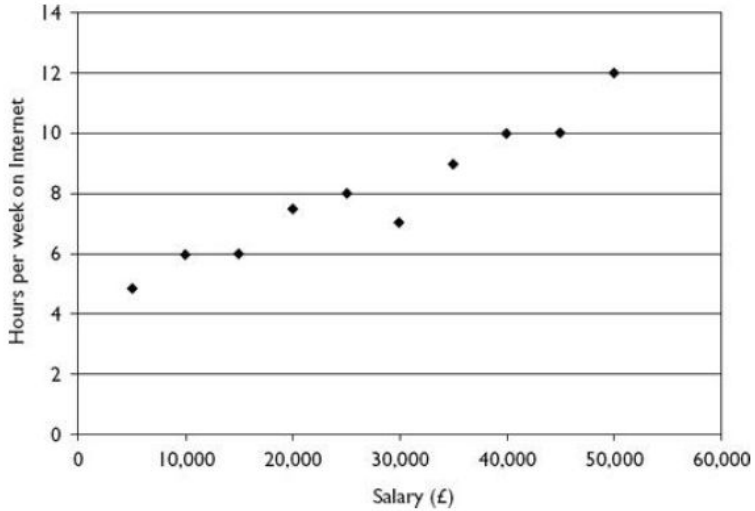

Figure 2.8: Relationship between salary and Internet access

Visual Aids for Quantitative Data Analysis—Line graphs

- Line graphs are used for showing trends in data.

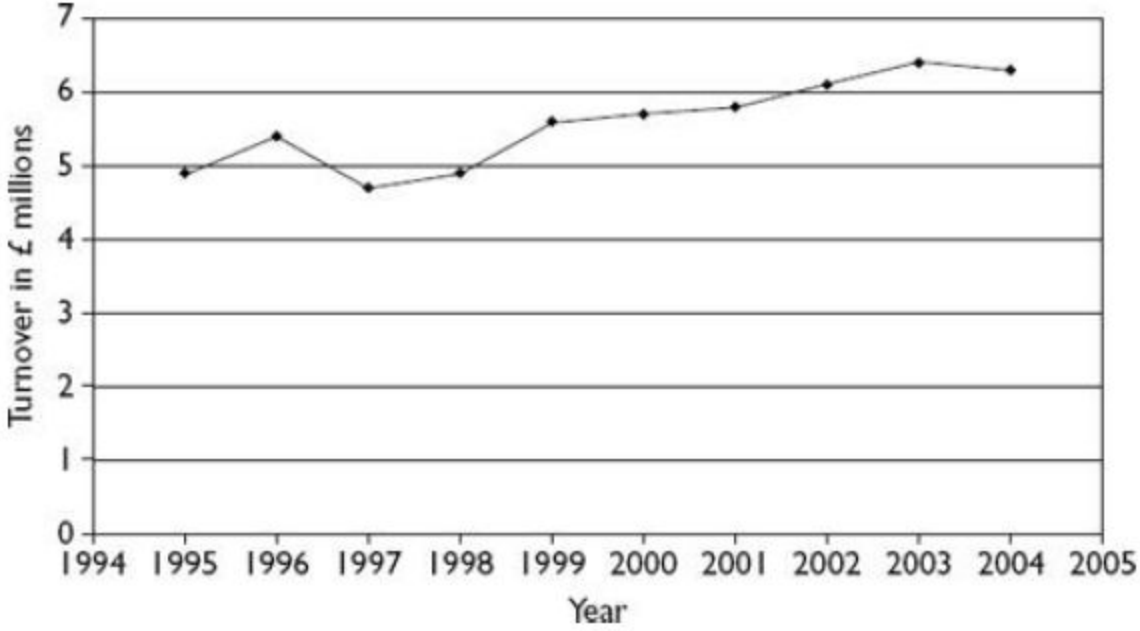

Figure 2.9: Annual turnover, 1995–2004 inclusive

Using Statistics for Quantitative Data Analysis

- Describing the central tendency It can be useful to know about the central tendency of the data, that is, where the majority of the values tends to be found.
- We have three statistical measures for describing the central tendency: the mean, median and mode.

Mean

The mean is the measure most people are referring to when they speak of the ‘average’ in everyday language. It is found by totalling all the values found and dividing by the number of cases. For example, from a set of exam results:

Smith	77
Watson	73
Singh	69
Hassan	64
Jones	52

The mean is 67.

Using Statistics for Quantitative Data Analysis

Median

The median is the mid point in a range of scores or data results. To find it, we list the values in order (either highest to lowest, or lowest to highest, it doesn't matter) and read off the middle value. For example, for a set of examination results:

Smith	77
Watson	73
Singh	69
Hassan	64
Jones	52

The median is 69.

Using Statistics for Quantitative Data Analysis

Mode

The mode is the value that is most common in your data set. It is found simply by finding which value occurs most frequently in your data set. For example, in the results:

52, 52, 64, 64, 69, 71, 73, 73, 73, 77

The mode is 73.

Using Statistics for Quantitative Data Analysis

Describing the distribution

In order to describe how widespread the values in a data set are and how evenly spread they are, that is, we need to find out about the distribution or dispersion of the data.
We have three statistical methods for describing the distribution of values in a data set:

a. range,
b. fractiles and
c. Standard Deviation.

Range

The range tells us how far apart the highest and lowest data values are. For example, in the data set:

52, 52, 64, 64, 69, 71, 73, 73, 73, 77

the highest value is 77 and the lowest 52, and the range is 25.

Using Statistics for Quantitative Data Analysis

Describing the distribution

Fractiles

Fractiles help us divide up the data values we have.
We've already met the median – the point where 50 per cent of the data values lie to one side of it and 50 per cent to the other (see above).
In effect, the median divides the spread of data into two.
But we could divide the spread into smaller parts:

a. Quartiles divide the spread into four, so each quartile contains one quarter of the data values in the set.
b. Deciles divide the spread into ten.
c. Percentiles divide the spread into 100.

Using Statistics for Quantitative Data Analysis

Describing the distribution

Standard deviation (SD)

The SD is probably the most used measure of distribution. It tells us the average amount of variability in a set of scores – or, to put it another way, the average distance of each data value from the mean.

Standard Deviation

The *larger* the SD is, the larger the average distance each data value is from the mean.
The *smaller* the SD is, the smaller the average distance each data value is from the mean.

Qualitative Data Analysis

- Qualitative data includes all non-numeric data – words, images, sounds, and so on – found in such things as interview tapes, researchers' diaries, company documents, websites and developers' models.
- It is the main type of data, or evidence, generated by case studies, action research and ethnography
- Qualitative data analysis involves abstracting from the research data the verbal, visual or aural themes and patterns that you think are important to your research topic.

Analysing Textual data
Analysing Non-textual Qualitative Data
Grounded Theory
Computer-aided Qualitative Analysis

Quantitative Data Analysis—Analyzing Textual data

Data preparation

- First of all, you need to get your data into a form ready for analysis. As far as possible, get all your materials in a similar format—all on the same-sized sheets of paper, for instance.
- This can help with filing and sifting through the material. Audio tapes may have to be transcribed—remember that 1 hour of tape can require 4–5 hours for transcribing.

Data analysis

- Start off by reading through all of your data to try to get a general impression. Now, start to identify key themes in the data.
- Initially you could use just three themes:
  - Segments that bear no relation to your overall research purpose so are not needed (at least for the current study).
  - Segments that provide general descriptive information that you will need in order to describe the research context for your readers (for example, history of a company, number of employees, location, time your respondents have spent in their current job role).
  - Segments that appear to be relevant to your research question(s).

Quantitative Data Analysis—Analyzing Non-textual Data

- Non-textual qualitative data includes audio tapes or sound clips, videos, photographs, and multimedia documents, as found on the web.
- In the social sciences, where much of the research with qualitative data occurs, there has been far more use of textual than non-textual data.

Data preparation

Data preparation is similar to that for textual data

Data analysis
As with textual analysis, you then need to analyse the data looking for themes and patterns. Some researchers treat images as if they are a true representation of some aspect of the real world – for example, photographs are provided to illustrate an ethnographic account of life in a group of people.

Quantitative Data Analysis—Grounded Theory

- Grounded theory is a particular approach to qualitative research where the intention is to do field research and then analyse the data to see what theory emerges, so that the theory is grounded in the field data.

Selection of people and instances

- Researchers using grounded theory do not start out by identifying a sample of people or instances to investigate.
- Instead, they start off with just one person (or instance), generate the data, analyse it and on the basis of their first emerging ideas from the data then decide who or what to look at next.
- This process of data generation → data analysis → data generation continues indefinitely.

Quantitative Data Analysis—Grounded Theory

Data analysis

The grounded theory researcher should approach data analysis with an open mind—not with preconceived ideas about what will be relevant or what will be useful concepts around which to categorize the data? There are three phases of coding: open, axial and selective.

1. **Open coding:** the initial process of labelling units of data, based on terms and concepts found in the data, not those found in the literature or a pre-existing theory.
2. **Axial coding:** as a list of codes begins to emerge, the researcher moves to a higher or more abstract level of analysis and looks for relationships between the codes. It will be found that some codes can be incorporated under broader headings, and some codes are found to be more important (axial) than others.
3. **Selective coding:** the researcher focuses attention on just the core codes – those that have emerged as being vital for any explanation (theory) of the complex phenomenon being investigated. These will be combined into a theory that explains the phenomenon under investigation.

Quantitative Data Analysis—Grounded Theory

Theories

Grounded theory research should lead to theories that have practical relevance for the people in the situation studied. This means that the researcher's explanations of events or situations should 'make sense' to the people involved, and ideally should help them address their practical needs.

Quantitative Data Analysis—Computer-aided Qualitative Analysis

There are software programs to help you analyze qualitative data—both freeware and commercial software products.

- You should find out whether your institution already has such software tools.

End of Chapter 2