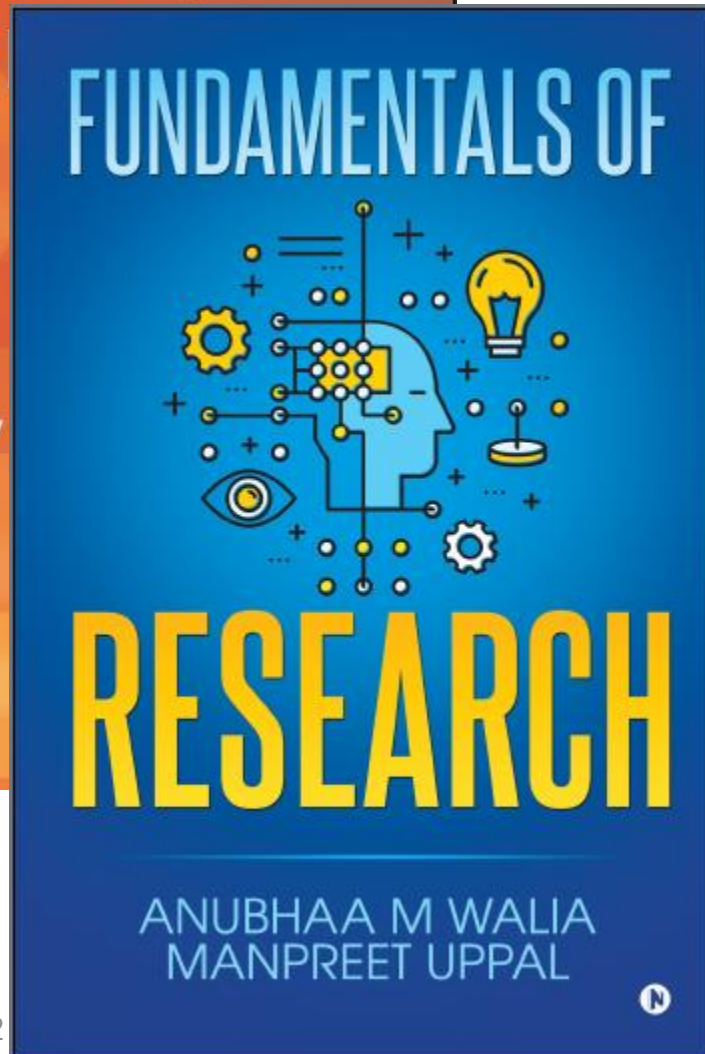


Research Fundamentals

Unit – 2: Research Process Model

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Prepared for BECE of NCIT

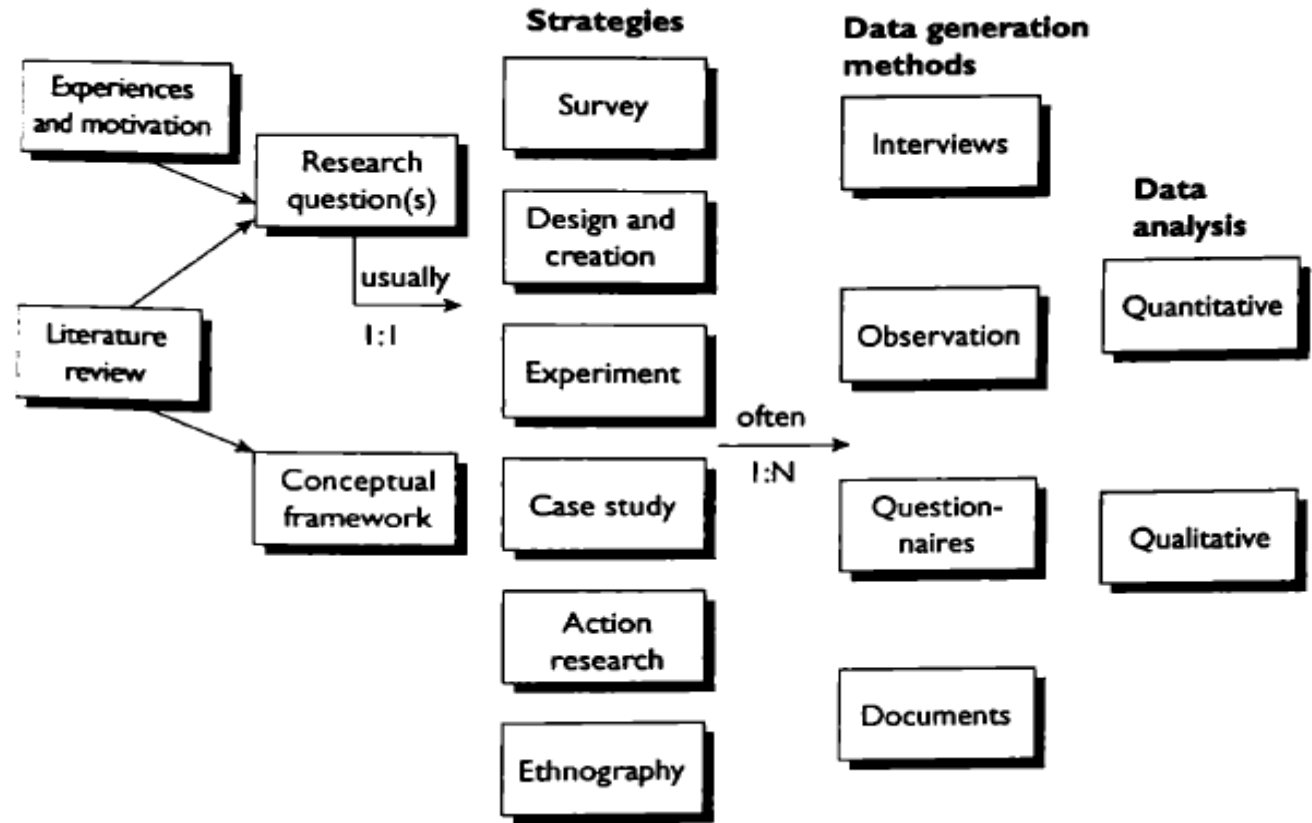


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Research Process Overview

- Define a research problem in order to provide a reason for doing the research.
- The problem will generate
 - the subject of the research,
 - its aims and objectives,
 - what sort of data need to be collected
 - what kind of analysis is needed



Research Process Model

Research Process Model (contd.)

- Personal experiences and motivation
 - why you are doing research
 - your motivation
 - personal experiences, likes, dislikes, strengths, weaknesses

Research Process Model (contd.)

- Literature review
 - Study
 - the books, journal articles and conference papers that have already been written on the topic
 - any related computer artefacts that have previously been produced
 - Find out what has been done before, and what topics remain to be addressed.
 - Critically evaluate previous work, and look for themes that link different authors' work together.
- The main aim is to trawl through all the available information sources in order to track down the latest knowledge, and to assess it for relevance, quality, controversy and gaps.
- Where to find information ?
 - Library catalog, Journals and newspapers, Electronic databases etc.
 - Information Services (of Govt. and in Public sector)
 - Museums and Galleries
 - People and The Internet (Evaluation is needed!)

Literature Review (contd.)

- Conducting a LR

- Searching
- Obtaining
- Assessing
- Reading
- Critically evaluating
- Recording
- Writing review
- Plagiarism

- Bibliography and references

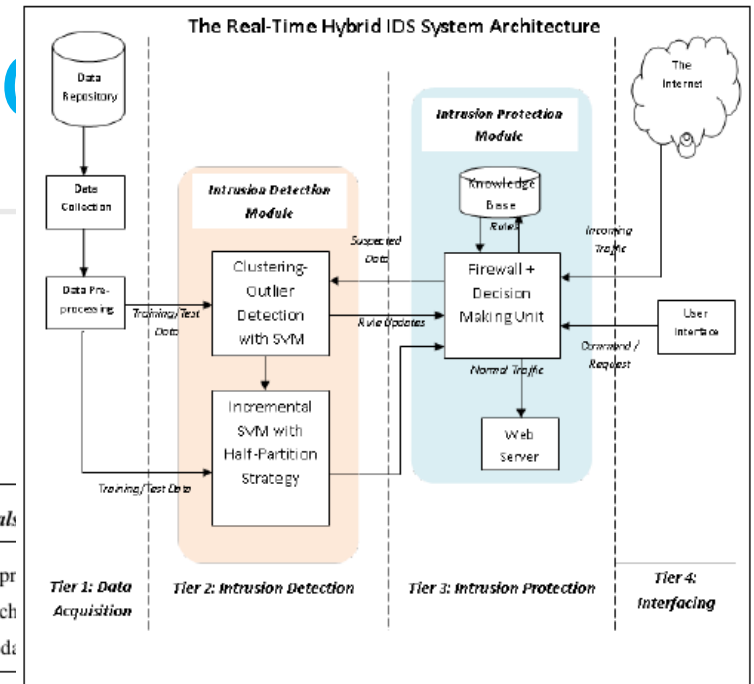
- Bibliographic detail
 - author(s) (surname, initials),
 - Year of publication,
 - title of book,
 - edition (if not the first edition),
 - place of publication,
 - Publisher etc.
- Referencing style
 - Harvard, MLA, APA, IEEE etc.

Research Process Model (contd.)

- Research question
 - You need a question or a set of questions
- Formulate a question by
 - Asking yourself, and
 - Seeing what others have proposed
- Main question:
 - Are school exam results a true test of a student's intelligence?
- Sub-questions:
 - What constitutes intelligence? (Investigating a concept, i.e. 'intelligence'.)
 - What ways of testing intelligence are there? (Exploring different perspectives – i.e. other intelligence tests, and thus investigating the concept 'test'.)
 - What sort of school exams are there and how are they marked? (Investigating another concept – i.e. 'exams'.)
 - How do school exam criteria match those of the criteria of other intelligence tests? (Split into aspects – in this case, criteria of exams and other intelligence tests.)

Research Process Model (cont)

- Conceptual framework
 - factors that comprise your topic
 - way of thinking about the topic
 - way of tackling your research question(s)
 - approach to analyzing any generated data
 - approach to designing and creating any new IT product
 - approach to evaluating your research



Problems	Goals	
How to detect intrusions in large network traffic?	Find out an pr clustering tech huge da	
	Find out a quick multi-dimensional classification method	SVM classification selected.
Infrequent traffic patterns are overlooked or undermined	Detect data patterns which are occurring in a small portion	k-Medoids is combined with outlier detection
	Increase detection rate by decreasing the false positives	Incremental SVM is applied
Detection time should be very small with higher accuracy	Maximize the rate of accuracy in detecting anomalies	SV selection strategy is implemented
	Decrease time in detecting attacks	Half-partition method is developed

Research Process Model (contd.)

- Strategies
 - survey,
 - design and creation,
 - experiment,
 - case study,
 - action research and
 - ethnography.

Research Process Model (contd.)

- Data generation methods
 - Interview
 - Observation
 - Questionnaire
 - Document
- Triangulations: -
 - Method, Strategy, Time, Space, Investigator, Theory

Research Process Model (contd.)

- Data analysis
 - Quantitative - uses mathematical approaches such as statistics to examine and interpret the data.
 - Qualitative - looks for themes and categories within the words people use or the images they create.

Strategies→Survey

- Obtain the same kinds of data from a large group of people (or events), in a standardized and systematic way.
- Look for patterns in the data that you can generalize to a larger population than the target group.
- Planning and Designing a survey:-
 - 1)data requirements,
 - 2)data generation method,
 - 3)sampling frame,
 - 4)sampling technique,
 - 5)response rate and non-responses,
 - 6)sample size.

Strategies→Survey→Sampling techniques

- probabilistic sampling

- Random sampling
- Systematic
- Stratified
- Cluster

- non-probabilistic sampling

- Purposive
- Snowball
- Self-selection
- Convenience

Strategies→Design and Creation

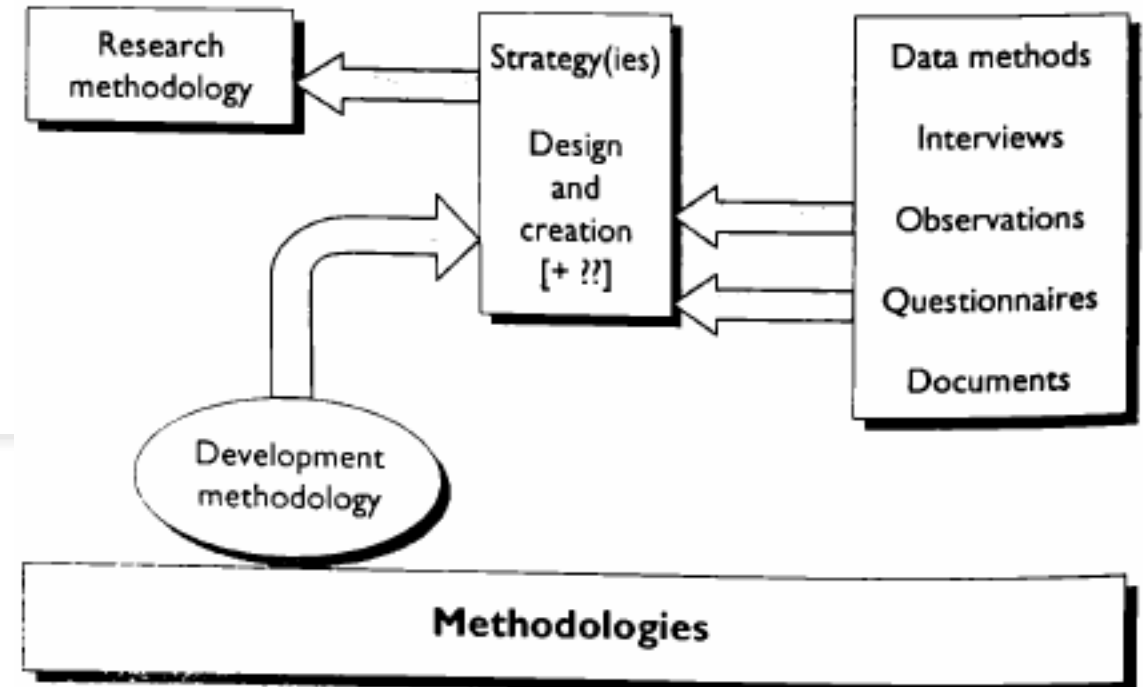
- The design and creation research strategy focuses on developing new IT products, also called artifacts.
- Types of artifacts
 - Constructs
 - e.g. entities, objects or data flows.
 - Models
 - e.g. data flow diagram, a use case scenario or a storyboard.
- Types of artifact (contd.)
 - Methods
 - e.g. formal mathematical algorithms,
 - e.g. software systems, information engineering etc.
 - Instantiations
 - e.g. a system which demonstrates that constructs, models, methods, ideas, genres or theories can be implemented in a computer-based system.

Strategies→Design and Creation→

Planning and Conducting

- The design and creation process: Learning via making
 - It is a problem solving approach
 - Iterative process having five steps –
 - (1) **awareness** : recognition and articulation of a problem,
 - (2) **suggestion** : an idea from the problem to the solution,
 - (3) **development** : the tentative design idea is implemented,
 - (4) **evaluation** : examination of the developed artifact and comparison with the existing ones.
 - (5) **conclusion** : ensuring that the knowledge gained is identified.

- System Development Methodology



Strategies→Experiments

- Try something out and find out what happens.
 - A strategy that investigates cause and effect relationships, seeking to prove or disprove a causal link between a factor and an observed outcome.
 - Start by developing a theory about their topic of interest, which leads to a statement (called hypothesis) based on the theory that can be tested empirically via an experiment.
- Characteristics of an experiment-based research: -
 - Observation and measurement
 - A process of observation, manipulation and re-observation
 - Proving or disproving relationship between two or more factors
 - Identification of causal factors (cause and effect or dependent and independent)
 - Explanation and prediction
 - Repetition

Strategies→Experiments→ Planning and Conducting

- Hypotheses
 - a statement that has not yet been tested empirically but for which it is possible to devise empirical tests
- Independent and dependent variables
 - independent variable affects one or more dependent variables and is not affected by other variables.
 - A dependent variable changes as a result of changes to the independent variable
- Controls
 - 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
- Observation and Measurement
 - involves observations, making measurements of the dependent variables and observing change.
- Internal and External Validity
 - the measurements you obtain are indeed due to your manipulations of the independent variable, and not to any other factors.
 - results are not unique to a particular set of circumstances but are generalizable.
- Quasi- or field experiments
- Experimental designs
 - One group, pre-test and post-test
 - Static group comparison
 - Pre-test/post-test control group
 - Solomon four-group design
 - Group A is pre-tested, treated and post-tested.
 - Group B is pre-tested, receives no treatment, and post-tested.
 - Group C receives the treatment and is post-tested.
 - Group D receives no treatment and is tested.

Data Generation Methods → Interviews

- A research interview is
 - A planned conversation having an agenda and proceeding
 - Conducted and controlled by the researcher
 - Not conducted covertly (interviewees know and agree the purpose, mode and the outcome)
- Interviews are conducted in case study, ethnography, survey etc.
- Types of Interviews: -
 - Structured interview
 - Unstructured interview
 - Semi-structured interview
- Planning and Conducting Interviews
 - Interview Preparation
 - Scheduling
 - Recording
 - Seating and equipment
- Post-interview tasks
 - Transcribing
 - Checking

Data Generation Methods → Observations

- Researchers sometimes use observation rather than asking questions
- A few common observations are Seeing, hearing, smelling, touching, tasting etc.
- Researchers carry either Systematic observation, or Participant observation
- A systematic observation may be
 - observing a group meeting — number and type of contributions made by each member of the group;
 - observing a queue at a university IT help-desk — time of arrival of each student, time student reaches head of queue, time taken to deal with the student's query;
 - sample of people - observing everything one person does for a given time period, then switching to another person for the same length of time, and so on.
- In a participant observation,
 - researcher takes part in the situation under study,
 - participation may be overt or covert
 - Role of the researcher may be complete observer, complete participant, participant-observer and practitioner-researcher.

Data Generation Methods → Observations (contd.)

- Overt and Covert approach of observation

Observation Type 1	vs.	Observation Type 2
Highly systematic observations of pre-defined types of events		Observations of anything and everything
Narrow concentration on particular type of event		Broad focus
Observer takes no part in the proceedings		Observer participates fully in the proceeding
Fact of observations taking place is Known to all		Fact of observations taking place is known to none except the researcher
No explanation, or false explanation given for presence of observer-researcher		Full explanation given for the presence of the observer—researcher
Short duration — could be as little as 5 minutes		Long duration — possibly years
Record-keeping uses only simple note taking		Record-keeping uses technology
No feedback given afterwards to the observed		Full feedback given afterwards to the observed

Data Generation Methods → Questionnaire

- A questionnaire is sent out to a sample of people, who are asked to complete it and return it to the researcher.
- The researcher analyses the responses, and makes generalizations about the actions or views of a larger population than the sample.
- Questionnaires can be
 - **self-administered** (the respondent completes the questionnaire without the researcher being present.) or
 - **researcher-administered** (the researcher asks the respondent each question in turn and writes down the responses)
- A questionnaire must be designed and constructed such that valid, reliable data are generated at reasonable cost.

Data Generation Methods → Ques → Planning and Designing Questionnaires

- Form of administration
- Question content and wording
- Question types
 - factual data and opinions
 - Open-ended and Closed questions
- Format of questions and responses
 - Yes/No
 - Quantity questions
 - Agree/disagree
 - Degree of (dis)agreement – e.g. LikerT scale
 - List questions
 - Rank order question
- Layout and structure
- Pre-test and pilot
- Validity and Reliability
 - Content validity
 - Construct validity
 - Reliability

Data Generation Methods → Documents

- Source of documents-
 - (1) Organization,
 - (2) Individual,
 - (3) Publication,
 - (4) Previous research (secondary data!?)
- Two types of documents: -
 - **found documents** and
 - **researcher-generated** documents.

Data Generation Methods → Documents → Planning and Conducting Document-based Research

- Obtaining access to documents
 - **Free access** e.g. visiting the library, using the web, government-published reports, company annual reports, public archives of previous research,
 - **Paid access** e.g. market research companies publish their findings by charging a price.
 - **Sensitive and Confidential Access** like internal company memos or police records.
 - Access with **Copyright** transfer or special permission
- Using secondary data and research data archives
- Evaluating documents
- Analyzing documents
 - **Documents as vessels** (documents are seen as receptacles that hold content)
 - **Documents as objects** (documents are treated as entities in their own right.)

Data Analysis → Quantitative

- Quantitative data means data, or evidence, based on **numbers**.
- Data analysis looks for **patterns** in data and draw conclusion.
- A simple analysis may use tables, charts or graphs etc.
- Types of Quantitative Data:-
 - Nominal data - describes **categories** and has no actual numeric value.
 - Ordinal (ranked) data - numbers are allocated to a **quantitative scale**.
 - Interval data – similar to ordinal data, but the scaling difference is uniform / proportionate.
 - Ratio data – like interval data, but **a true zero** to the measurement scale is used.
 - Discrete data - a **whole number**, not a fraction of a number.
 - Continuous data – **real numbers**
- Data coding is used in quantitative data

Data Analysis → Quantitative → Visual Aids for Quant. Data Analysis

- Tables
- Bar charts
- Pie charts
- Scatter graph
- Line graphs

Data Analysis → Quantitative → Statistics for Quant. Data Analysis

- Mean, mode and median
 - – describe **central tendency**
- Range, fractiles, standard deviation
 - - describe **distribution**
- Correlation, regression, chi-square test, T-test
 - - find **relationships**, test **hypothesis** and **significance**

Data Analysis → Qualitative

- Qualitative data includes all **non-numeric data or evidences** like words, images, sounds etc.
- Generated mostly by case studies, action research and ethnography
- Qualitative data analysis involves **abstracting** from the research data **the verbal, visual or aural themes and patterns**
- Quantitative (numeric) analysis may also be done on qualitative data by using **quantification techniques**, for instance, by counting the occurrence of the words, texts etc.

Data Analysis → Qualitative → Analyzing Textual Data

1. Data Preparation - get your data into a form ready for analysis
2. Data Analysis – identify key themes viz. related, not relevant, appeared-to-be-relevant and
3. Theme analysis – either by deductive or by inductive approach
4. Find interconnection among themes, categories and sections.
5. Interpretation of the analysis

Data Analysis → Qualitative → Analyzing Non-textual Data

- **Non-textual qualitative data** includes audio tapes or sound clips, videos, photographs, and multimedia documents.
 1. Data Preparation – same as in textual analysis
 2. Look for themes and patterns – e.g. in multimedia data
Denotation, Connotation, Production, Author, Viewer etc. are sought
 3. Use **Grounded theory** to analyze - do a field research and then analyze the data **to see what theory emerges** so that the theory is grounded in the field data.

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Thank you



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