Quantitative Research

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Quantitative Research: Definition

(Source: Wikipedia)

- In sociology, **quantitative research** refers to the systematic empirical investigation of social phenomena via statistical, mathematical or computational techniques.[1]
- The objective of quantitative research is to develop and employ mathematical models, theories and/or hypotheses pertaining to phenomena.

Quantitative Research: Definition

- The process of measurement is central to quantitative research because it provides the fundamental connection between empirical observation and mathematical expression of quantitative relationships.
- Quantitative data is any data that is in numerical form such as statistics, percentages, etc.[1]

Quantitative Research: Definition

- In layman's terms, this means that the quantitative researcher asks a specific, narrow question and collects a sample of numerical data from participants to answer the question.
- The researcher analyzes the data with the help of statistics.

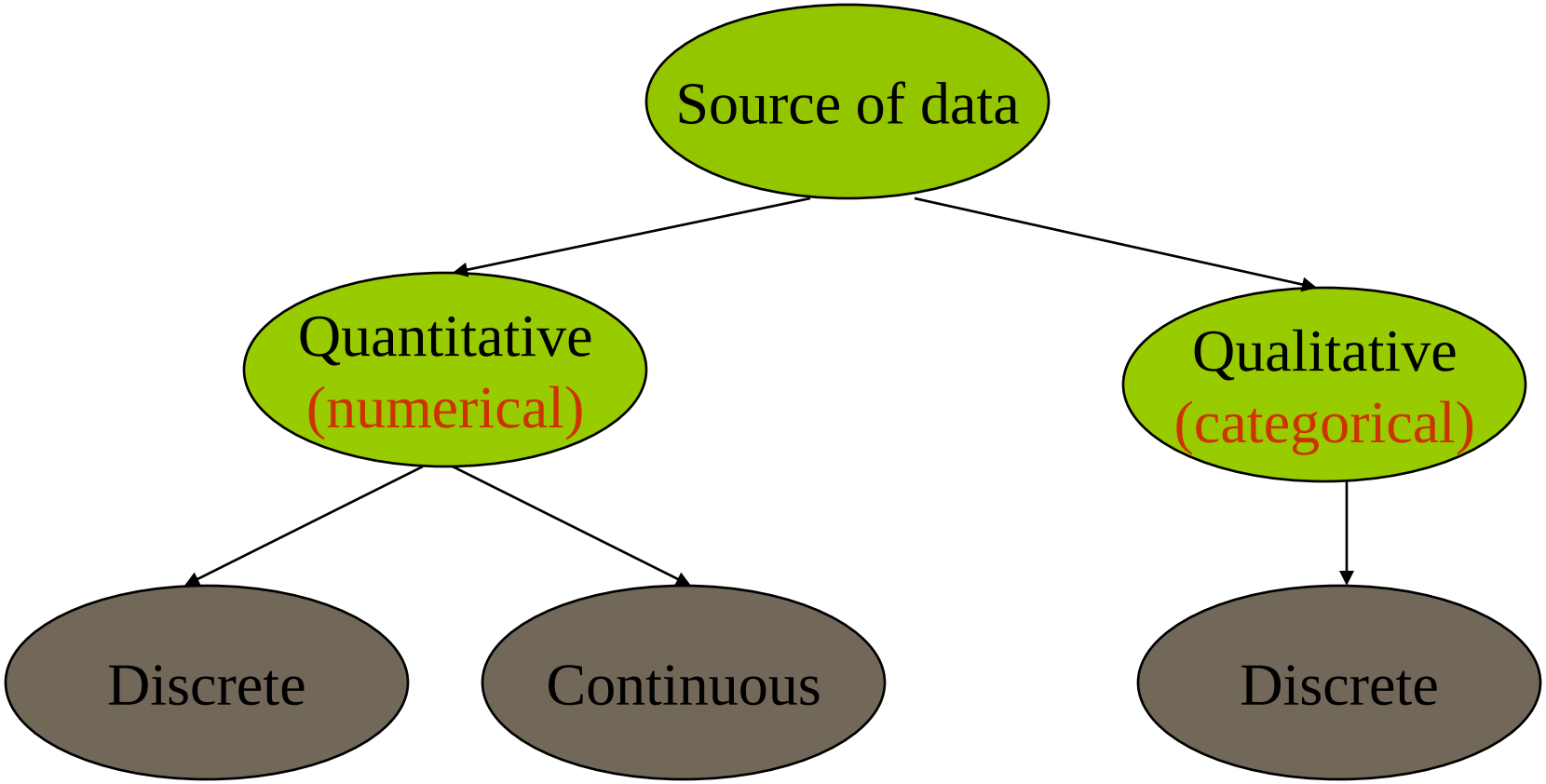
Quantitative Research: Definition

- The researcher is hoping the numbers will yield an unbiased result that can be generalized to some larger population.

Six Types of Quantitative Research

- Experimental
- Survey
- Meta-Analysis
- Quantitative Case Study
- Applied Behavior Analysis
- Longitudinal

Source of Data



Quantitative or Numerical Data

- Discrete Data
  - Only certain values are possible (there are gaps between the possible values)
- Continuous Data
  - Theoretically, any value within an interval is possible with a fine enough measuring device

Types of Data

- Primary data: data observed and recorded or collected directly from respondents
- Secondary data: data compiled both inside and outside the organization for some purpose other than the current investigation

Types of Data

Primary

Data Collection

Observation

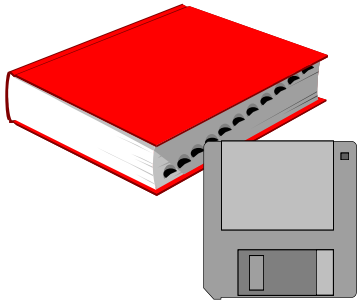
Survey

Experimentation

Secondary

Data Compilation

Print or Electronic



Categorical Data

Ratio Data	Differences between measurements, true zero exists	Height, Age, Weekly Food Spending
Interval Data	Differences between measurements but no true zero	Temperature in Fahrenheit, Standardized exam score
Ordinal Data	Ordered Categories (rankings, order, or scaling)	Service quality rating, Standard & Poor's bond rating, Student letter grades
Nominal Data	Categories (no ordering or direction)	Marital status, Type of car owned

Building Conceptual/ Theoretical Framework

Theory

- **Theories** are constructed in order to explain, predict and master phenomena (e.g. relationships, events, or the behavior). In many instances we are constructing models of reality.

A theory makes generalizations about observations and consists of an interrelated, coherent set of ideas and models.

A theoretical framework is analogous to the frame of the house.

Just as the foundation supports a house, a theoretical framework provides a rationale for predictions about the relationships among variables of a research study

Theory

Theories are ***generated*** by using ***inductive processes***

A ***deductive approach*** is used to evaluate and modify existing theory by ***testing predictions*** about relationships between observed phenomena

Theoretical Framework

- It provides a context for examining a problem i.e. theoretical ***rationale for:***
- Developing hypotheses
- A frame of reference/base for
  - Observations
  - Definitions of concepts
  - Research designs
  - Interpretations
  - Generalizations
- Serves as a guide to systematically identify logical, precisely defined relationships among variables

The Use of a Theoretical Framework as a Guide in a Research Study

The theoretical framework plays an important role in guiding the entire process of the research study

- **Theories** are constructed in order to explain, predict and master the phenomena (e.g. relationships, events, or the behavior). In many instances we are constructing models of reality.
- A theory makes generalizations about observations and consists of an interrelated, coherent set of ideas and models.

The Use of a Theoretical Framework as a Guide in a Research Study

If the framework is logically sound and substantiated by previous research studies, there is a strong possibility that the predictions or hypotheses evolving from that framework will be supported

In some cases, a theoretical rationale is inappropriately used. e.g. a theory designed to explain a particular behavior in infants may not be appropriate for the study of behaviors in adults

Formulating the Theoretical Framework

Purpose:

- It helps the researcher see clearly the variables of the study;
- It can provide the researcher a general framework for data analysis;
- It help the researcher in preparing a research proposal using descriptive and experimental methods.

Conceptual Framework

- A **conceptual framework** is used in research to outline possible courses of action or to present a preferred approach to an idea or thought.

How to Develop a Theoretical Framework/Conceptual framework

1. Select concepts

   a *concept* is an image or symbolic representation of an abstract idea. e.g. health, pain, intelligence …

2. Identify the interrelationships between concepts

How to Develop a Theoretical Framework/Conceptual framework

3. Formulating definitions: to develop a theoretical framework that can generate and test hypotheses, concepts must be clearly defined

A. Conceptual definition … conveys the general meaning of the concept
B. Operational definition … adds another dimension to the conceptual definition by delineating the procedures or operations required to measure the concept

Some concepts are easily defined in operational terms, e.g. pulse, other concepts are more difficult to define operationally, e.g. coping

How to Develop a Theoretical Framework/Conceptual Framework

4. Formulating the theoretical rationale

- Through the literature review, an investigator becomes aware of or confirms identified theoretical connections between variables
- In evaluating the formulation of the theoretical rationale, the internal structures, such as concepts and their definitions, should have clarity and continuity, and the approach to understanding phenomena, whether inductive or deductive, should be logical

Types of Theories & Types of Research

Theories may *describe* a particular phenomenon, *explain* relationships between or among phenomena, or *predict* how one phenomenon affects another

Types:

- Descriptive theories
- Explanatory theories
- Predictive theories

Types of Theories & Types of Research

Descriptive theories "describe or classify specific dimensions or characteristics of individuals, groups, situations, or events by summarizing the commonalities found in discrete observations

To test descriptive theories, researchers conduct descriptive research studies

Types of Theories & Types of Research

Explanatory theories "specify relations among the dimensions or characteristics of individuals, groups, situations, or events

Explanatory theories are tested by using correlational research

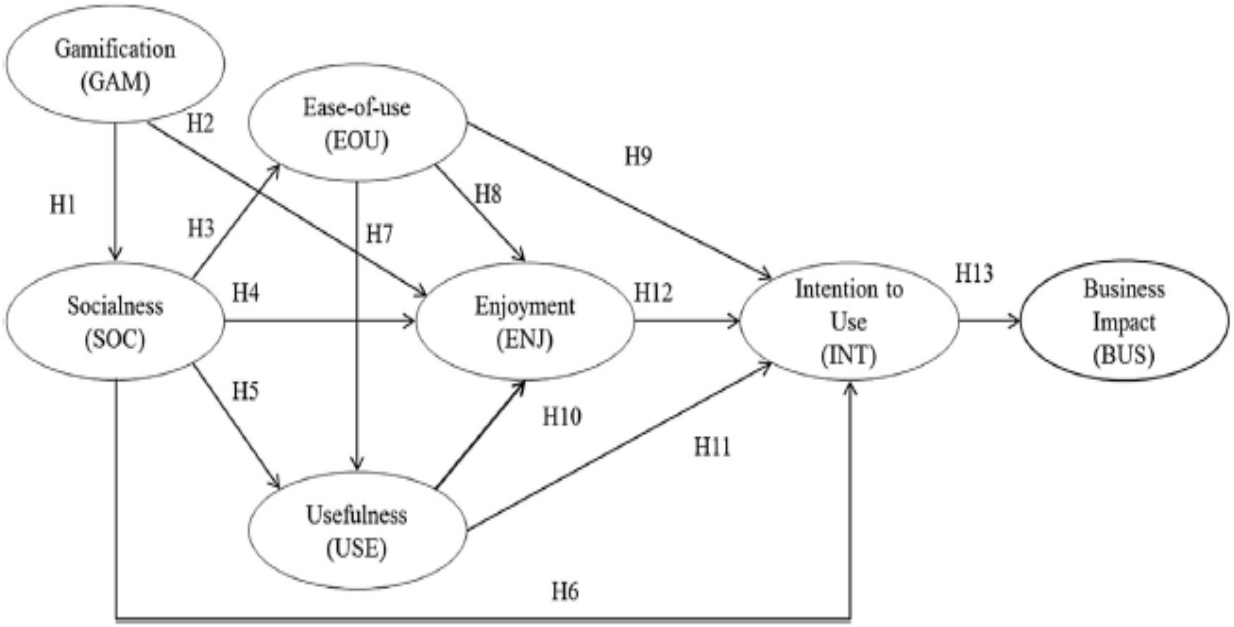
Types of Theories & Types of Research

Predictive theories are intended to predict "precise relationships between the dimensions or characteristics of a phenomenon or differences between groups"

Predictive theories are tested through

Experimental or quasi-experimental research designs

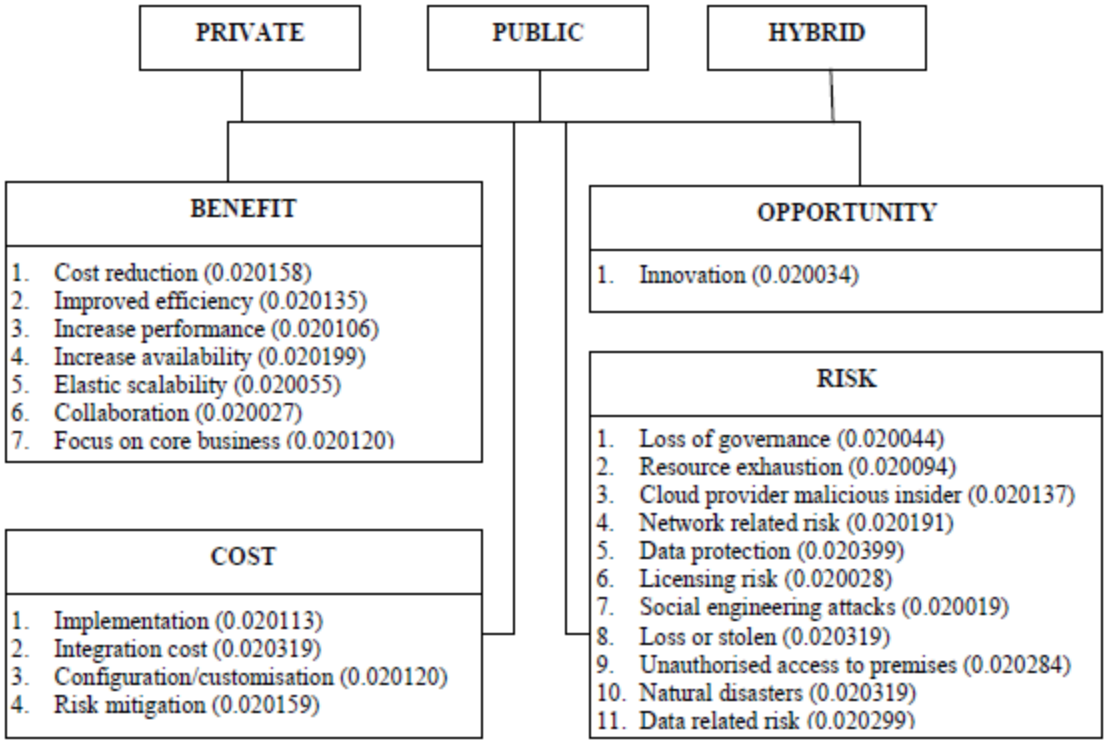
Example of A Theoretical Framework



Rodrigues, Oliveira & Costa, 2016

Example of A Theoretical Framework

Figure 3 Final model of proposed framework for selecting cloud deployment model for Indonesian Government

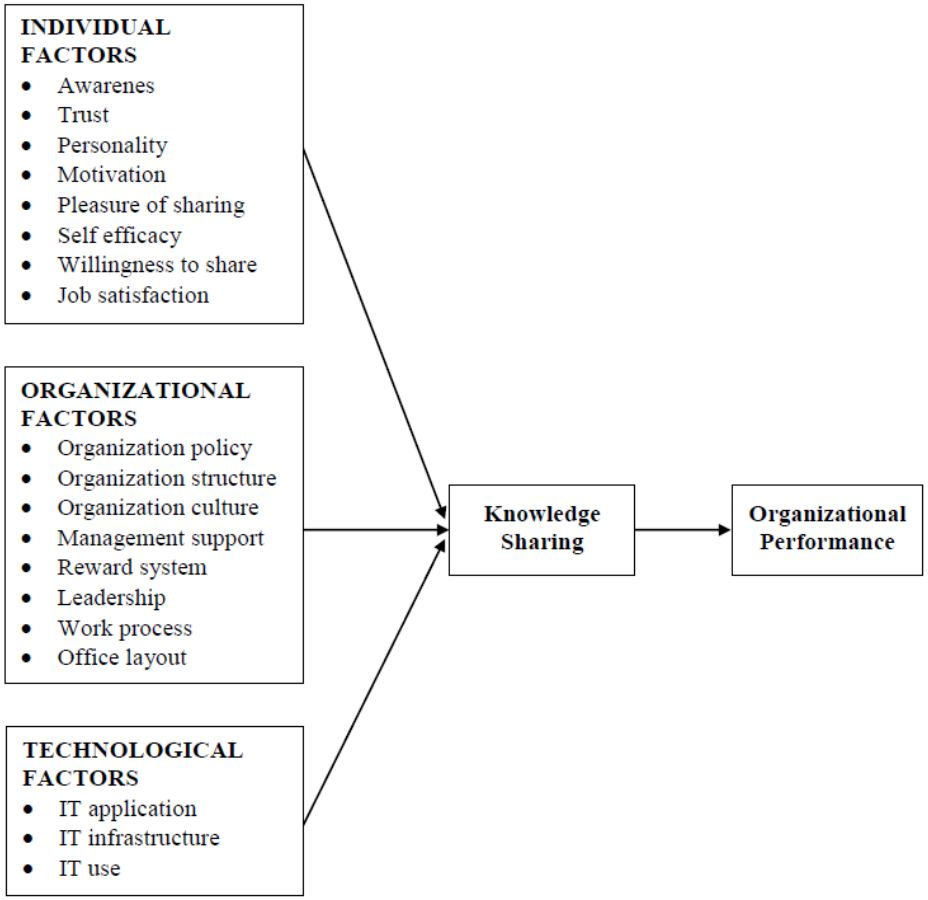


Framework for selecting cloud deployment model in government institutions using BCOR, entropy and TOPSIS approach

Fatih et al., 2015

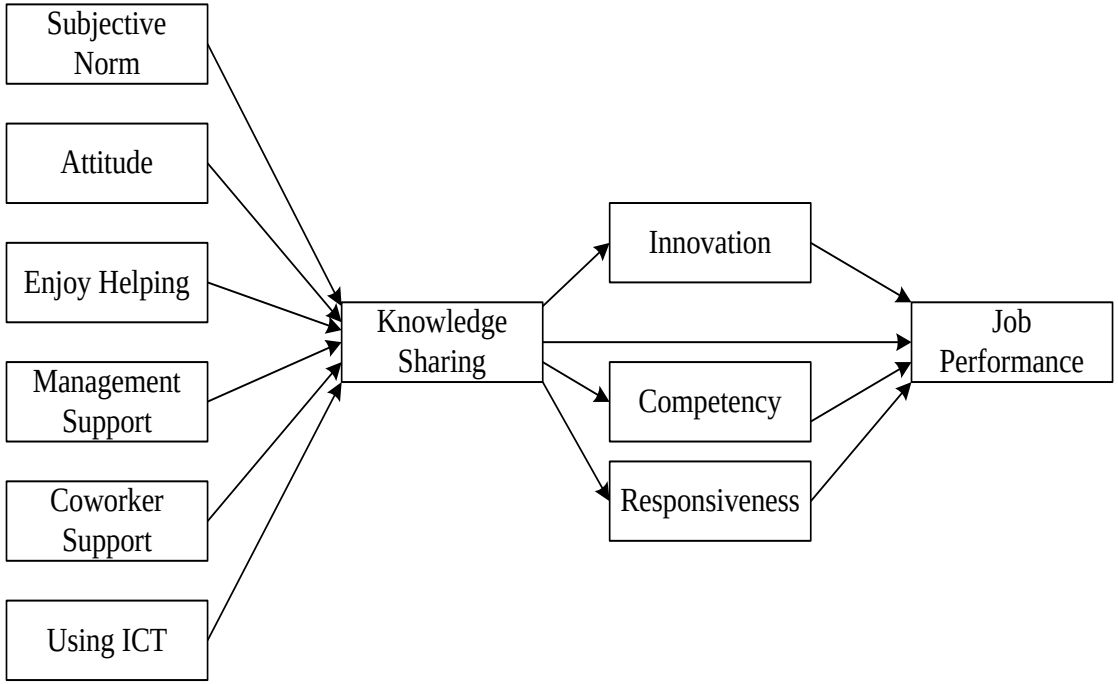
Example of A Theoretical Framework

- Can you criticize this theoretical framework?



Example of A Theoretical Framework

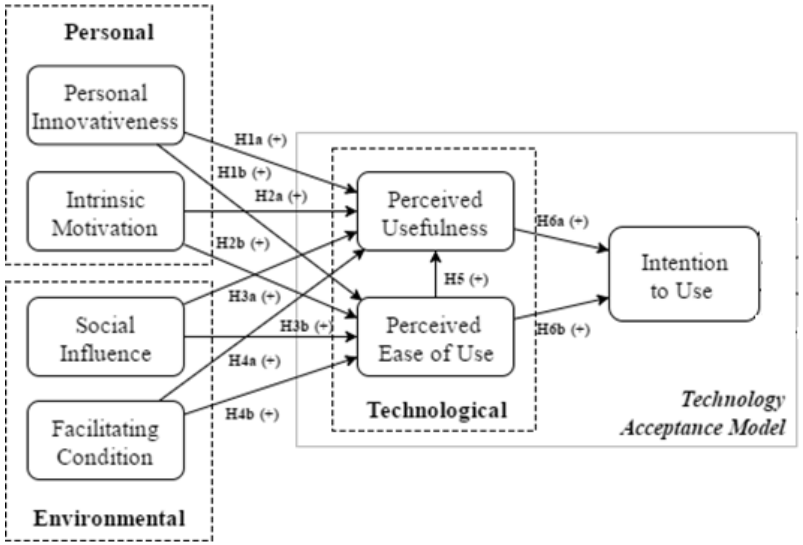
- Knowledge Sharing on Social Workers in The Implementation of Social Welfare



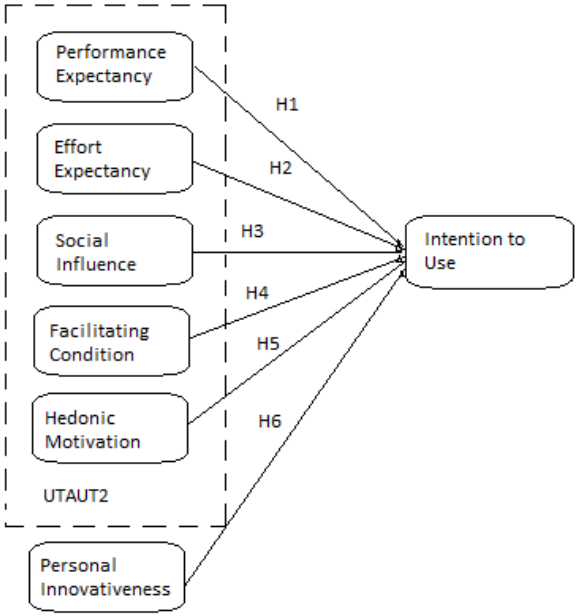
Is it a good model? Do social workers need “innovation” in their work?

Theoretical Framework: Varying Model with Different Perspectives

- The same set of variables can form different perspectives
- For example:



Model 1



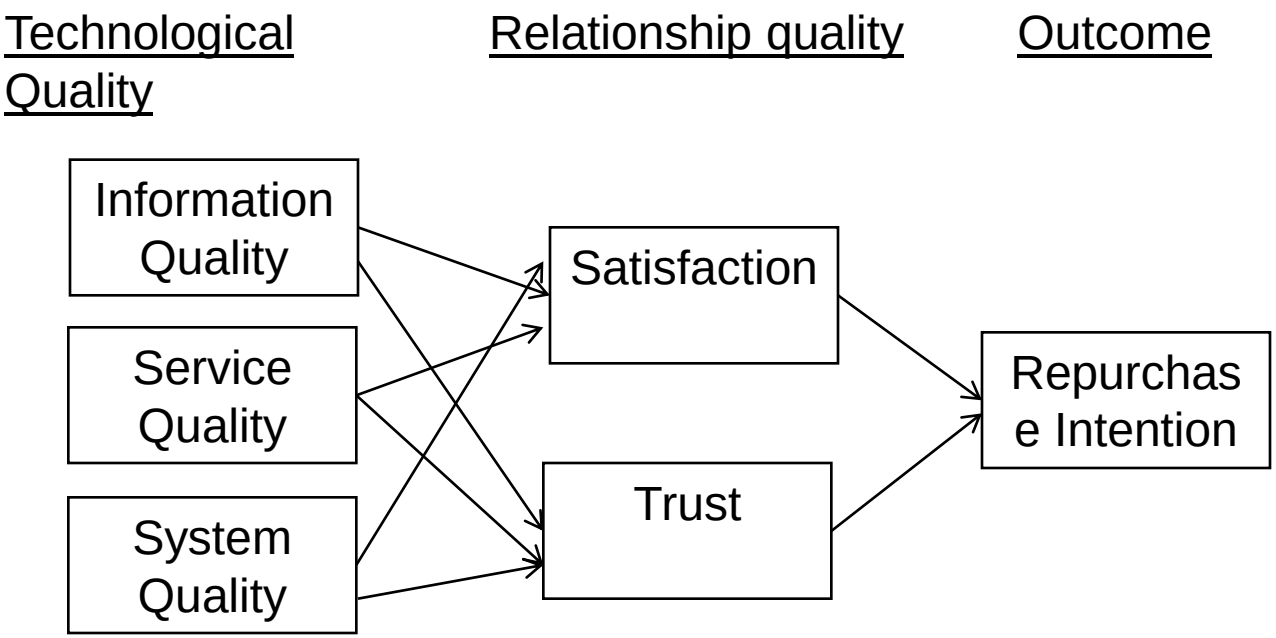
Model 2

Theoretical Framework: Varying Model with Different Perspectives

- How to form those perspectives?
  - Knowing various theories, for example underlying theories of human behavior:
  - Some well-known theories
    - Theory of Reasoned Action (TRA)
    - Theory of Planned Behavior (TPB)
    - Social Cognitive Theory (SCT)
    - Stimulus-Organismic-Response (SOR)
    - Elaboration Likelihood Model (ELM)
    - etc

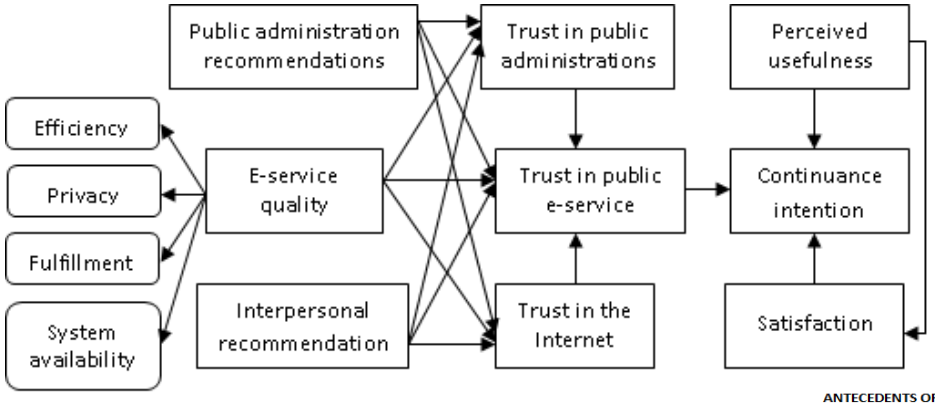
Theoretical Framework: Varying Model with Different Perspectives

- Example: consumer behavior in e-commerce



Adapting Theories from Other Domain

- See previous slide in Session 1.

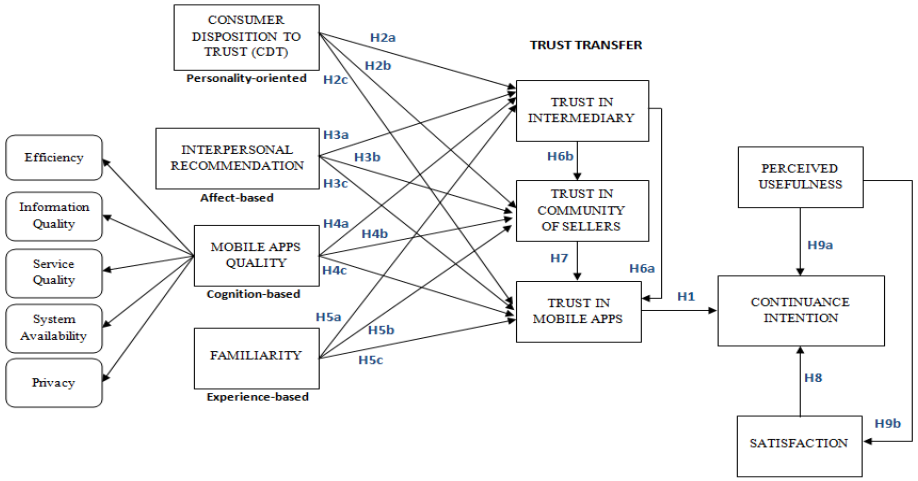


Belanche et al., 2014

Domain e-government

My PACIS paper, 2017

Domain e-service (gojek)



Common Mistakes in Theoretical Framework Development

- The proposed model is very complex
  - The authors just unify the models from other researchers (just confirming existing theories)
- The model is illogical
  - We can test the model by using our common sense "is it logical to the best of our knowledge?"
- The proposed model should focus to answer the "gap" we found in the theory
  - The simpler is the better, as long as it has impact for answering the theoretical gap
- Confused first order and second order construct, between formative and reflective

Criticizing the theoretical framework

1. Is the theoretical framework clearly identified?
2. Is the theoretical framework consistent with what is being studied?
3. Are the concepts clearly and operationally defined? Do they reflect the area of investigation?
4. Was the literature review sufficient to support the proposed relationships?
5. Is the theoretical basis for hypothesis formulation clearly articulated? Is it logical?

Criticizing the theoretical framework

6. Are the relationships among propositions clearly defined?
7. Is the instrument used to measure the variables consistent with the theoretical framework?
8. Are the study findings relevant with the theoretical rationale?

Collecting Data

Collecting Quantitative Data

- Identify your unit analysis
  - Who can supply the information that you will use to answer your quantitative research questions or hypotheses?
- Specify the population and sample
- Information you will collect
  - Specify variables from research questions and hypotheses
  - Define the operational of each variable
  - Choose types of data and measures

Instrument You Will Use To Collect Quantitative Data

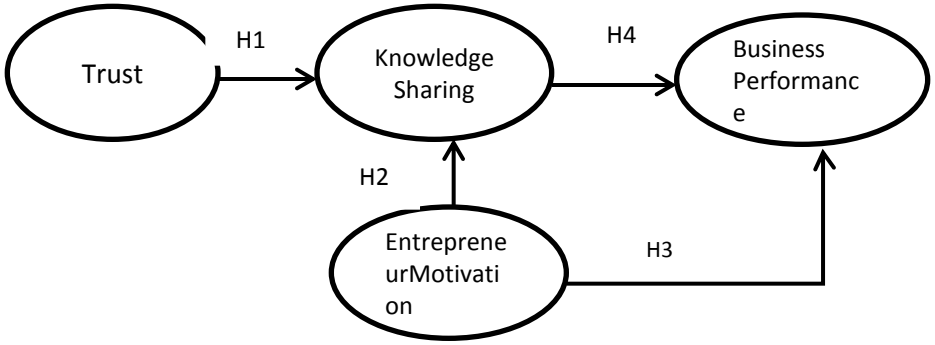
- Locate or develop an instrument
- Search for an instrument
- Criteria for choosing a good instrument
  - Did the authors develop the instrument recently, or can you obtain the most recent version?
  - Is the instrument widely cited by other authors?
  - Are reviews available for the instrument?
  - Is there information about the reliability and validity of scores from past uses of the instrument?
  - Does the procedure for recording data fit the research questions/hypotheses in your study?
  - Does the instrument contain accepted scales of measurement?

Instrument You Will Use To Collect Quantitative Data

- Please be careful when developing instrument, each variable should be clearly defined
  - Trust
    - Trust to Application, Trust to Seller, Trust to Internet, Trust to Member of Community?
- Read carefully the intended meaning of each variable before adopting it for developing your instrument
- Different variables may represent the same concept, same variables may represent different concept
  - Perceived Ease of Use and Effort Expectancy represent the same concept
  - E-Wom Intention can represent two meanings:
    - Intention to Adopt E-Wom (from others)
    - Intention to Spread E-Wom (to others)

Instrument You Will Use To Collect Quantitative Data

- Indicators should represent the variable



Knowledge Sharing Among Female Business Owners to Enhance SME Business Performance in Indonesia

Trust in this model is defined as trust among community members

Trust (wrong indicators?)

- I believe the information of fellow entrepreneurs is very useful
- I believe that employees provide accurate information
- I believe that employees can be reliable
- I believe that the company helped each other

Collecting Quantitative Data

- What information you collect?
  - Observations
  - Interviews and questionnaires
  - Documents
  - Audiovisual materials
- Use formalized instrument to collect each information.

Analyzing Data

Descriptive Statistics

- Describe trends in the data to a single variable or question on your instrument.
  - We need Descriptive Statistics that indicate:
    - general tendencies in the data mean, median, mode,
    - the spread of scores (variance, standard deviation, and rang),
    - or a comparison of how one score relates to all others (z-scores, percentile rank).
  - We may describe any of our variables: independent, dependent, control or mediating.
- Respondents demographic can be presented using descriptive statistics

Descriptive Statistics

TABLE II

RESPONDENT DEMOGRAPHICS

Demographic Variables		Frequency	Percentage
Gender	Female	686	71%
	Male	277	29%
Age	15-20 years	353	37%
	21-25 years	490	51%
	26-30 years	59	6%
	31-40 years	40	4%
	41-50 years	19	2%
	> 50 years	2	0.2%
Work	Student	725	75%
	Government employees	37	4%
	Private employees	127	13%
	Entrepreneur	32	4%
	The others	42	4%
Frequency of Social Media's Use	Several times a day	786	82%
	Once a day	102	10%
	3-5 times a week	37	4%
	1-2 times a week	20	2%
	Seldom	18	2%

- Descriptive data can be presented as graphics or table.
- To make it compact and concise, table is preferable

Statistical Analyses & Threats to Validity

- Recall that there are two major types of designs.
  - If you are interested in the association between **continuous** variables, you should use a *correlational* design.
  - If you are interested in **comparing** two (or more) groups, it is likely you will use an *experimental* design.
- The design you use will determine:
  - statistical analysis you will perform
  - threats to validity you will most likely need to address
  - conclusions you can make from your research.

Hypothesis Testing

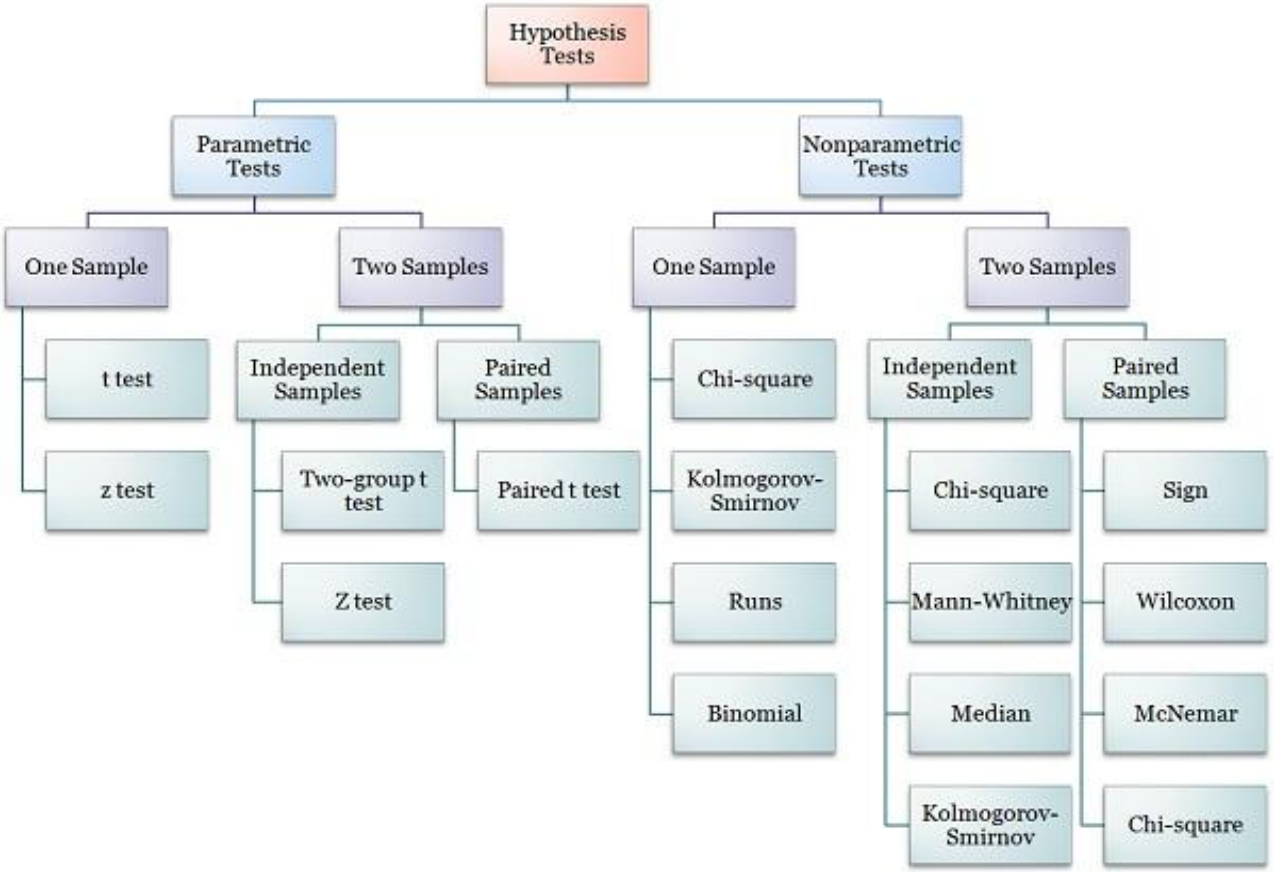
- Evaluate data distribution whether normal or not
  - Normal – parametric test
  - Not-normal – nonparametric test

Comparison Chart

BASIS FOR COMPARISON	PARAMETRIC TEST	NONPARAMETRIC TEST
Meaning	A statistical test, in which specific assumptions are made about the population parameter is known as parametric test.	A statistical test used in the case of non-metric independent variables, is called non-parametric test.
Basis of test statistic	Distribution	Arbitrary
Measurement level	Interval or ratio	Nominal or ordinal
Measure of central tendency	Mean	Median
Information about population	Completely known	Unavailable
Applicability	Variables	Variables and Attributes
Correlation test	Pearson	Spearman

Hypothesis Testing

- Statistical tool



Hypothesis Testing

Equivalent Tests

PARAMETRIC TEST	NON-PARAMETRIC TEST
Independent Sample t Test	Mann-Whitney test
Paired samples t test	Wilcoxon signed Rank test
One way Analysis of Variance (ANOVA)	Kruskal Wallis Test
One way repeated measures Analysis of Variance	Friedman's ANOVA

Structural Equation Modeling

- Structural equation modeling (SEM), as a concept, is a combination of statistical techniques such as exploratory factor analysis and multiple regression.
- The purpose of SEM is to examine a set of relationships between one or more Independent Variables (IV) and one or more Dependent Variables (DV).

Structural Equation Models

Combine three concepts

- Latent variables
  - Pearson (1904), psychometrics
  - Factor analysis model
- Path analysis
  - Wright (1934), biometrics
  - Technique to analyze systems of relations
- Simultaneous regression models
  - Econometrics

Six Steps to SEM Modeling

1. Specification
2. Implied Covariance Matrix
3. Identification
4. Estimation
5. Model Fit
6. Respecification

SEM Model Evaluation

- Measurement model evaluation
  - Internal validity (loading factor, average variance extracted)
  - Discriminant validity (cross loadings)
  - Reliability (cronbach's alpha, composite reliability)
  - Model fit
- Structural model evaluation
  - p-value/t-value
  - Path coefficient

Model Fit

- Covariance-fitting methods: covariance fit measures such as
  - Chi-square statistics
  - Goodness of Fit Index (GFI), AGFI
  - Normed Fit Index (NFI), NNFI, CFI
  - Etc.
  - Basis is the discrepancy function
- PLS path modeling: prediction-based measures
  - Communality
  - Redundancy
  - Stone-Geisser's Q2

SEM Tools

- Covariance-based SEM (Lisrel, Amos)
- Variance-based SEM (PLS)

Multi-Criteria Decision Analysis

Multi-criteria decision analysis (MCDA) is a formal, structured and transparent decision making methodology. Its ism is to assist groups or individual decision makers to explore their decisions in the case of complex situations with multiple criteria.

MCDA assists the decision maker in confidently reaching a decision by:

- enabling decision makers to gain a better understanding of the problem faced;
- organising and synthesising the entire range of information;
- integrating objective measurements with value judgments;
- making explicit and managing the decision maker's subjectivity; and
- ensuring that all criteria and decision factors have been taken properly into account.

MCDA Methodology

MCDA is an umbrella term for a range of tools and methodologies. The level of complexity, interaction with the decision maker and level of detail utilised in the decision making process can vary substantially.

In general the decision maker follows the same process:

1. Identify multiple criteria on which to base their decision;
2. Identify multiple alternative solutions to their decision;
3. Provide (subjective) ranking or weighting of criteria; and
4. Provide values, rankings or weighting of alternatives for each criteria.

MCDA Methodology

- Analytic Hierarchy Process (AHP)
- Analytic Network Process (AHP)
- PROMETHEE
- Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS)
- Entropy
- AHP + TOPSIS
- Fuzzy-AHP
- Fuzzy AHP TOPSIS
- etc

When Working With MCDA

- AHP, TOPSIS, etc. are just tools
- The main concern is what problems that you actually want to solve
  - Choose an interesting domain/problem
  - Innovative approach in developing the model (different perspectives in selecting the criteria, etc.)
- Instead of solving problems in a particular domain, you also can contribute in enhancing the MCDA technique
  - For example: Fuzzy-AHP was developed to address the shortcoming of AHP

When Working With MCDA

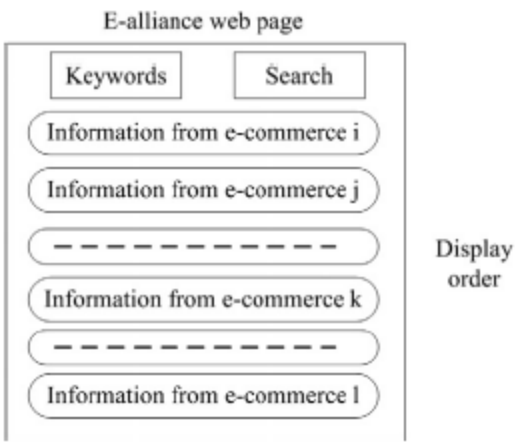


Fig. 2. E-commerce web sites information display order in e-alliance.

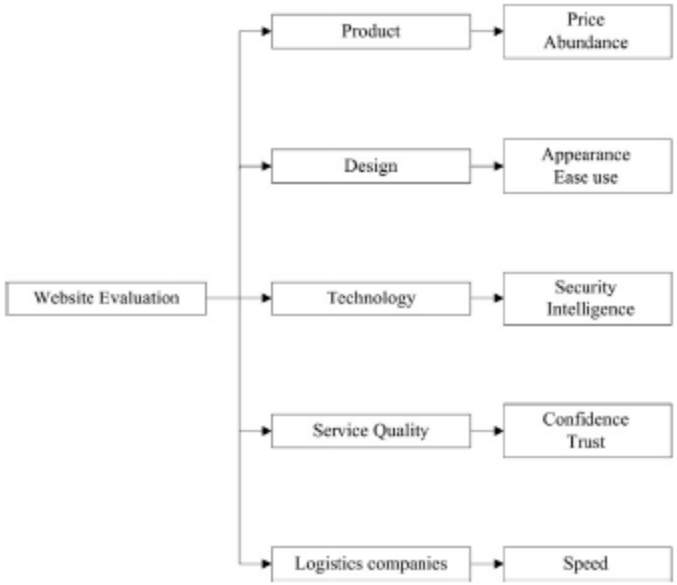
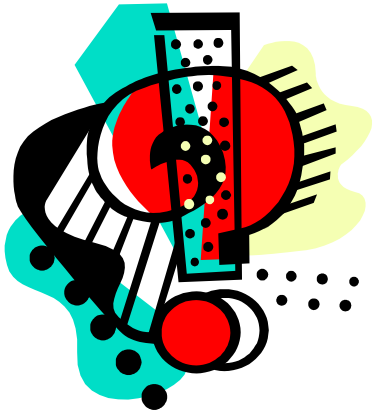


Fig. 3. Criteria influence web sites comprehensive quality.

Example of MCDA-Related Publications

- An extended Fuzzy-AHP approach to rank the influences of socialization-externalization-combination-internalization modes on the development phase (Tyagi et al, 2017)
- A fuzzy AHP-TOPSIS framework for ranking the solutions of Knowledge Management adoption in Supply Chain to overcome its barriers (Patil & Kant, 2014)
- Rank B2C e-commerce websites in e-alliance based on AHP and fuzzy TOPSIS (Yu et al., 2011)

Group Assignment (60 minutes)

- Group of four people (same as your previous group)
- Do the following:
  - Create the theoretical framework for the topic that you have chosen in previous assignment
  - Define each variable
  - Define the instrument that you will used to collect data. Give appropriate references.

Thank You